BOOK REVIEWS

Barnes (H. L.), Editor. *Geochemistry of Hydrothermal Ore Deposits.* 2nd edition. New York and Chichester (John Wiley & Sons), 1979. xviii + 798 pp., 162 figs. Price £18·50.

The first edition of this important work, which grew out of a symposium organized for his friends by H. D. Holland at Princeton in September 1964 appeared in 1967 under the editorship of H. L. Barnes, who noted in his preface that the theory of formation of ore deposits had only recently undergone the renaissance common to many other areas of geological science since 1948. In fact a great period of development, if not of breakthrough, was beginning in the 1960s, particularly with the revival of interest in the contents of fluid inclusions, with the analysis of minerals for stable and unstable isotopes, and with the application of thermodynamics (the paucity of data notwithstanding) to postulated ore-forming systems. A very few active geothermal systems precipitating ore minerals, including Salton Sea, Cheleken, and Discovery Deep had been found, enabling something of a uniformitarian approach to be made. The decade to 1979 has witnessed further very great progress, fully justifying a complete revision, in the course of which several of the original authors have dropped out and a number of new ones have come in.

Perhaps the first sign of major progress is to be found in B. J. Skinner's introductory review of the many origins of hydrothermal deposits, in which he states categorically that all hydrothermal solutions are brines. Today there will be little if any dissent from this proposition, but it has important implications; thus if a hydrous magma ultimately expels its water, it is likely to be a brine; but the enormous volumes of hypersaline brine shown by oil-well drilling to be present in depth in all sedimentary basins, though they cannot be of igneous origin, can certainly also provide hydrothermal transport for ore minerals. Thus the second edition, in addition to an extended chapter by C. W. Burnham in which he traces magmatic evolution from the genesis of calc-alkaline magmas through the hydrous magma stage to the aqueous phase, also contains a new chapter, by J. S. Hanor, on the sedimentary genesis of hydrothermal fluids. H. P. Taylor, who dealt with oxygen isotope studies in the first volume, adds those of hydrogen in the new edition, and shows how $^{18}O/^{16}O$ and D/H ratios can be used to discriminate between meteoric and juvenile waters, and to trace the evolution of water of metamorphic and connate origin. He concludes: 'Remarkably, ore deposits have been shown to be formed from almost every kind of water one can imagine in the Earth's crust: ocean waters, saline formation waters, pristine meteoric waters, "^{18}O-shifted" meteoric waters, metamorphic waters and magmatic waters, as well as mixtures of several.'

The acceptance of brine as the transporting medium has made it much easier to understand the chemistry of the process, especially the solubilities of the ore minerals (discussed by Barnes) and the non-ore minerals (the gangue minerals of the first edition) described by H. D. Holland and S. Malinin. Chloride-complexing offers a sensible answer where none existed before, and perhaps other halides may be found to act in a similar way. Both chapters refer to much new work between 1964 and 1974. This is also true of studies of phase relationships among the sulphides, covered by P. B. Barton and B. J. Skinner, who summarizes a formidable amount of data and discuss some of it in relation to the mineralogical phase rule. In a new chapter on Mass Transfer among minerals and solutions, H. C. Helgeson looks at reaction paths on activity and chemical potential diagrams, showing that these are vector quantities that can be described in terms of linear algebra; the subject is then beginning to advance into areas where theoretical chemistry has something to contribute. The identification of the stages of formation of new mineral phases during metasomatism of wallrocks by hydrothermal solutions, discussed in the first edition by C. Meyer and J. J. Hemley, and in the second by A. W. Rose and D. M. Burt provides material for a great deal of thermodynamic interpretation, though only the alteration associated with 'porphyry' copper mineralization and in skarns is considered in any detail; greisening receives only scant attention, and mass transfer of Mg, Si, and F, quantitatively very widespread in some low-temperature deposits is not considered.

As to the sources of the metals, these are more difficult to pin down once hydrous magma ceases to be recognized as the principal carrier; in many cases there is little hope that this problem can be solved convincingly. However, where galena is present, determination of the lead isotopes has proved to provide more useful information that was expected a decade ago. The ratios $^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ turn out to be sensitive indicators of provenance leading B. R. Doe and R. E. Zartman to coin the term Plumbotectonics to head

the chapter in which they show how comparisons of these ratios can be used to identify the environment from which the lead was derived. Sulphur isotopes, here discussed with carbon isotopes by H. Omoto and R. O. Rye, offer a means of distinguishing between magmatically derived sulphur and sulphur formed by the reduction of sulphate in sea water. Nevertheless, the applications of these stable isotope data appear less straightforward than they did a decade ago.

Finally, E. Roedder considers the case for regarding fluid inclusions as true samples of the ore fluids, and A. J. Ellis, B. G. Weissberg, P. R. L. Browne, and T. M. Seward discuss the actualistic evidence from explored and active geothermal systems.

For anyone working in the field of ore genesis this book is an essential reference, bringing the American literature up to date to 1975 and contributing many ideas, some of which require more rigorous investigation. The authors would not, I am sure, wish it to be regarded as the last word on the subject; the disagreements between themselves is a sufficient indication of that. But it does show an important branch of geochemistry in a healthy, developing condition. For the thermodynamic and other data, a standard notation has been introduced in this edition, which is a compromise between that used by some geochemists and that recommended by IUPAC.

KINGSLEY DUNHAM

Mitchell (R. S.). *Mineral Names: What Do They Mean?* New York (Van Nostrand Reinhold Co. Ltd.), 1979. xviii + 229 pp. £10·45.

Etymology is rather a minority taste, and even the great J. D. Dana gave it short shrift: 'As a name is a name after it is once adopted, the origin of the word is not of much importance' (*Syst. Min.*, 3rd edn., 1850, p. 171). Professor Mitchell must have set himself the task of fleshing out the dry bones, and has succeeded admirably; I can strongly recommend this book to all who prefer their learning to be pleasurable, and as a companion to the standard texts on descriptive mineralogy.

The early part of the book gives it its characteristic flavour, and twelve, too-short chapters (pp. 3–80) deal with names derived from persons, places, impersonal names (botanical terms, institutions, companies, tribes, mythological characters), chemical composition, Greek and Latin terms, terms from other languages, and with prefixes, suffixes, symbols, and rules for the formuation of names. These sections could be fascinating if extended, but unfortunately they are confined to a few examples in each category. The main part of the work is devoted to an alphabetical listing of names and their derivations (pp. 83–205), and closes with three short appendices, a general bibliography, and an index.

Writing a review tends to bring out the pedant lurking within, even though Ruskin is said to have described it as 'mere upholsterers' work', and to produce a hankering for the book that the author might have written—but didn't. I am thus led to regret the fact that the present author, unlike his predecessor A. H. Chester (*A Dictionary of the Names of Minerals including their History and Etymology*, 1896), chose to reject completeness in favour of a somewhat arbitrary selection based on M. Fleischer's *Glossary of Mineral Species* (*1975*), and to omit all but general references. The latter is not a serious fault, since most of the original references can be found elsewhere; but where biographical information is included that results from the author's researches, it ought to have been properly documented.

Personal names constitute by far the largest single class of roots of the mineral names listed, accounting for some 45% of the 2665 or so in the book, and of these nearly a quarter (about 300) need more information. Professor Mitchell has found much that is new to me, but if he had consulted the *World Directory of Mineralogists* by Font-Altaba and Hooker (IMA, 1970) he could have added another forty-five dates of birth; and L. J. Spencer's *Biographical Notices of Mineralogists Recently Deceased* (*Mineral. Mag.* vols. 19–25 and 28) add a few more, including E. Bertrand (1844–1909), J. B. de A. Ferraz (1883–1926), R. von Görgey (d. 1915), F. Grünling (1857–1919), T. Hohmann (1843–97), K. Jimbo (1867–1924), and V. Billiet (d. 1945, not 1944). Dates for J. Imhof (1902–69), H. (not J.) Jordan (1808–87), and R. Sinner (1890–1960) are in *Die Mineralien des Binntales* (H. A. Stalder *et al.*, Bern, 1978). No mineral reference work seems to have identified the correct Robert Ferguson (1767–1840), a landowner, politician, and collector, of Raith, near Kirkaldy, Scotland. Eötvös Lorand (1848–1919), the Hungarian physicist, is to be found in many reference and biographical works under his family name, Eötvös.

There remains a considerable number of eponymous persons for whom no dates nor other personal data appear to be on readily accessible record, and it is fortunate that many are still alive and able—if reminded—to supply the missing details. Collectors, dealers, mine managers, and others, unless they have published or achieved fame (or notoriety) in some other manner, usually escape notice in reference works; and the task of pursuing them in newspaper files or public records can be