

and certainly he covers the ground excellently, within the confines of the specific topic of relevant synthetic systems at one atmosphere. He employs petrological licence to stray into petrogeny's residua system but stops before reaching peralkaline equilibria. After using 80% of his text on one-atmosphere phase diagrams, he gives a review of high-pressure equilibria which, although useful as a summary of relevant synthetic systems, is far less searching than the preceding chapters. By the time he considers hydrous and carbonated high-pressure systems, the text has mostly become little more than an annotated guide to where to find the major literature. Consideration of natural basic liquids, rather than their synthetic analogues, is concentrated in two chapters. In one there is a stimulating account of how the crystallization of various major basic and ultrabasic layered intrusions may be understood by reference to various synthetic-system phase diagrams. This section draws on Morse's work on Kiglapait, together with the published accounts of Skaergaard, Stillwater, Muskox, and the like. In view of the recent flurry of radical re-interpretations of the crystallization mechanisms of these plutons, it should be noted that this text takes the crystal sedimentation hypothesis as gospel and makes no mention at all of any alternatives.

In the final chapter on 'Some Applications to Basalt Magma Genesis' the book runs into the inevitable problems of attempting to discuss a very broad subject from an artificially restricted viewpoint. An account of basalt genesis which virtually ignores the contributions of geophysics, fluid dynamics, experimental studies of natural basalts and peridotites, and both elemental and isotopic geochemistry is a potential minefield of oversimplification for a student who, in the preceding chapters, will have enjoyed many examples of the author's thoroughness when dissecting phase diagrams. Perhaps I am griping unnecessarily at a book which deserves to be a great success. Nevertheless, I wish that Dr Morse had omitted most of his discussions of natural basic liquids in favour of more examples of his spectacular excursions into the mysteries of *PTX* space.

R. N. THOMPSON

Bloss, F. D. *The spindle stage: principles and practice*. Cambridge and New York (Cambridge University Press), 1981. xii + 340 pp. 160 figs. Price £35.00.

This book, immediately on opening, gives the impression of being very attractive and inviting; the type face is clear and easily legible; there is a

high concentration of beautifully clear and crisp figures, each with a very full and detailed caption; and the text is very well organized with numerous heavy type and italic headings to sections and paragraphs. The writer is obviously an enthusiast for the subject and the book can hardly fail to be attractive to anyone even remotely interested in practical crystal optics.

The work concerns the comparatively simple optical observations that can be made on any anisotropic crystal fragment with the aid of a relatively simple and inexpensive piece of equipment, the detent spindle stage (an improved version of the Wilcox spindle stage). On the basis of these observations, both orthoscopic and conoscopic, augmented by oil immersion techniques, the reader is shown in the early chapters how a great wealth of optical information about the specimen can be obtained. With a stereographically plotted extinction curve, it is demonstrated very clearly how it is possible, via stereographic constructions, or mathematical relationships, or derived (equivibration) curves, to determine the orientations of the principal vibration directions and, in the biaxial case, to determine the orientations of the optic axes and the value of  $2V$  with, in favourable cases, considerable accuracy.

Two chapters are devoted to RI determination by oil immersion and cover fully such techniques as the dispersion method, the single and double variation methods, and extrapolation techniques. There is also detailed discussion of associated matters like recognition of index differences, knowledge of the oil's index, optical filters, monochromators, tunable dye lasers, focal screening (dispersion staining), the Abbé refractometer, and even the use of the spindle stage with a known standard crystal as a refractometer.

Chapter 6 is devoted mainly to a description of computer program EXCALIBR. On the basis of spindle stage extinction measurements made with up to four different wavelengths, EXCALIBR computes the orientations of the optic axes, the bisectrices, and the optic normal; computes the value of  $2V$ ; and indicates which optical directions exhibit dispersion.

The final three chapters cover a wide variety of research uses of spindle stage techniques including the following. 1. The use of a spindle stage with goniometer head to permit both optical and X-ray studies on one crystal mount. This allows highly accurate determination of the angular relations between crystallographic axes and optical directions and is of considerable value in the triclinic case. 2. The determination of several sets of extinction data for one crystal mount by varying the setting of either arc, thereby achieving increased

accuracy in determination of 2V, etc. 3. The determination of retardation and the principal birefringences with very high accuracy by the use of compensators. 4. Determination of the relation between thermally induced structural changes and optical properties.

It is very difficult to be adversely critical of this work. However, the impression is unfortunately given in chapter 6, by the placing here of a section on the use of half-shade plates etc., that extreme accuracy of extinction measurements is only necessary when generating data for use with EXCALIBUR. This section would be of far more value if placed near the beginning of the work, perhaps as a separate short chapter on extinction determination, the corner stone of the whole work: these techniques would then be more obviously associated with *all* extinction measurements regardless of their ultimate use.

F. E. TOCHER

Jeffery, P. G. and Hutchison, D. *Chemical Methods of rock analysis*. 3rd edition. Oxford and New York (Pergamon Press), 1981. xvi + 380 pp., 27 figs. Price £25.00.

The third redaction of a book implies the status of a standard text, but for those unfamiliar with previous editions an outline of the contents may be helpful. The work may be divided under three main headings. (1) Preparation of material for analysis, including decomposition procedures. (2) Schemes of analysis both classical and rapid. (3) A series of chapters in the determination of individual elements.

It is normal for successive editions of a book to grow both in size and price but in the present economic conditions it has been necessary to 'slim down' this third edition to avoid an unacceptable cost. Happily, this has been achieved without affecting its basic value. The reduction in the number of pages has, for the most part, been effected by reducing the number of Tables (48 to 4), Figures (104 to 27), and by eliminating the structural representations of spectrophotometric reagents. Excision of the chapter on statistical considerations is personally considered a significant loss. Whilst recognizing the authors' view that such matters are widely known it is only by repeated exposure that an equally wide application can be attained. Less serious, though a source of some regret, is the elimination of the short sections on occurrence at the start of each element chapter, which served to place the elements in their geochemical contexts and to act as a bridge between

the analyst and the user of analytical results. The appearance and appeal of the book is to that extent changed towards a series of 'cook-book' instructions.

The good news is that this edition contains much material that is new, not only in element determinations (particularly those for the precious metals) and references up to and including 1979, but also extending the coverage of full analysis schemes based upon atomic absorption spectrophotometry. The continuing trend away from separation by precipitation and measurement by weighing is recognized by the substitution or addition of methods involving solvent extraction or ion-exchange, commonly followed by flame or electrothermal AAS.

The regret expressed by the authors in the preface, that they were not able to deal with the physical methods used for the analysis of geological materials, is surely misplaced. The particular value of this book is that it offers alternatives to such techniques whose precision may be excellent but whose accuracy can only be checked by recourse to chemical methods such as those presented. The needs of those laboratories which do not have the high capital investment or which cannot justify such expenditure on instrumentation should not be set aside lightly. It could be argued that there is a great need for methods of chemical determination which could win wide acceptance as 'standard methods' against which the performance of any new procedures or new instruments could be measured. Such a compilation would take some time and no little effort to achieve, but there is no reason why procedures equivalent in standing to those of the British Standards Institute and other organizations should not eventually emerge—which might ease the task of those who set up standard materials. It would not be unreasonable to regard this series of books as a first step in this direction—subject to revision with new methods being introduced strictly on merit.

In their apologies for the method of preparation of the book, i.e. directly from the authors' typescripts, the publishers express the hope that this method will in no way distract the reader. Far from being a distraction, the thin, and therefore seemingly pale type demands a high degree of concentration, certainly from those of us advancing in years. A welcome and positive contribution by the publishers is the recognition that this is no library book, but one which deserves and will earn its place on the laboratory bench, to which end they have supplied a more resistant cover.

Even taking into account the reservations expressed above, the overall worth of the book remains. It is recommended alike for those preparing or attending introductory courses in geo-