

an unusual feature is the occasional tip for colour-blind students. Some of the terminology I do not like. The use of 'polar' instead of 'polariser' (admittedly used by some other writers too) is, I think, an unhelpful abbreviation not sanctioned by any dictionary, American or British. And the use of 'plane light' instead of 'plane polarised light' surely runs the risk of being mistaken for plain ordinary light. Also 'optic plane' and 'optic angle' are less clear than the usual fuller terms. The use of *X*, *Y* and *Z* axes for the isotropic and uniaxial indicatrices is likely to confuse students. British students familiar with length-slow accessory plates will be surprised by the statement on p. 46 that accessory plates are constructed length-fast.

The figures are very well drawn, though an exception is Fig. 6.1*b* which either has the *c*-axis in the wrong position or an incorrect perspective. The diagrams illustrating cleavage attitudes in thin section are perhaps misleading as in my experience even moderately oblique cleavages will not be visible.

On the whole, the amount of information given in these chapters will serve the needs of most students at all levels. The only surprising omissions are the lack of any information on liquids which could be used by those who wish to make their own sets of immersion oils, and the lack of reference to the Universal Stage. Although the Spindle Stage is more appropriate for purely mineralogical work, the U-stage is still widely used in petrology, especially in the increasingly fashionable area of preferred orientation studies.

More than half the book consists of systematic mineral descriptions. They are up to date, and clearly set out with a perspective drawing of optical and crystallographic features for each mineral. There are, in addition, diagrams of typical sections, and, where appropriate, tables or figures showing relationships between composition and optical properties. The descriptions are complemented by comprehensive identification tables (the addition of a column with R.I. would have made Fig. C.1 in the tables even more useful). There are few obvious errors, but I noted consistent misspellings of chlorophaeite, piemontite, and thomsonite (elsewhere Hutchison and dichroism too), and the garnet drawing on p. 166 is misorientated. Also, the inclusion of volcanic glass under tectosilicates without explanation seems odd. I looked especially carefully at the feldspar descriptions, and whilst one could quibble at a few points (e.g. granophyre is not quartz and K-feldspar; microcline and orthoclase are often euhedral as well as anhedral; ambiguities in the bottom right of the Carlsbad-albite diagrams need to be pointed out), the whole section is comprehensive and well put. The number of minerals

included is as many as most students will ever need, though I was surprised to see colemanite in but aenigmatite, eudialyte, and phillipsite out.

Overall this book impresses one for its careful assembly and presentation. For students wanting optical mineralogy in one volume this is clearly a book to be considered.

D. SHELLEY

Gübelin, E. J., and Koivula, J. I., 1986. *Photoatlas of Inclusions in Gemstones*. ABC Edition, Zurich, pp. 532, 15 illus. in black and white, 1449 in colour. Price SFr 320.00; £110 from Gemmological Instruments Ltd., London.

This book is the successor to Gübelin's *Internal World of Gemstones* published in 1974. In this volume the superb photography by Gübelin is reinforced by the innovative photographic genius of Koivula who has won awards for his photographic research and is a senior research gemmologist with the Gemological Institute of America. The result is a photographic feast coupled with the results of their own research work and enhanced with chapters by other leading scientists. Despite the scientific input, the average reader will find everything explained in lucid, not too technical, terms.

Essentially the book is divided into six uneven parts. Part I (30 pages) contains the introduction and a very informative section (with good diagrams) on photomicrography and the specialized illumination of the gemstone. The uses of phase-contrast microscopy and the shadowing technique are described here. Part II (68 pages) discusses the genesis, of mineral inclusions in gemstones and this is followed by three specialist contributions from Dr E. Roedder on 'The origin of fluid inclusions in gemstones'; Dr Henry O. A. Meyer on 'The inclusions in diamonds and the genesis of diamond' and 'The formation of quartz and its inclusions' by Dr H. A. Stalder. These sections are accompanied by a series of fine colour photographs.

Parts III (102 pages) and IV (218 pages) form the real core of the Photoatlas. Part III (arranged alphabetically as is Part IV) deals with a series of individual mineral species inclusions found in a variety of host gemstones. The species described include (among many others) amphibole, apatite, chromite, feldspar, glass, goethite, graphite, ilmenite, magnetite, quartz, sphene, tourmaline and multiple inclusion scenes, aggregates and twins. The fantasy of inclusions and their odd shapes in gemstones leads the authors to create in the imagination an old fashioned stove, a shrew and a prehistoric bird amongst other extraordinary resemblances.

Part IV (the largest) is the most important part of the book and deals with 25 host species and their varieties. Some idea of the comprehensive nature of the treatment provided may be gauged by the section on emerald. The inclusions in stones from Brazil (several localities), Habachthal, Ajmer, Colombia (several mines), Lake Manyara, Mozambique, Pakistan, Sandawana, Transvaal, Urals, Zambia are all described and usually with several different photographs for each locality. Each photograph is provided with a concise description of the various inclusions and details of the type of lighting and the magnification. Ruby, sapphire and other important commercial gemstones are given comparable treatment and there is a very fine section on treated corundums. This part and the following Part V will be of crucial importance to the practising gemmologist.

Part V (88 pages) deals with the inclusions of man-made stones. It opens with a short review of the development of the various methods of gemstone synthesis and discusses the use of the terms imitation, artificial and synthetic. Over 40 photographs are used to illustrate inclusions in a wide variety of glasses. Synthetic emeralds (50 photographs) receive full treatment and photographs of several types, such as Lennix, Biron and Regency-created are included. Synthetic ruby (90 photographs) is described and figured comprehensively and includes details of the latest Knischka, Kasha and Ramaura types. Synthetic sapphires of various colours are also illustrated very fully.

Part VI (15 pages)—the 'concluding thoughts'—includes a geological timetable, a glossary of scientific expressions used, an extensive bibliography and a list of works cited. A very welcome addition to this volume is the provision of an index.

This *magnum opus* is exactly that. The provision of some 1400 photographs and descriptions could be confusing, but here they have been logically arranged and a good contents list and index provided. The book is not just beautiful, it is also a comprehensive laboratory manual for those (most gemmologists!) who do not have access to the enormous range of natural stones from numerous localities or the range of very clever fakes which are now produced. Criticisms can be few, the reviewer (and some of his friends) find the outer cover disappointing in its near monochrome appearance, and the page margins somewhat ungenerous for the superb contents. It is to be hoped the binding will stand up to the very hard usage that many copies will receive. At £110 (in London) the book is expensive, but this is understandable when one considers the very extensive use of colour and the superb reproduction. The reviewer recommends buying the book first and affording it afterwards. It

is the ideal gift for the gemmologist, jeweller, mineralogist, geologist (or anyone else for that matter) who has everything else.

E. A. JOBBINS

Milnes, A. G. *Geology and Radwaste*. London and Orlando (Academic Press), 1985. xvi + 328 pp., 97 figs. Price: Cloth £50.00, Paper £36.95.

At a time when the philosophical, political and technical problems associated with the management and disposal of waste material which emits ionizing radiation are very much in the public eye, an up-to-date source-book would seem most welcome. This book attempts to cover the whole range of geological factors which must be considered in the establishment of selection criteria for the identification of the safest disposal system for the various forms of radioactive waste (radwaste) while interspersing a degree of philosophical discussion of the role that earth scientists are being required to play in an involved economic-political game.

The book, which contains fifteen chapters, is divided into three parts. The first of these, comprising two chapters, deals with the various sources of radwaste and the physico-chemical characteristics of both high-level and low-level forms, followed by an over-view of the options available for their containment or dispersal in, hopefully, safe disposal systems.

The second, and by far the largest, part of the book is concerned with the inter-relationships of those geological processes active at or near the Earth's surface and within the crust, which are considered relevant to the selection of radwaste repositories and the assessment of their long-term stability. Successive chapters deal with the general composition of the Earth's crust, geological time, surface processes (biogeochemical aspects, denudation, and deposition), sedimentary rocks, volcanic processes, natural and synthetic crystalline rocks, physical processes in the upper crust, fluid-rock interaction, ocean processes and, finally, climatic change and continental glaciation. Throughout this section, examples of radwaste management or disposal are interjected within the systematic review as illustrations of the effects of the various processes on the waste or repository.

The final part, entitled 'Applications', again consists of only two chapters. The first discusses predictive modelling of the behaviour of radionuclides in the natural environment in relation to the selection of criteria for safe disposal. The final chapter gives some specific examples of repositories and, concluding in a more philosophical vein,