radioactive disequilibrium within the ^{238}U, ^{235}U and ^{232}Th decay series. Theory, analytical methodology and applications dealt with are particularly important to scientists interested in geological, hydrological, oceanographic, palaeoclimatic and archaeological problems. However, it is doubtful if readers with no more than a 'modest knowledge of fundamental physics, chemistry and geology' will be able to follow the more specialised sections.

Subject matter is based on some 1800 papers, the majority of which have been published since 1970. It is unfortunate, however, that of the 33 authors nearly half are resident in the U.S.A. with others divided between the United Kingdom, Canada and Australia. This tends to give an imbalance to global aspects of the behaviour of uranium and thorium nuclides at the geosphere-biosphere boundary.

The sections on nuclear physics, geochemistry and analytical techniques including chemical procedures, radiation spectrometry and mass spectrometry are excellent. In particular, they provide up-to-date information of value to students, scientists and engineers not versed in these subjects.

Following sections are devoted to radionuclides in igneous rocks, surface hydrology, ground water, oceanic geochemistry, estuarine environments, carbonate and sulphate precipitates in fresh water, marine sediments and marine phosphates and carbonates. Dating applications are given in the fields of archaeology, palaeoclimatology, palaeosea levels, landscape evolution and to lead-210 dating applied to sediments. Two sections of considerable practical significance concern (*a*) the application of radionuclide transport in relation to radioactive waste disposal—a subject that has been neglected for much too long—and (*b*) exploration geology. The former, which is based almost entirely on post-1980 publications could have been strengthened by more reference to the physical properties of uranium and thorium minerals as natural analogues in the understanding of radionuclide mobilisation and sorption processes. The latter section is not particularly inspiring, but this, no doubt, is due to the decline in uranium exploration over the past two decades.

The volume is clearly printed and illustrated, as would be expected from the OUP, but it is suggested that if a third edition is contemplated it might better be presented as two volumes: one dealing with appropriate nuclear physics, chemistry, geochemistry, geochronology and analytical methodology; the other with applications. As it is, the volume should be read by all interested in environmental aspects of uranium and thorium nuclides and in particular by scientists and engineers involved in nuclear waste disposal.

S. H. U. Bowie

Reed, S. J. B. *Electron Microprobe Analysis. Second Edition.* Cambridge (Cambridge University Press), 1993. xviii + 326 pp. Price £45.00 (hardback).

The first edition, published in 1975, justifiably became a standard text on the subject, and over the years has been consulted extensively by microprobe analysts. This second edition is a welcome, somewhat overdue, revision which follows closely the original format of a practical approach coupled with sound theoretical principles. As in the first edition, each chapter incorporates historical, theoretical and practical perspectives to describe a specific aspect of electron microprobe analysis. After the introductory chapter, the next three chapters relating to the theoretical and design features of the electron microprobe are little changed. Chapter 5 on scanning, includes sections on the use of colour, storage and processing of X-ray images. Chapters 6 to 8 deal with the principals, theoretical and practical aspects of wavelength-dispersive spectrometry, and Chapters 9 to 10 with energy-dispersive systems. Chapters 11 and 12 provide a detailed treatment of *quantitative* analysis by wavelength-dispersive and energy-dispersive means respectively; together with a comparison of the two. Chapters 13 and 14 cover the more theoretical details of X-ray generation and interaction with the matrix, and Chapters 15 to 16 are devoted to absorption and fluorescence correction procedures, with a worked example of matrix corrections in practice (Chapter 17). Chapter 18 takes a theoretical and practical approach to light element analysis, and the book concludes with useful appendices on data relating to characteristic X -rays.

Those familiar with the first edition will welcome this second edition to their bookshelves. To those new to the field of electron microprobe analysis, I can strongly recommend this book because of its eminently readable style and because it succeeds on several different levels: it provides general background information, it combines a theoretical base with practical appli-

cations, and it is a source of reference from which the analyst can readily sample.

C. T. WILLIAMS

Kerrick, D. M. (ed.) *Contact Metamorphism.* Washington D.C. (Mineralogical Society of America: Review in Mineralogy, Vol. 26), 192, xvi + 847 pp. Price $26.00.

My first thought while leafing through the contents of this sturdy volume was that the authors had left us with nothing else to do with thermal aureoles except apply the collected knowledge gathered together here. I began to fear that, by its very comprehensiveness, the volume might inadvertently secure the demise of its own subject through a public perception of a line ruled across the page and marked 'knowledge of this field is now complete'. Well, of course, by fourth thoughts I was beginning to see some glimmerings of things still left to think about, but Derrill Kerrick and his authors are really to be congratulated on a work that is awesome in its scope and completeness, and more than maintains the standards of its stable-mates.

Kerrick, in a succinct opening chapter, introduces many of the themes of the volume, and draws comparisons with regional metamorphism. I fail to see why he need be so tentative in suggesting that some areas of low-*P* regional metamorphism are intermediate in character, representing regional-scale contact metamorphism. The bulk of the chapters are in any case of broader scope than just contact metamorphism. A highlight is Labotka's summary of the properties and compositions of metamorphic fluids; not only do you get an instant reference for all the equilibrium constants and equations of state you need for C–O–H fluid calculations (no, I haven't checked for typographical errors), but for once, the often more abundant salt components are also taken into account.

P–T conditions for low-pressure rocks are dealt with in two chapters. Pattison and Tracy take on the metapelites, dividing them up into facies series with distinctive assemblages and developing a petrogenetic grid to illustrate phase relations between them. Use of geothermometers and geobarometers is also reviewed briefly and there is an exhaustive list of those aureoles which have been described in English, classified according to facies series. This may be galling for Welsh language enthusiasts and other anglophobes, but a godsend to anyone looking for a particular natural example to prove his latest inspired idea, or just wanting good teaching ideas. Tracy and Frost carry out a similar exercise on low-*P*–high-*T* phase equilibria in all the other rock types that do anything interesting during contact metamorphism. My edition his copious errata to the figure captions for this chapter.

The theme of metamorphic fluids returns with a review of Brenan of metamorphic permeability and its implications for how fluids move through crystalline rocks. This chapter considers both cracking and fracture permeability, and equilibrium fluid distributions along grain boundaries. Unfortunately, metamorphic secondary porosity, long predicted from stable isotope studies, and increasingly imaged by cathodoluminescence or back-scattered electron microscopy, does not get comparable billing.

Metasomatism in aureoloes is described and summarised by Barton, Ilchik and Marikos, in a chapter which comes dangerously close to letting metamorphic petrologists know that some aureoles contain ore deposits. Their pragmatic recognition of a wide range of fluid types and sources in aureoles is sharply juxtaposed against a chapter by Ferry which takes a highly theoretical approach to a very simplified system.

Further chapters deal with several practical approaches to aureole studies: Nabelek on stable isotopes, and Furlong, Hanson and Bowers on modelling thermal regimes. This chapter is a particularly important introduction to modern modelling methods that incorporate evaluating fluid flow. Kinetics of specific reactions in aureoles (although not necessarily the underlying processes) are discussed in chapters by Joesten and by Kerrick, Lasaga and Raeubrn. The book concludes with chapters on aureole tectonics by Paterson, Vernon and Fowler, and on 'aureole systematics' (the most extensive lists yet, of aureoles described in English) by Barton, Staude, Snow and Johnson.

With all this in 850 pages, what else can be said? The main omission that I felt was the emphasis in most chapters on contact metamorphism as a low pressure equivalent of regional metamorphism, where most of the same rules still apply (e.g. lithostatic pressure = fluid pressure), rather than as a deeper equivalent of geothermal field alteration, closely related in space and time but not always operating under the same constraints (e.g. fluid pressure = lithostatic pressure). There have been studies, notably the work of Fournier in Yellowstone, which attempt to link contact metamorphism to contemporary active processes rather than to our inferences of deeper, and still more obscure, events and this must surely be an important direction in the future. That said, such criticism is offered primarily because it is obligatory to demonstrate that the reviewer has read the