estimation of the most likely values of blocks of ore, or of the whole deposit, and the prediction of the errors of such estimates. Classical techniques for ore-reserve estimation by the methods of isolines, triangles, or polygons are not only subject to bias, but it is also extremely difficult to determine the reliability of the final estimate. Geostatistical methods allow these difficulties to be overcome.

The collection of papers in this volume is without doubt of fundamental importance in this field, particularly those in the first four sections (Basic Concepts, Kriging, Ore-waste discrimination, and Theoretical new developments) concerned mainly with the theoretical aspects. These expository papers, mainly from the Fontainebleau school or its ex-students, present a formidable arsenal of new geostatistical techniques. Already methods introduced only a few years ago, and still to see widespread use in the mining industry (e.g. Universal kriging) are being discarded and replaced by Transitive kriging, Disjunctive kriging, and Transfer functions. However, the mathematical techniques involved are highly complex, and will prove a considerable barrier to comprehension in most cases. Perhaps what is now required is a large number of *comparative* case histories to demonstrate to the mining world the advantages of both the old and new approaches in terms of reliability of estimation and computational cost. Some papers in the Kriging, Ore-waste discrimination, Industrial applications, and Case studies sections include practical examples. Applications of interest outside the mining field include optimal interpolation methods for contouring using kriging (A. Hass; M. Alfaro and F. Miguez), petroleum reservoir estimation (A. Hass), and the spatial distribution of ore deposits (F. P. Agterberg).

It is a pity that the organizers of the meeting did not feel that an elementary review of the principles of geostatistics might have a place in this volume in order to make it more understandable to a wider audience. With the exception of a 'Tentative glossary of geostatistical terms and notations' (rather curiously worded in places) included after the meeting as a result of suggestions from the participants, the volume consists solely of the papers as presented, with the exception of three papers by M. W. Clark and J. B. Thornes; P. Delfiner; and F. Muge, H. Pereira, and L. Cortez; whose absence is not explained. It is also to be greatly regretted that no record of the discussions appears as these were often most informative.

The volume is published with English as the major language and some papers in French. This should considerably help its dissemination to the international geological and mining community.

The style of the book is adequate and as would be expected when reproduced from 'camera-ready' typed material, and the illustrations are clear. Very few misprints were encountered.

In summary, this book is a collection of papers of fundamental importance to geostatistics, and as such will be invaluable to advanced students of the subject and to practitioners in the field. It is not suitable as an introductory text (nor was it intended to be that) but could easily have had more widespread appeal by the inclusion of additional introductory material.

R. J. HOWARTH

Beus (A. A.) and Grigorian (S. V.). *Geochemical Exploration Methods for Mineral Deposits* (transl. from Russian; technical editor A. A. Levinson). Wilmette, Illinois (Applied Publishing Ltd.), 1977. x + 287 pp., 94 figs. Price $32·00.

The development of exploration geochemistry in the 1930s in Russia and Scandinavia followed the establishment of strong schools of geochemistry and it was Fersman, a student of Vernadsky, who was the first modern exploration geochemist to recognize the importance of primary and secondary halos associated with ore deposits. In Russia theoretical geochemistry has remained the basis of exploration geochemistry, whereas in the West geochemical prospecting is more dependent on sophisticated analytical and computer technology, exploration criteria being derived empirically from large amounts of data.

As the more readily detectable surface deposits are discovered, a change of emphasis will be required from extensive to intensive methods such as the use of conceptual models; the impact of the porphyry copper model on discovery rates being the best-known example of this approach. The publication of a text that places particular emphasis on primary geochemical halos for mineral exploration is thus timely and it will provide a useful reference for those investigating mineral deposits or following up anomalies identified on geochemical maps.

The title, which suggests that the book is a general text on exploration geochemistry, is misleading. The most important chapters to the exploration geochemist are the first five in which theoretical concepts (Chapters 1-3) are developed into practical criteria in Chapter 4—geochemical specialization of rocks—and Chapter 5—primary geochemical halos. Much of this discussion provides a new viewpoint on rock geochemistry for mineral exploration to the Western geochemist and it should be recognized that Soviet geochemists have claimed success in discovering buried ore deposits as deep as 'some hundreds of metres';

criteria for distinguishing mineralized granitoid complexes and supra-ore from sub-ore primary halos are of particular interest. The remaining chapters on secondary dispersion, the scope and objectives of exploration, and statistical methods provide little new information, although they give an insight into 'the state of the art' of Russian exploration geochemistry. The methods of chemical analysis and data processing appear considerably less advanced than those of many Western countries with reliance placed on simple statistics such as ratios of elements that are readily determined by optical spectrographic methods. The emphasis on geochemical theory rather than advanced technology makes the text of particular value to exploration scientists working in developing countries.

The book is attractively bound and well presented although it suffers from poor diagrams, a lack of photographs of equipment, terrain, or procedures, and the use of units of concentration of the type $1{,}5.10^{-4}$ for the clarke for beryllium, for example. A general criticism is also the lack of quantitative information on the mineral deposits discussed. The theoretical sections of the book are presented confidently and clearly, however, and the editor's former experience with *Geochimica et Cosmochimica Acta* has clearly stood him in good stead. The book is an advanced rather than introductory text and is recommended to practising economic geologists, exploration geochemists, researchers, and senior students.

JANE PLANT

Wolf (K. H.), editor. *Handbook of Strata-bound and Stratiform Ore Deposits.* Amsterdam and New York (Elsevier Scientific Publishing Co.), 1978. Part I. *Principles and General Studies.* Volume 1. *Classification and Historical Studies.* x + 338 pp., 74 figs. Price U.S. $47.75/Dfl. 124.00. Volume 2. *Geochemical Studies.* xvi + 363 pp., 107 figs. Price U.S. $47.75/Dfl. 124.00. Volume 5. *Regional Studies.* xi + 319 pp., 72 figs. Price U.S. $47.75/Dfl. 124.00.

The seven volumes of this ambitious and expensive commercial venture not being available in the normal way for review, this article deals only with the two volumes of Part I, and with the volume containing contributions on mineralized regions in the British Isles. The post-Second World War period has seen important new developments in the understanding of stratiform deposits (concordant with the enclosing strata) and strata-bound deposits (those confined in or controlled by bedded wallrocks but nevertheless displaying discordant features;—the term is due to the late C. F. Davidson), and editor Wolf justifies his volumes as a means of bringing together a widely scattered literature, as generating new ideas, and as part of the present age of specialization. There has been a determined attempt by some Continental investigators, particularly in France (the gitologists), Austria, and Germany to see as many metalliferous deposits as possible as normal products of sedimentation or early diagenesis. No doubt this is correct in the cases of the unenriched jasperoid iron ores of the Pre-Cambrian, or the chamosite–siderite or minette ores of the Phanerozoic; but for the base-metal deposits in platform limestones, fluid-inclusion thermometry and chemistry have shown it to be incorrect in virtually every case investigated. Lithostatic or other metamorphism can rarely if ever be invoked to explain temperatures of formation, normally in the range 90–180 °C in these deposits; the interesting article in Volume 1 by A. J. Bernard and J. C. Samama stating the French position fails to deal with this problem. On the other hand, where sea-bottom vulcanicity has prevailed, the necessary conditions of temperature and brine-circulation have often been achieved to produce concordant base-metal concentrations among volcanogenic sediments. The application of this conception to major sulphide deposits in metamorphic terrains by Haddon F. King (who contributes to Volume 1 an account of Australian ideas), Chris Oftedahl, and David Williams has been particularly fruitful. There have been attempts to apply a similar concept to the platform limestone environment but these have been far less successful and today many workers prefer to appeal to deep formation brines, expelled from major sedimentary basins or mineralized by solution of evaporites, as the active agents, or else to hark back to the magmatic hydrothermal hypothesis that the stratiform/strata-bound school of thought was designed to kill off. As far as strata-bound deposits go, the problem of most interest to the economic geologist is the mechanism by which specific beds in the wallrock strata controlled the emplacement of oreshoots that are plainly recognizable as epigenetic. Having regard to this, one may justifiably question whether the concentration on a class of strata-bound deposits to the extent of producing a seven-volume handbook really advances the discipline of metalliferous geology as a whole. Certainly, the existence of the band-waggon has attracted adherents; but what possible reason can there be for including the Cu–Zn–Pb veins of the English Lake District, or the Bunmahon veins in Eire; there is not a strata-bound deposit among them in any meaningful sense. It is not surprising that it was necessary to include P. Gilmour's good article on transitional deposits.