

necessary laboratory techniques that are required for their proper study. The emphasis throughout is on the practical use of the optical techniques, and only the bare essentials needed to understand the inter-relationships of optics and crystallography are given. Nevertheless there are clear expositions of the biaxial indicatrix and interference figures and useful sections of the interpretation of interference figures, orientation diagrams, and the universal stage. This part of the text ends with a series of ten determinative tables, ranging from minerals listed in order according to their refractive indices to minerals that commonly display anomalous interference colours.

The chapters on principles and techniques occupy almost 100 pages: the remainder of the book is devoted to mineral descriptions. Here there is a fairly standardized format with details of optical properties, orientation diagrams, occurrence, and distinguishing features. The text throughout is well illustrated with a nice blend of text-figures and photomicrographs. A Michel-Lévy interference colour chart is bound in at the end of the book.

The over-all impression is one of a crisp practical approach to this facet of determinative mineralogy and the book would be unhesitatingly, indeed enthusiastically, recommended but (and it is a big but) for the price. The text has been typewriter-set, a style perhaps acceptable if it reduces the cost, and admittedly there are many diagrams, but a price of over £15 is so far beyond the range of the average student as to render this book inaccessible to its major market. Nor is this a book for libraries—it is essentially a laboratory manual—and one can but recommend one of the several cheaper well-established alternatives available.

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ALLÈGRE (C.-J.) and MICHARD (G.). *Introduction to Geochemistry*. Dordrecht, Holland, and Boston, U.S.A. (D. Reidel Publ. Co.), 1974. xii+142 pp., 85 figs. Price cloth Dfl. 50.00 (\$19.00); paper Dfl. 32.50 (\$12.00).

This is designed as an undergraduate textbook on geochemistry; it was first published in French in 1973 and has now been translated into English with a few additional figures and paragraphs.

After an introductory chapter, considering the Earth as a chemical system, there are chapters on the equilibria of phases in the lithosphere and in the hydrosphere: the former although essential for the general plan of the book will bring little new to petrologists, but the latter will be of interest to all geochemists. The second half of the book turns to topics of wider geochemical interest, dealing first with the geochemical fractionation of trace elements—mainly with the behaviour of trace elements in magmatic processes but also covering the entrapment of trace elements in sediments. The consideration given to partition coefficients is rather meagre, but the differentiation of the rare earths is expounded clearly and the crystal-field theory is touched upon. The chapter dealing with irreversible processes of element transfer relies very much on the work of Helgeson to unify the principles of mineral equilibria with the behaviour of solutions, and continues with the concept of residence time (the box model) and chemical diffusion-reaction coupling. The transference of elements in a non-equilibrium state is illustrated by the development of manganese nodules on the ocean-floor.

It is perhaps in the last two chapters, dealing with the fractionation of both stable and radioactive isotopes, that this book differs from many other texts. In the lighter isotopes, particular attention is paid to their natural fractionation and to the $^{18}\text{O}/^{16}\text{O}$ and $^{32}\text{S}/^{34}\text{S}$ ratios and their use in geothermometry and in the study of the genesis of hydrothermal deposits. In the description of radioactive isotopes, attention is given to the general equation for the evolution of a radioactive system, and details of the U/Pb, K/Ar, and Rb/Sr systems are discussed, with consideration of isochrons, Concordia diagrams, and variations in $^{87}\text{Sr}/^{86}\text{Sr}$ ratios.

Throughout the book a basic knowledge of both chemistry and geology is assumed. References cited in the text giving credit for the original work are not necessarily listed in the bibliography, where the authors have chosen sometimes to refer to more readable reviews. This will be a useful text for courses in geochemistry, a topic for which there is in general a lack of suitable course books, but although the approach is good the attack is rather superficial. Time and time again one wishes the authors could have gone much further into various problems, at best no doubt giving a much larger text but at least giving a fuller and more comprehensive bibliography.

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[GRIGORIEV (D. P.) and ZHABIN (A. G.)] Григорьев (Д. П.) и Жабин (А. Г.), Онтогенез Минералов (*Ontogeny of Minerals*), in Russian. Moscow (Publishing House 'Nauka'), 1975, 339 pp., 236 figs., 39 tables. Price 2.23 roubles.

Although there are fine, detailed descriptions of minerals, common practice in the mineralogical and petrological literature is to dwell but in a cursory manner upon the peculiarities of individual minerals making up an aggregate or rock. This book by an eminent Russian mineralogist and his pupil is meant to stress the necessity of careful studies of the individual crystals or aggregates of a mineral in order to gain better information about its genesis. The biological term 'ontogeny', becomingly picked up in 1955 by Professor Grigoriev and since then widely used in and outside the Soviet Union, conveys a broader sense to the genesis of mineral individuals and aggregates, non-crystalline and metamict products included. 'Each mineral (mineral individual, N.B.) recites its own history' is the leitmotiv of the book.

The book, very well printed and with a very pleasant outer appearance, comprises an introduction along historical lines and three main chapters: Nucleation of the Mineral Individuals; Growth of the Mineral Individuals; and Alteration and Destruction of the Individuals. Homogeneous and heterogeneous nucleation, growth mechanisms and modification of crystal forms, mechanical and chemical alterations, and recrystallization phenomena are all amply illustrated by examples of minerals occurring under varying geological settings; cosmic environments are hinted as well. Attention is also paid to pseudomorphs and radiogenic alterations of minerals. Many of the examples are original, others taken from richly quoted literature. From 728 entries, 496 are in Russian, thoughtfully selected in order to display a cross-section of the present-day 'ontogenetic' trend in the studies of Soviet mineralogists.