the box. Perhaps Lewis's original definition, which specified diamond as an essential constituent, was more percipient than we thought. It would be naïve to expect this exceptional eruptive rock to submit to the standard classificatory devices applied to the more common magmatic rocks, but it is a pity not to find a more searching examination of the issue, if only to see how the nettle of kimberlite definition (and its relationship to other magmatic rocks) might be grasped. Kimberlite composition is complicated horribly by the content of extraneous material, and post-emplacement alteration, so that a recent attempt at kimberlite classification on the basis of olivine-free groundmass compositions merits serious consideration.

Lack of mineralogical boundaries means that rock chemistry is equally unconstrained and to provide for this, averages are given. Listing of average ultramafic and ultrabasic rocks is valuable, and could have been extended to include average alnöite, melilitite, and leucitite as well. Averages without ranges are always a mixed blessing, and one can only boggle at the Siberian kimberlite average (623 samples) showing 18.7% H_2O^+. For this reason, the chemical composition range diagram is a good idea, but the limits shown do not encompass all the data tabulated, and the marked average positions do not correspond with those in the table. Analyses of dyke and sill kimberlites are usefully separated in another table (some of these such as Benfontein being 'virtually uncontaminated by xenoliths') and even here the ranges they exhibit are still staggering, e.g. K_2O contents from 0.05% to over 5%. Not only is kimberlite a hybrid *rock* but the analyses quoted seem consistent with the claims of some other workers that kimberlite 'liquid' itself is an inhomogeneous mix. In the present state of knowledge, expressions such as 'pristine kimberlite' (p. 53), 'the kimberlite liquid' (pp. 49, 65, etc.) and 'kimberlite magma' (pp. 41–2, etc.) must be recognized as conceptual, for (as the author indicates on p. 223) they are not susceptible to any precise definition: indeed, the singular noun itself may be delusive. Dawson's use of 'complex, hybrid' continually alerts us to the difficulty, and with the addition of the trace element and isotope geochemistry, and a comprehensive chapter on mineralogy, the book happily provides an up-to-date view of the scope and complexity of the materials that currently come under the name kimberlite.

Xenoliths are easier to categorize than the kimberlites they contaminate, but it is their diversity that makes kimberlite so hard to pin down. So much has been written about them that to produce a review in itself is a major undertaking. In Chapter 7 Dawson classifies first on probable depth of origin, and then after a summary of the crustal xenoliths, concentrates on the mantle samples. These are grouped into four clear categories (peridotites/pyroxenites; eclogites; metasomatized peridotites; and glimmerites) plus a fifth group for miscellaneous xenoliths (which turns out to comprise only the 'alkremite' group of xenoliths, plus one other specimen). The complex mass of data is sifted, summarized, and well presented with the aid of tables, diagrams, and photographs. The following chapter provides an equally skilful view of the megacrysts in kimberlites.

In the coverage throughout the book, and in the bibliography, the reader is treated to the distillation of many years of active experience in the study of these fascinating rocks. Somewhat disappointingly, the finished product is flawed by many typographical and textual errors, but if someone throws a lifeline across a rising flood of information, do not complain unduly where it is rough or tangled: grab it and be thankful. I shall certainly hang on to my copy!

D. K. BAILEY

Morse, S. A. *Basalts and phase diagrams: an introduction to the quantitative use of phase diagrams in igneous petrology*. Berlin, Heidelberg, and New York (Springer-Verlag), 1980. xvi + 493 pp., 241 figs. Price DM 62.00 ($36.60).

This is one of those curious books which has a sub-title giving a very different emphasis from the title and a text which is a hybrid between the two. The sub-title immediately raises the question of whether this is supposed to be a book about the geometry of phase diagrams or a latter-day version of Yoder's monograph on basalts. The answer lies in the sub-title. The core of this admirable volume is an exceptionally elegant and detailed exposition —written in a lucid and pungent style—of both crystallization and melting in the principal phase diagrams which are commonly used in attempts to understand the evolution of basic magmas at low pressures. The level of detail may be judged by the example of the description of the system diopside–anorthite–albite at one atmosphere. This occupies a complete chapter of 43 pages, including 29 meticulously drawn diagrams. The analysis of forsterite–diopside–silica requires 35 pages and even albite–anorthite is dissected at a level of detail running to 14 pages. This display of geometric gymnastics and the accompanying clear expositions of such matters as the phase rule should make the book a necessity for anyone working or studying in this field.

But what is the field? Dr Morse clearly considers it to be the genesis and evolution of basic magmas

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