

the Skaergaard and Bushveld (Chapter 17—'Is the Bushveld Complex Igneous?') are of non-magmatic origin. This argument is based almost entirely on the highly subjective interpretation of two textural features. The first is the slightly rounded and 'corroded' nature of the plagioclase crystals poikilitically enclosed in clinopyroxene (or of olivine crystals in plagioclase). According to Augustithis 'these ophitic intergrowths are not due to simultaneous pyroxene/plagioclase crystallisation' but are 'blastogenetic'; an interpretation which pays little heed to recent work on the importance of diffusion in the melt around growing crystals or the effects of mutual interference at the interfaces of crystals. The second is the interpretation of the late-stage granophyric quartz/feldspar intergrowths in rocks such as the Skaergaard gabbros as metasomatic. That these interpretations could be taken as evidence for a metamorphic/metasomatic origin for gabbroic rocks in general and layered intrusions in particular in spite of the enormous wealth of field, geochemical, mineralogical, experimental, petrographic, structural, and other evidence to the contrary not only exposes the philosophical fallacy behind much of this book, but virtually destroys its credibility.

The anti-magmatic bias so pervades this book that it comes as both a surprise and a relief to discover (in Chapter 19 on the Archaean spinifex rocks) that spinifex texture is accepted as a magmatic phenomenon, although the author does not seem to appreciate the importance of the difference between supersaturation and supercooling in this context.

Two other criticisms of this book are that it contains several pointless chapters (for example, Chapter 14 on 'Layered basic and ultrabasic complexes' consists simply of four pages of quotations from other, often well known, works) and that in many cases extensive literature is ignored. Noteworthy in the latter context are Chapters 13 (Kimberlites) and 5 which is devoted almost entirely to the Galician 'eclogites' but makes no mention of the extensive, and more accurate, account by Vogel. There is also a tendency for over-illustration, notwithstanding the fact that it is an 'atlas', with numerous instances of several photographs showing the same thing. On the whole photographs are good although the photomicrographs tend to lack enough contrast for my personal taste.

Technically, the presentation is quite good with relatively few printing errors, but the text is written in rather clumsy English which, together with an excess of overlong technical jargon, makes it read more like a translation than an original text. More serious, however, is the strange fragmented style

in which it is written, there often being no obvious connection between one sentence and the next, which can make it difficult to follow the sense of the argument. Also, there are numerous minor flaws ranging from mistakes such as not realising Gwyneth (Challis) is not a 'him' to the irritating use of words like 'olivinefels' (instead of peridotite), etc.

If this book had been the objective and comprehensive study of the petrographic features of basic and ultrabasic rocks that its title implies it would have been a useful reference work in spite of its price of around £61.00. However, in view of the controversial nature of much of the interpretation accompanying the photographs, and the extremely restricted, if not biased, coverage of topics and examples, it is difficult to envisage much of the market for this book.

F. G. F. GIBB

Moseley (F.), Editor. *The Geology of the Lake District*. Leeds (Yorkshire Geol. Soc.), 1978. viii + 284 pp., 83 figs., 13 pls., 1 coloured geol. map. Price £6.50.

The English Lake District is an area of outstanding beauty and scientific interest. Over the past decade it has featured prominently in plate tectonic interpretations of the evolution of the Caledonides and yet, before the publication of this book, the only comprehensive account of its geology was published in 1916! It is appropriate, therefore, that the Yorkshire Geological Society should choose 'The Geology of the Lake District' as the title of the most recent addition to its Occasional Publications Series. It is particularly appropriate that this volume should be dedicated to the memory of the late Dr G. H. Mitchell whose work on the stratigraphy and structure of the Borrowdale Volcanic Group did so much to increase our understanding of Lake District geology.

The book comprises eighteen chapters written by research workers active in the area and covers every aspect of the subject. In an introductory chapter, Moseley reviews the geological history of the Lake District and places the area in the context of the geological evolution of the North Atlantic region. This is followed by a review of Lake District palaeomagnetic data by Faller and Briden in which the authors show how the latitude and meridional orientation of the British Isles have changed since the Ordovician.

The next three chapters discuss the structure of the Lake District. Chapters by Bott on the pattern of gravity anomalies and by Collar and D. J. Patrick on the results of the IGS aeromagnetic survey set geophysical constraints on the deep

crustal structure, while Soper and Moseley describe the tectonic fabric of the area. This last chapter is worthy of special mention since it provides the first comprehensive review of this complex subject and largely resolves the controversy over the timing of the main phases of deformation in the Lake District.

Not surprisingly the largest part of the book is concerned with stratigraphy and includes chapters on all the systems represented in the area. This section begins with a review, by Wadge, of the Lower Ordovician stratigraphy—a subject which has undergone considerable revision over the last few years. The following chapters cover the Skiddaw Group (Jackson), Eycott and Borrowdale volcanic rocks (Millward, Moseley, and Soper), Upper Ordovician and Silurian (Ingham, McNamara, and Rickards), Devonian (Wadge), Carboniferous (Mitchell, Taylor, and Ramsbottom), Permian and Triassic (Arthuton, Burgess, and Holliday), and the Quaternary (Pennington). In all cases these chapters are up to date (1978) and provide a thorough review and modern interpretation of the sequence of strata observed in the area.

Igneous intrusions are dealt with by Firman in a chapter inserted between the Silurian and Devonian chapters (a chronologically appropriate slot for many of the Lake District intrusions). Rb–Sr ages of the more important intrusions were published by Rundle (*J. geol. Soc. Lond.* **136**, 1979, pp. 29–38) too late, unfortunately, to be incorporated fully into this book though Firman added a brief note after the book had gone to press summarizing Rundle's conclusions.

The mineral deposits of the Lake District have been exploited intermittently over the past 800 years or more and mining continues today with the extraction of tungsten from the Carrock Mine and hematite from western Cumbria. The history of this mining, the distribution and genesis of the mineral veins and the potential for future exploitation are reviewed by Firman in Chapter 15.

The remaining three chapters cover aspects of geology usually given only a brief mention or ignored altogether in regional geology texts. These are off-shore geology (Fletcher and Ransome), hydrogeology, and environmental geology (both by C. K. Patrick). All three subjects are of growing public interest and so their inclusion in this book is most welcome.

In conclusion, this is a comprehensive text which will stand for many years as the authoritative work on Lake District geology. My only reservation about the book lies in the adoption of the term 'Eycott Group' (Plate 1 and Chapter 6) to include both the volcanic rocks of the type area and

sedimentary rocks of the same age occurring elsewhere in the Lake District. Over the years the word 'Eycott' has become inextricably associated with volcanic rocks and so the usage proposed here, though stratigraphically correct, is certain to lead to confusion.

The book has been very well produced, is beautifully illustrated and has been published at a very reasonable price. It is an invaluable source of reference for research workers in many fields and is essential reading for anyone, professional or amateur, with an interest in this fascinating part of Britain.

J. G. FITTON

Sand (L. B.) and Mumpton (F. A.), Editors. *Natural zeolites occurrence, properties, use*. Oxford (Pergamon Press), 1978. xii + 546 pp., 429 figs., 158 tables. Price \$82.50.

Since the discovery of thick altered tuff beds consisting almost entirely of zeolites in many parts of the world in the late 1950s, the status of this mineral group has changed from being little more than a 'museum curiosity' to that of an important commodity for which, as Professor Mumpton describes in the introduction to this selection of papers presented at Zeolite '76 (Tucson, Arizona), new applications are being found almost on a monthly basis. Research on the dehydration, adsorption and ion-exchange properties of chabazite and mordenite between 1930 and 1950 established that the zeolite group had a wide range of potential applications. At that time, however, it was assumed that zeolites only occurred in cavities in basaltic rocks and, as there was no way in which they could be extracted in amounts large enough to support a commercial operation, synthesis seemed to be the only answer. Considerable commercial investment was directed to the development of synthesis processes and by the time the large natural zeolite deposits were recognized, a vast body of knowledge existed on the structure and properties of synthetic zeolites. From then on, again quoting Mumpton, 'there is no doubt that the side-by-side efforts of the chemists and geologists have had a synergistic effect on the overall development of natural zeolite technology'.

The forty-five papers in this book are almost equally divided between zeolite mineralogy/geology and technology. The first section, 'Crystal Structure and Mineralogy', contains a general survey of zeolite structural chemistry by Gottardi, followed by detailed structural chemical studies of chabazite, ptilolite, offretite-levynite, barrerite, mordenite, and dachiardite. An article by Mumpton and Sand on the morphology of zeolites