from radiation damage by electrons, neutrons and decay particles.

The final quarter of the book is about microstructures arising from deformation. McLaren was directly involved in the early work (1960's) on dislocations in quartz and this chapter clearly shows his continuing interest. After discussing the fundamentals he illustrates them in quartz, feldspar, calcite, dolomite, olivine, pyroxene and perovskite. He completes the chapter by relating the deformation microstructures to geologic processes. No space is given to diffraction contrast from shock-induced microstructures which would be especially useful at this time of cometary impacts and dinosaur extinctions.

I found myself of two minds after reading the text: (1) I wished McLaren had covered the field more evenly or (2) had expanded on the explanations of diffraction contrast for those examples he did cover. He could have written an excellent practical manual. It is clear that this book is strongly oriented toward amplitude contrast imaging, framework silicates and deformation microstructures. It is well illustrated with 188 figures, features a detailed account of imaging theory and in spite of what McLaren states is filled with practical imformation about TEM, mineralogy and rocks. It definitely belongs next to the classic and useful texts of Hirsh, Howie, Nicholson, Pashley and Whelan; Edington; and Wenk.

The book will be especially useful as a supplement for graduate students learning microscopy as well as researchers wishing a compilation of McLaren's research efforts which are extensive, instructive and carefully done. The price is high and Cambridge University Press would do well to bring it out in paperback for the significantly lower price I paid for the paperback edition of the third volume of Putnis and Liebermann's Cambridge Topics in Minerals Physics and Chemistry. This would bring the price closer to the reviews published by the professional societies and within a student's reach.

G. L. NORD, JR.

Mange, M. A. and Maurer, H. F. W. *Heavy Minerals in Colour*. London (Chapman and Hall), 1992. 147 pp. Price £50.00

The stated aim of this book is to provide a manual to assist in the microscopic identification of the most common heavy minerals in sediments. Three-quarters of the book is dedicated to detailed descriptions and illustration of 61 transparent mineral species. The descriptions are clear and concise, and the colour photographs are excellent. For any sedimentary petrographer who has struggled with heavy-mineral grain identification using descriptions, line drawings and black-and-white photographs in texts such as Milner's Sedimentary Petrography this atlas of heavy minerals comes as a very welcome aid. Each mineral is illustrated by a grain mount consisting of a number of grains which show the range of morphologies and features typical of that mineral. Where appropriate, pleochroism and interference colours are illustrated by presenting pairs of photographs with the polarizer at different orientations. All minerals are shown in both plain polarized light and under cross-polars. The more common minerals such as zircon and apatite are given greater attention with more photographs and longer descriptions.

In some cases the text accompanying each mineral includes some general remarks and appropriate references. It is a pity that this extract information is limited to only some instances, and is always rather brief. Further information about each mineral and some guides into the specialist literature in that field would have added to the usefulness of this book. There is space in this book to provide further information: each mineral description starts on a new page, leaving numerous blank expanses of paper which add up to almost a quarter of the page area in the description section. Although this makes for very easy use of the book, it is tempting to suggest that this space could have been occupied by more information.

The first thirty pages of the book describe the principles and practice of the study of heavy minerals in sediments. Short chapters on applications and limitations, methods, presentation and analysis are clear, concise and provide adequate references. These sections are clearly only intended to provide a brief introduction to the topics, although further discussion and information would have been welcome in several instances. In particular, a couple of examples of how data may be presented and further brief case studies which illustrate the range of applications of heavy mineral analysis would have made this text more complete. In contrast to the high quality illustration of the minerals, the figures and tables in this first section are rather crude by comparison. A book which is otherwise of very high quality in terms of presentation has been spoilt by unimpressive diagrams and tables apparently typed and drawn up with a pen and ruler. An identification summary table in an appendix is

difficult to read and use because of similar poor presentation.

This book may not be the comprehensive guide to heavy mineral identification and applications that one might have wished for, but it is nevertheless a valuable aid to heavy mineral analysis and it certainly succeeds in its aim to assist in the identification of mineral grains. An essential book for any sedimentary petrographer with an interest in provenance studies or other applications of heavy minerals.

G. NICHOLS

Voll, G., Töpel, J., Pattison, D. R. M., and Siefert, F. (eds.) *Equilibrium and kinetics in contact metamorphism.* 1991. Berlin, Heidelberg and New York (Springer-Verlag), 484 pp., 209 figs. Price DM 228.00.

The sub-title of this book, 'The Ballachulish igneous complex and its aureole' is a succinct summary of the nature of its coverage of the 'Equilibrium and kinetics in contact metamorphism'. It is said in the preface that this is probably 'the most comprehensive study of a single igneous complex–contact aureole system yet published', and this is not an understatement. The book represents the results of detailed, multidisciplinary investigation conducted in Edinburgh and Germany. It is divided into five parts: an introduction to the regional geology (2 chapters), the intrusive complex (5 chapters), the contact aureole and its rocks (8 chapters), interactions between the intrusion and the contact aureole (3 chapters) and a concluding discussion (3 chapters).

The introductory chapters provide a guide to the regional and local setting of the detailed studies, but fail to summarise the geology of the intrusive complex. A synopsis of the nature of intrusion complex and its aureole, and the timing of emplacement would have been highly useful, as one is not provided in the following chapters. This introduction is followed by a series of chapters detailing the petrography, mineralogy and geochemistry of the magmatic rocks of the Ballachulish complex. This information is linked into descriptions of the field relations to detailed discussion of petrography, mineralogy and geochemistry tied in with field relations to enable the emplacement and differentiation sequences to be determined together with the P–T–f_{O_2} of crystallisation and the water content of the magma. Details of pyroxene textures and sub-solidus behaviour, used to estimate crystallisation temperatures, and geophysical evidence on the 3-D form of the intrusion follow.

Discussion of the aureole is opened with a clear, well introduced discussion of pelite zones and reactions, plus relevant petrogenetic grids. Excellent agreement of natural and modelled assemblages is demonstrated, implying at least a gross approach to equilibrium. Melting reactions in aureole rocks are analysed, and the segregation of melts into 'hydraulic' fractures discussed. As with the magmatic rocks, there is an impressive collation of both field, laboratory and theoretical information used to describe and analyse the processes involved. A fascinating discussion of melt-component redistribution during crystallisation of the melt fraction of migmatites enables a rationalisation of the conflicting compositions of naturally- and experimentally-derived melts. This section on melting is of greater interest and importance than contact aureoles alone. The chapters on pelites and migmatites are profusely illustrated with photographs of both rocks in the field and thin sections—a welcome feature. Carbonate-rich rocks of the aureole are discussed both in terms of their petrology and the mechanism of reaction at two isograds. This is a rare case study of the mechanisms of reaction in an environment where temperatures were changing rapidly in a relatively well-constrained fashion. The idea that a decreasing degree of overstepping is encountered in a mineral zone travelling in a direction away from the contact towards isograd is developed and profitably used to expore the textural complexities. Quartz grain coarsening is modelled in conjunction with thermal model data, and again the agreement of field and laboratory data (this time over the role of water and its quantitative effects) is impressive. Also described are the kinetics of alkali feldspar ordering and exsolution and structural variations in cordierites.

The next section commences with evidence of P–T–A_{H_2O} conditions in the complex: impressive agreement between results of different methods for aureole and intrusion lead to the presentation of four temperature profiles through the aureole. Oxygen-isotope data indicate lack of hydrothermal circulation, and the authors speculate that the early, hot dioritic intrusion acting on the regionally-metamorphosed host rocks effectively sealed the aureole before the wetter magma of the granitic pluton core was emplaced. These two sets of data on aureole temperature distribution and the lack of hydrothermal circulation are essential input to a quantitative thermal model of the Ballachulish complex and its aureole. The resultant thermal model is crucial to all of the kinetic studies included in the book, and what