underground can be interpreted to provide useful information in water resources and pollution studies.

The first four chapters provide an introduction to the hydrogeochemistry which follows. They are rather brief and some of the explanations of hydrogeological terms are idiosyncratic to say the least. Reference should be made to one of the classic hydrogeological texts such as Todd or Freeze and Cherry to provide an overview of basic hydrogeological concepts.

Chapter 5 defines the basic chemical terms which need to be mastered as a prerequisite to data processing which itself is considered in Chapter 6. The author is clearly an enthusiast and shows how it is possible to put life into tables of dry data by imaginative processing. However, it is a personal view and, for example, there is no mention of the Stiff, Piper and Durov diagrams widely used by hydrogeochemists.

Chapters 7 and 8 review the planning of hydrochemical studies and the measurement of parameters such as pH, temperature and alkality which have to be measured at the borehole or well site. The meat of the book lies in Chapters 9, 10, 11 and 12 which review the use of stable and radiogenic isotopes and noble gases in groundwater studies. These are useful chapters with introductory theory followed by well-referenced examples. However, again it is the omissions which stand out, with only a passing mention of the use of the uranium decay series and no examples of how all the techniques have been brought together to tackle a problem, such as the work at the Stripa Mine in Sweden.

Chapter 13 is largely a collection of case histories or groundwater pollution incidents and shows how the tools of the hydrochemist can be used to model and monitor such pollution.

This is very much a personal view written by a geochemist who is an enthusiastic proselytiser for his subject. It will be a useful addition to the bookshelves of advanced students and researchers in hydrogeology who want to know how they can apply isotopic techniques to the solution of problems related to groundwater resources and pollution.

J. D. MATHER

Chatterjee, N. D. *Applied Mineralogical Thermodynamics*. Berlin, Heidelberg and New York (Springer-Verlag), 1991. xvi + 321 pp. Price DM 98.00 (paperback).

This book is subtitled 'selected topics' to emphasise the fact that several aspects of thermodynamics in geology, in particular silicate melts and aqueous solutions, have been omitted. The author has, therefore, stuck to the area he knows best, solid–solid and solid–fluid equilibria. The book is pitched at a fairly high level and would not be suitable as an introductory text for undergraduates but would be very useful in a graduate class or as a 'how-to' manual for research students. To help succeed in the latter role, the author makes liberal use of well-chosen worked examples, which, in this subject area, are essential. There are also discussions of uncertainties, errors and error propagation in several chapters, which really help show what can and cannot be derived from different types of data.

The book starts with a brief review of the basic concepts of free energy, standard states, mixing properties, partial molar properties, the equilibrium constant and the Gibbs-Duhem equation. This is followed by chapters on the measurement of thermodynamic properties (chapter 2) and on equations of state for pure and mixed fluids (3). The former does not, as perhaps implied, describe the experimental methods, but rather the information these methods give and how, with examples, the information can be manipulated. Chapter 3 covers fugacity, activity and simple equations of states for fluids, with the emphasis on the popular MRK equation. As in most of the book, the author doesn't delve deeply into the theoretical background of topics such as MRK or mixing properties of fluids and solids. He treats them rather as equations with adjustable parameters, an approach which I find somewhat unsatisfying, but which may be alright at this level. Chapters 4 and 5 deal, respectively, with calculation of solid–solid and solid–pure fluid reactions. These are based on numerous examples which serve well to illustrate the methods and uncertainties and also the validities of various assumptions that one may make. These are followed by a chapter on solid–mixed volatile equilibria and one on the derivation of internally consistent data bases from a combination of phase equilibria and calorimetric data. In the latter the author briefly describes the different mathematical methods and then emphasises mathematical programming. Chapters 8 and 9 complete the book with an extensive discussion of crystalline solutions (8) and the calculation of heterogeneous equilibria involving solid solutions (9) and geothermometry and geobarometry (9). Although the discussion of statistical thermodynamics is brief, the author gives an extensive description of most of the solution models in common use and covers such topics as short-range order, mixing on different sites and reciprocal solid solutions. As in

most of the book, there are good worked examples and discussion of uncertainties.

As implied above, the book takes a practical rather than theoretical approach to the subject and is thus most suitable for advanced students and researchers with an interest in applying thermodynamics to specific petrological problems. When viewed in this light it is successful and merits extensive use.

B. J. WOOD

Eberhart, J. P. *Structural and Chemical Analysis of Materials—X-ray, electron and neutron diffraction—X-ray, electron and ion spectroscopy–Electron microscopy*. (Translated by J. P. Eberhart), Chichester and New York (J. Wiley and Sons), 1991, xxx + 545 pp. Price £95.00.

The first, French language, version of this book was published in 1989 by Bordas, Paris. The English translation, by the author, is a specially welcome addition to the relatively few books that introduce the non-specialist to techniques currently used in investigations of the microstructure and chemical composition of the interiors and surfaces of materials. It is essentially a textbook, rather than a laboratory handbook. The book provides an excellent and readily comprehensible account of both the basis for and equipment used in the most important imaging, diffraction and microanalytical methods. It does not specifically address minerals or indeed any particular group of materials.

In Part 1 (Chapters 1 to 8) the author presents elementary, largely unmathematical, but nevertheless fairly rigorous explanations of interactions between various forms of radiation and solids, thus giving the physical basis of modern instrumentation. A foundation of knowledge about crystallography and optics is assumed and the coverage is otherwise fairly comprehensive. (An organisational choice made here is to leave the discussion of irradiation damage processes until later: pp. 448–451, 490). Part 2 (two chapters) is concerned with the production and measurement of radiation, i.e. with sources, detectors and spectrometers; basic designs are described and illustrated. Part 3 (two chapters) covers the application of diffraction techniques to materials analysis; a bare minimum of theory is reproduced (some topics are summarised in appendices, e.g. reciprocal lattices, Fourier transforms). Much of the content of Parts 1, 2 and 3 will be familiar to graduates in the physical sciences.

The six chapters that form Part 4 cover various X-ray, electron and ion spectrometric methods (XRF, EPMA, XPS/ESCA, Auger, X-ray absorption methods, EELS, SIMS, etc.). Part 5 consists of four chapters that address the various types of electron microscopy (TEM, HVEM, SEM, STEM, AEM, STM). The advantages and limitations of the various techniques are presented, together with specimen requirements, analysis correction methods, sources of errors, etc. Here also are briefly mentioned both the processes and practical effects of irradiation damage by electrons and ions.

The book is nicely produced and has an attractive format. The use of many sub-headings, italicised keywords, bold face definitions, boxed summary statements, etc., give clarity and make for easy relocating of particular topics. The book does not go into great practical detail; indeed the author stresses that readers are expected to seek review papers and specialist texts for greater technical information. It is adequately illustrated with line drawings, but has very few half-tones considering the inclusion of subject matter like imaging. For such a textbook, the selling price (£95 for 545 pages, including six appendices) seems high, and this will surely severely limit purchase by individuals.

D. J. BARBER

Hambrey, M. J., Fairchild, I. J., Glover, B. W., Stewart, A. D., Treagus, J. E. and Winchester, J. A. *The Late Precambrian Geology of the Scottish Highlands and Islands*. London (Geologists' Association), 1991. vii + 130 pp., 25 sketch maps. Price £8.50.

The Geologists' Association has been publishing field guides to classic areas of British Geology ever since the International Geological Congress was held in London in 1948. These guides have traditionally detailed the geology of a limited area through a series of itineraries designed to illustrate the regional geology. The latest GA Guide, prepared by Hambrey and his associates, represents a departure from this well-tried formula. This guide illustrates rocks of a particular age, the late Precambrian (Proterozoic), as they are represented in Scotland. Itineraries included in the guide cover classic localities for the study of the Dalradian Supergroup, the Moine Assemblage and the Torridonian Complex, extending from Islay to the Grampian Highlands and northwards to the Assynt District in the Northwest Highlands. Road improvements in recent years have made much of this area accessible within 2–3 hours of Edinburgh, Glasgow or Inverness.

The present guide has been conceived on a grander scale than many of its predecessors. Its