Earth models, seismological, compositional and thermal, are elegantly explained and brought right up to date with an authoritative summary of the literature. The book (264 pages) includes approximately 470 references and an appendix for the PREM (seismic) model for the mantle and core. It is well illustrated, and indexed with some 250 items. The book is well produced, and the text virtually error-free, through one important boob on page 97 has inverted the important concept of liquidus and solidus. The book provides an extremely useful introduction and handy references to researchers working in the earth sciences, physics and materials science. It will provide an almost essential upgrade to a number of undergraduate courses, including the more traditional geology and geophysics. It is very highly recommended.

A. P. Jones

Ganguly, J. (Ed.) *Difffusion, Atomic Ordering and Mass Transport* (Advances in Physical Geochemistry, Volume 8). Berlin, Heidelberg and New York (Springer-Verlag), 1990. xiii + 567 pp. Price DM 290.00.

The latest volume in this well-established series brings together thirteen review-style articles which are connected by the general theme of atomic migration and diffusion. This is a very broad field and is tackled here on a variety of scales from the atomic to the geological outcrop, using both theoretical and experimental methods. The relationship between the chapters may therefore seem somewhat tenuous, and it is unlikely that many readers will be familiar with more than a few of the topics presented here. However, each chapter is representative of a particular approach to some diffusion-related problem, and the list of the 22 contributors confirms that the leading practitioners in the field are displaying their wares (see M.A. 91M/4233-4245).

The book is loosely grouped into themes which reflect the scale of the process discussed. The first three chapters deal with mainly theoretical approaches to the microscopic interactions which control atomic transport and ordering. Kubicki and Lasaga outline the role of molecular dynamics computer simulations in determining diffusion in silicate melts; Ross presents a summary of Ising models and their application to cation ordering in a number of mineral systems, and Downs discusses how electron density is determined from X-ray diffraction data and then applied to computer models of crystal structures.

Chapters 4–10 deal with volume diffusion in various mineral systems, principally from an experimental point of view. Chakraborty and Ganguly review compositional zoning and cation diffusion in garnets, and the implications to geothermo-barometry and geochronology; Morioka and Nagasawa summarize ionic diffusion experiments in olivine; Jaoul, Sautter and Abel describe the nuclear microanalysis techniques for measuring diffusion profiles. Volume diffusion is known to be affected by various factors: Goldsmith emphasises the effect of pressure on Al, Si diffusion and oxygen isotope exchange, Graham and Elphick describe the role of hydrogen in enhancing oxygen diffusion, while Kramer and Seifert discuss experiments designed to measure the effect of strain. In Chapter 10 Parsons and Brown summarise and add to their body of work describing the mechanisms and kinetics of exsolution in alkali feldspars.

Moving to grain boundaries introduces larger scale problems with more immediate applications to petrological processes, Joesten presents a very useful summary of grain-boundary diffusion with a discussion of how the available data can be applied to mass transport in metamorphic rocks. In Chapter 12 Lesher and Walker discuss the role of thermal gradients in diffusional mass transport in magmas (the Soret effect), and in the final chapter Lichtner presents in 100 pages, a detailed account of quasi-stationary state approximations to fluid/rock interactions and their application to a number of geological processes.

There is much of interest in this volume and the themes discussed are central to our understanding of geological processes. The chapters are all written to a high standard and the editor has done a good job in ensuring a uniformity of presentation and style. Bringing together these chapters provides a good impression of the range of activities at the frontiers of the subject, and practising research workers will find the book a useful source of information as well as providing a fairly high-level introduction to fields beyond their specific expertise. The book should certainly by available in institutional libraries wherever serious research and teaching are carried out.

A. Putnis

Mazor, E. *Applied Chemical and Isotopic Groundwater Hydrology*. Milton Keynes (Open University Press), 1990. x + 274 pp. Price £37.50.

This book emphasises the physical and chemical properties of water and their variations with time. Its strength lies in its use of numerous examples and case histories to show how the chemical information coded into water during its passage 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