world's largest copper mine. Nchanga (Zambia) holds third place and Bingham Canyon, for long supreme, fourth; Panguna (Bougainville) developed by RTZ is fifth.

The book is divided into three parts: I. Management of Copper Technology; II. Strategy in the Industry; III. Company Histories. The first section covers exploration, mining, smelting, refining, fabricating, sales, and politics while the second gives an illuminating historical review, by periods, somewhat weighted towards the United States, but interestingly written. Among the companies reviewed are, of course, Anaconda, Kennecott, AMAX, ASARCO, and Phelps Dodge, with nine other American concerns, and six foreign companies. Here one can only regret that it has been possible to say so little about the Soviet Union in view of its increasing importance in so many fields of mineral production. As is well known, the copper industry is more sensitive than most to fluctuations in world economy that have a marked effect upon price and therefore upon exploration, development, and associated technologies. The industry has survived reasonably well the onslaught of nationalization, but seems as far as ever from finding an answer to the vagaries of price.

KINGSLEY DUNHAM

Gribble (C. D.), Durrance (E. M.), and Walsh (J. N.). *Ardnamurchan: a guide to geological excursions.* Edinburgh (Edin. Geol. Soc.), 1976. x + 120 pp., 2 figs., 14 geol. sketch-maps, 1 coloured geol. map (in pocket). Price £2·00.

Although based on the earlier guide by Richey, this field guide includes recent ideas on the form and structure of such Tertiary igneous centres and outlines some of the remaining problems, which include the spatial and temporal association of acid and basic magmas that gave rise to most of the plutonic intrusions of Centre 2. A 68-page text is followed by a comprehensive bibliography covering the recent work on the igneous rocks of Ardnamurchan, and by details of seven excursions (45 pp.). There is a glossary of Ardnamurchan place names (but no derivation of the name *Ardnamurchan*) and an important new geological map (1:40 000). Extra copies of the latter are available (both folded and flat), price 60p each.

In Centre 3 one of the problems still unresolved is whether the intrusions comprising the complex dip inwards or outwards: although none of the recent studies has disproved the original concept that the intrusions are a series of outward-dipping ring dykes, the fluxion structure of three of the gabbros suggest a funnel or saucer shape (if it is assumed that the fluxion structure is a flow phenomenon and lies parallel to the wall of the intrusion). All the basic rocks of Centre 3, the eucrites, gabbros, and the dolerite, are closely related and form three separate and distinct groups of rocks, which are part of a differentiation sequence (MM 40-335). The tonalite and quartz monzonite in the very centre of the complex cannot have formed, however, by continued fractionation of the magma and are interpreted as hybrids formed by partial remelting and assimilation of country rocks into basic magma.

Despite the general title, the main text pays scant heed to the Moine country rocks, which have a story to themselves (MM **32**-866), and although more detail is accorded to the Mesozoic sediments, little mention is made of their metamorphism. Glebe Hill sapphire locality in the hypersthene gabbro is documented, however, whether this plagioclase–spinel–corundum assemblage represents xenoliths of an aluminous bole produced by weathering of adjacent Tertiary lava or thermally metamorphosed basic igneous rock.

But in the main it is for the excellent documentation of the Ben Hiant vent associated with Centre 1, the layered hypersthene gabbro and the granophyric quartz dolerites of Centre 2, the ring intrusion of Centre 3 and the Great Eucrite, and the spectacular cone-sheets on the coast near Kilchoan that this guide will be welcome. Its true pocket-size will ensure its use in the field and its price should ensure its presence on the shelves of most petrologists (or in their pockets).

R. A. HOWIE

Walton (Anne). *Molecular and Crystal Structure Models.* Chichester (Ellis Harwood, Ltd.) and New York (John Wiley: Halsted Press), 1978. 201 pp., 58 figs. Price £9·00.

Although Dr Walton's book is about molecular and crystal structure models of all kinds, quite a large proportion of it is of relevance to readers concerned with the structures of minerals and related inorganic compounds. The three kinds of model most used in this context are: spheres in contact, balls and spokes, and polyhedra. Their relative merits are discussed, and for each many examples are mentioned, made from a wide variety of materials including metal, glass, plastics, wood, and paper. Information is given about ready-made complete models, model-making kits for assembly, and even more basic do-it-yourself versions; for the latter, suitable jigs, adhesives, and other accessories

are recommended. Among the possible components of home-made models are such friendly objects as curtain rods, 'poppet' beads, babies' rattles, and pipe cleaners!

A very useful appendix lists over seventy suppliers of models and model-building materials, although as it happens, one that advertises regularly in a well-known mineralogical journal is not among them. The author has been wise in giving the reader an idea of prices not in absolute inflation-prone terms but on a coarse scale of cheap–moderately cheap–moderately expensive–expensive. References and bibliography are extensive (but without titles) and range from short notes on particular model-making techniques, through papers on specific applications in teaching or research, to philosophical discussions on the concept of what is a model.

Many model users may think they already know enough about them for their needs, but I am sure that most will find additional useful information in this book. The price, £9 for 200 pages, on the Walton scale, must be at least 'moderately expensive', but this book should find a place on the laboratory shelf as well as in the libraries.

J. ZUSSMAN

Kimberley (M. M.), editor. *Uranium Deposits: Their Mineralogy and Origin.* Toronto (Mineralogical Association of Canada), 1978. 520 pp., 125 figs. Price $12.00.

This volume is the handbook produced to accompany the most recent of the Mineralogical Association of Canada's short courses. Held in Toronto in October 1978, this course obviously reflects the resurgence of interest and activity in the field of uranium exploration and geology in the present decade. With this in mind, the need for an up-to-date text on uranium geology is becoming increasingly apparent and this handbook will be welcomed as a contribution towards filling that gap.

In following the normal format for these course-books, the volume presents a compilation of twenty-one articles by eighteen contributing authors [MA 79-1060], mainly from Canada. The subject-matter is grouped in four main sections: Uranium Geochemistry, Uranium Mineralogy, Classification and Description of Selected Deposits, Roll-type and Stratiform Deposits and Deposits in northern Saskatchewan. As is to be expected from a multi-authored work, the content and style of contributions varies considerably and there are some areas of overlap and duplication. In general, broad-based review articles on all the main aspects are complemented with papers on specific topics or areas. An eighteen-page glossary concludes the book.

To some extent, some of the broader review articles suffer somewhat in comparison with the many excellent publications arising from symposia sponsored by the International Atomic Energy Agency and more experienced uranium geologists may find some treatments rather superficial. For example, it is felt that in view of the dominant contribution to global low-grade reserves, sandstone-type deposits might have been accorded more attention. However, as is indicated in the editorial, comprehensive coverage of world-wide uranium deposits is not pretended and perhaps one of the strengths of the book is that at least some information is given on all the important world occurrences and the geochemical and mineralogical factors relevant to their formation.

Particularly heartening to the mineralogist is the acknowledgement of the important role of mineralogy and the more specialized approach and techniques required in studies of uranium paragenesis. The complexity of the diverse modes of formation, the exceedingly high number of secondary uranium minerals, and the identification procedures necessary are covered in review articles by Steacy and Kaiman and by Morton. Also the value of a multi-technique mineralogical study for the characterization of uranium deposits is demonstrated well in reference to occurrences in Saskatchewan by Rimsaite.

It is to be regretted that this otherwise well-produced book is marred by numerous errors in the text, not all of which can be attributed to printing, and some of which may be confusing to the undergraduate/post-graduate readers for whom the volume in primarily intended. Nevertheless, the rapid publication after completion of the articles has resulted in a very up-to-date work, making it of considerable value to any worker in the field of uranium geology and at the exceptionally reasonable price of $12.00 it can be strongly recommended.

I. R. BASHAM