Malachite, cuprite, chrysocolla, tenorite, native copper, and cupriferous vermiculite are among the minerals produced. While the effects of leaching and oxidation are readily recognizable the extent of secondary sulphide enrichment is much less obvious. *Chalcocite* and *covelline* are clearly in part supergene: how far bornite has a similar origin is uncertain.

In the discussion of the origin of the deposits more attention is paid to the close association of ore with sedimentary features of the host rocks and to the lack of obvious structural controls, both suggestive of a syngenetic origin, than to the mineralogical and geochemical characteristics, which seem more easily explicable in terms of hypogene mineralization. However, the conflicting evidence from different mines is clearly set out and the contributors are not unanimous in the conclusions they draw. There is evidently scope for much further research, particularly in the study of the Katanga basin on a regional scale and to establish the extent of supergene sulphide enrichment in individual deposits. J. H. T.

RAMDOHR (P.). *Die Erzmineralien und ihre Verwachsungen.* 3rd edn. Berlin (Akademie-Verlag), 1960, xi+1089 pp., 637 figs. Price (bound) DM 88.00.

The appearance of three editions at 5-year intervals is an indication of the importance of this work for the now rapidly extending study of polished sections. This third edition makes its welcome appearance almost at the same time as the 'Festband' (Neues Jahrb., Abh. 94, 1960) offered to the distinguished author on his 70th year.

The book has been substantially enlarged (by about 200 pp. and 94 figures) while retaining fairly closely the arrangement of the 2nd edition. The general part (249 pp.) begins with a classification of the ore-deposits according to their geological origin (29 pp.): A, meteorites; B, magmatic series (abyssal–volcanic); C, sedimentary series (including mechanical aggregates, chemical precipitates, coal and oil, oxidation and cementation zones, together with a paragenetic table of ore-minerals (6 pp.); D, the metamorphic series (38 pp.). Ore minerals are perhaps more sensitive to metamorphic alteration than the silicates, and the study of these changes will no doubt play an increasing part in the interpretation of polished sections. This section provides a review of the extensive material already available, with an outline of the logical development of these studies; special importance is attached to examples of progressive

local metamorphism in ore-containing rocks, where the changes in the ore-minerals can be correlated with the well-known sequence of alteration in the transparent rock-forming minerals. The very early rearrangement of some sulphides, &c., offers special difficulties, but also special sensitivity as an indicator. The remainder of this section is a detailed study of the intergrowths (not forgetting the great technical importance of these structures for the mining industry); 172 pp. are illustrated by reference to many photographs (to avoid duplication, the photographs in this book carry explanatory notes which are not repeated in the text). The appearance of the grain itself (twinning, zoning, inclusions, &c.) is first illustrated; then come the intergrowths, which are commoner, more varied, and sometimes even more difficult of interpretation than the familiar 'eutectic–migmatitic–symplectic–graphic' varieties of texture in the rocks. The Schneiderhöhn classification of textures is followed throughout although 'the names are too much borrowed from petrological nomenclature'. The relation of texture to the mode of origin is examined for many types of crystallization, often with inclusions. Primary crystals, colloidal growths, sediments, are illustrated with excellent photographs. Then decomposition: whether by paramorphism, unmixing (in detailed relation with the crystal symmetry), or more generally by chemical changes including oxidation and cementation. Radioactive haloes, usually only identified by transmitted light, are now illustrated in polished sections under vertical illumination.

The systematic part (819 pp.) contains the well-known descriptions of the ore-minerals, with additional species and recent optical and other data. There is naturally an extension of the range of variation [it is not known how far this may be due to the unnecessarily low standard of accuracy in some recent measurements (reviewer)]. X-ray data are given, but the author comments that deceptive similarities are common among the ore-minerals, so that complete descriptions should be required for identification. The author's descriptions of the uranium minerals are particularly welcome. Even though the references have been carefully limited there are now 653 items, with 14 more on p. 267.

A. F. H.