

REVIEWS

BRANNEY, M.J. *The ornamental and building stones of Stoke-on-Trent*. City Museum and Art Gallery, Hanley, Stoke-on-Trent. 1983. 51 pp., 9 text-figs., 14 plates, 4 appendices (including a glossary), index. £1.50 (+20p postage), paperback.

This slim, attractively produced, booklet is apparently intended for visitors to the Museum who wish to follow up their interest in building stones by examining examples in local buildings. On the assumption that many will have little knowledge of geology a four page introduction simply and effectively classifies rocks giving a few examples of those used as building stones in Stoke-on-Trent. Non-geologists will find this essential reading if they are to understand the subsequent chapters. A brief account of the history of building stones quarried locally is followed by a detailed itinerary for a three hour walk around Hanley starting and finishing at the Museum. Monumental stones in Burslem and Hanley cemeteries are also described in some detail. Brief notes made on materials used in buildings in Staffordshire, around the city, in Stoke-on-Trent itself and in Newcastle-under-Lyme are listed in three appendices. A glossary with 31 items, references, acknowledgements and an index complete this booklet.

Undoubtedly anyone indulging in the three hour walk, who conscientiously reads the introduction, follows the itinerary and uses the glossary will inevitably learn a lot of geology. Not only are the stones identified, their characteristics are described and frequently the mode of formation is discussed. Evidently the writer intended to avoid the use of unnecessary technical jargon and to explain unavoidable technical terms either in the text or in the glossary. Unfortunately he is only partially successful and unexplained terms such as "diagenesis", "botryoidal", "ultramafic", "geopetal" (spelt gepital in this text) "lopolith", "olistolith", "calcarenite", "calclutite" and "euhedral" are unlikely to be understood by people lacking a geological training. If a revised edition is ever published it is recommended that either the glossary is extended or the technical terms simplified (e.g. fine grained limestone instead of calclutite).

Readers of the *Mercian Geologist* will have no such difficulties and, unless they are already familiar with a wide variety of building stones, they will find the text interesting and informative. Indeed having reconnoitred Stoke-on-Trent with this booklet as a guide, it should be possible to identify similar ornamental stones in Nottingham and other East Midland towns. If the reader wishes to examine the local Staffordshire sources of building stones there will be difficulties unless Ordnance and Geological Survey maps are also consulted. The guide contains no map of the local geology and it is difficult, and sometimes impossible, to find the age of building stones formerly quarried locally. For instance it is only from the caption to a plate that one learns that the Keele Sandstone is Westphalian: the age of the famous Hollington Stone is kept secret until page 20 in spite of mention of its location, properties, ubiquitous use and history on pages 6, 7 and 8. The age of the sandstone formerly quarried at Tixall is not divulged. If, as the author claims "this booklet is written primarily for the geologist, be he student or amateur", then a map showing the geology and sources of local building stones would have been of far more interest than Fig. 7 which shows the location of such well known building stone quarries as Aberdeen granite, Connemara marble, Welsh slate, Bath stone etc.. Similar frustrations await the geologist who has an interest in the history of building stones or the scholar who attempts to follow up the references given in the text. The former will find less than 20% of the buildings mentioned are dated. The latter will be irritated by references in the text which are not in the list of references. Other minor criticisms are that four of the seven excellent photographs of building stone structures and textures have no scale.

Notwithstanding these criticisms this booklet is well worth buying if the purchaser intends to use it as a practical guide in Stoke-on-Trent. The author, publisher and Manpower Services Commission who supported it are all to be congratulated. This is the first publication of the Staffordshire Geological Recording Scheme and I look forward to future publications with interest.

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An old-fashioned romp through the Celtic Fringes

It is now over 20 years since the first tentative ideas emerged which were to culminate half a dozen years later in the theory of plate tectonics. Historians of science will tell us that resistance to the new global geology was short-lived. The reality is that, for many geologists, a muted reluctance to embrace the new gospel persisted for one good reason - that plate tectonics failed to account in detail for most of the geology of the continents. Today, twenty-one years after Vine and Matthews, the continental crust is the *new frontier* and promises to provide just as many surprises as the earlier exploration of the ocean basins.

So what's new? Why the sudden excitement? One new perspective arises from work in the Western Cordillera of North America - a huge area rapidly being re-interpreted as a collage of tectonostratigraphic ("suspect" or "exotic") terranes, now juxtaposed but originating from latitudes far removed from their present ones. Palaeomagnetic studies are crucial to this work but so too are good old-fashioned(!) stratigraphy, careful facies and provenance studies, and incisive analysis of biogeographic provinces. A second new data source - deep seismic reflection profiling by COCORP (Consortium for Continental Reflection Profiling) - reveals a great variety of shallow-dipping reflectors in the lower and middle crust, some extending down to and even into the mantle. A third component is the considerable evidence that most of the volume of the continental crust was already formed some 2,500 m.y. ago. Put these together and a startling new picture of continental evolution starts to emerge of wholesale tectonic shuffling and mixing, probably affecting the entire thickness of the crust. Some big mental readjustments are called for. We need to exorcise the last ghostly remnants of fixism, to anticipate tectonic diachronism on a massive scale, and to re-evaluate the significance of major discontinuities. We need to eschew the simple plate tectonic models which, after all, were never designed to explain the geology of continents. Most of all we need to realize that the geology in our own little patch may never make sense on its own.

The idea of compiling a review of Variscan geology in the British Isles was conceived in September 1977 at a symposium held at University College, Swansea. The volume finally appeared in 1983. In that five year gap COCORP profiles, "suspect" terranes etc. were launched publically and radical re-appraisals of several Variscan terranes emerged. A more unsettled gestation period could hardly be imagined. How, then, does this volume succeed in reflecting *new frontier* thinking? It certainly gets off to a fine start with an overview chapter (Rast) on the Variscan in Europe and North America. This is a perceptive essay which points up the problem of integrating decades of research published in several languages (and reflecting some radically different 'philosophies'). Never one to be more than a step behind current thinking (and usually a step or two ahead) Professor Rast skilfully reviews the old and presages the new - COCORP, suspect terranes and all! But there, I'm afraid, the *new frontier* insights end. Much of the rest of the book has a distinctly dated feel, each chapter reviewing the author's own ground more or less in isolation, and in a style that would hardly have seemed modern 10 years ago. There are a few dashes of broader perspective, notably the discussions of the Malvern Fault Zone (Chapter 5) and Variscan magmatism (Chapter 9); even a sideways glance at the rest of the orogen can hardly fail to stimulate! But for the most part the authors have stuck firmly to their own parishes. No dramatic insights, no bold new conjectures, no zing, no fizz, not even a bit of hustle and bustle to redress the pervasive parochialism.

What then is there? This volume contains a wealth of carefully summarised stratigraphic and structural information on some classic areas, and a good deal of detailed geochemical information on the igneous rock of S.W. England. The treatments differ markedly in emphasis - stratigraphic in southwest Ireland, structural in Wales and southwest England (fractures emphasized in the former, folds in the latter, and no prizes for guessing the authors!) There is a useful review (Floyd, Chapter 7) of recent work on the Lizard Complex and a *déjà-vu* sort of canter through the geochemistry of Cornish greenstones. The granites of S.W. England also receive a strictly mineralogical and geochemical treatment with nothing much on the mechanics of emplacement or mineralization. No easy reading here, and not much excitement either.

So information there is a-plenty, albeit somewhat uneven in balance. Newcomers to Variscan geology will surely appreciate it and undergraduates (looking for 'fail-safe' mapping areas) will treasure it. The page layout is clear and most of the maps are crisp and uncluttered. The text has been carefully proofed with hardly a gremlin to be found. It is a technical success but, taken as a whole, the book records the old tempo and barely hints at the new. And at £34 (or nearly 16p a page) many potential buyers will settle for the inconvenience of using the library copy.

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MOSLEY, F. *The volcanic rocks of the Lake District. A geological guide to the Central Fells.* 111 pp., 82 figs., references and index. £4.95, paperback.

Like many writers who have attempted to popularise his science Dr. Mosley tries to interest a very diverse readership. This book is, "intended to appeal to those for whom geology is a hobby: to the walker whose curiosity is aroused by the rocky crags and valleys, to students who have already been introduced to the subject at school and university, and to their teachers who will be experienced geologists, perhaps with considerable knowledge of the Lake District". Unlike most contemporary earth scientists Frank Mosley has achieved his objectives. He has produced a book which will stimulate and inform intelligent lay people, students and all geologists, whether they be amateur or professional, who visit the area. In the context of other Lake District guides this is an authoritative "geologists' Wainwright".

Dr. Mosley's approach is subtle, more subtle than he suggests in his preface. He does indeed "explain the geology in simple terms in the early chapters" and goes into fuller detail later. But these early deceptively simple chapters have much to interest the professional. Firstly one can admire his technique of explaining quite complex concepts in words and well annotated diagrams without having to resort to the clumsy device of a glossary. Secondly, these elementary chapters do contain information and ideas worth more than cursory consideration. For instance the introduction dealing with the plate tectonic setting of the Lake District contains a palaeogeographic map (a reconstructed environment in his terminology) which shows Anglesey and northern England displaced westwards and separated from Wales by an open sea (i.e. back-arc or marginal basin) during the Ordovician. This is a further development of his ideas foreshadowed by his statement published last year (1982) in a chapter in *Igneous rocks of the British Isles* (ed. D. Sutherland) that further interpretations "could involve a marginal basin at one time separating Wales from the Leinster-Lake District arc". He has evidently combined this thought with those of Nutt and Smith (*Nature*, 1981, vol. 290, pp. 492-495) and subsequent correspondents (*Nature*, 1981, vol. 293, pp. 760-762). As far as I am aware this particular palaeogeographic interpretation has not been published elsewhere.

In chapter 2 and in the beginning of chapter 3 he likens the Lake District volcanoes to those in the Cascades of NW America differing only in "that they were surrounded by water and a greater proportion of the ash was therefore deposited in the water". Morphologically the analogy is probably valid but I personally was disappointed that he did not take the opportunity to stress the differences between the Borrowdale Volcanics and modern volcanic rocks. There are for instance (as far as I know), no recorded modern volcanic rocks containing garnets, the significance of which the author mentions only *en passant* in an itinerary (p. 59). Nevertheless his emphatic statement that erosion of the Lake District volcanoes between volcanic events must have been at least as important during the Ordovician as it is today is both timely and perceptive. As he points out there was no plant cover during the Ordovician. A thorough going study of erosion surfaces and penecontemporaneous faulting of the Borrowdale Volcanoes might change our present ideas.

The major volcanic rock types are interestingly described in chapter 3, the writer confining himself to their field appearance. Quite rightly the importance of examining weathered surfaces before hammering the outcrops is emphasised as is the importance of avoiding unnecessary random hammering. This chapter is particularly well illustrated with good close-up photographs and line drawings. A witty drawing (Fig. 12) showing the characteristic advance of a lava developing flow-brecciation is already ear-marked by at least one geologist to enliven his lectures.

The effects of folding, faulting and cleavage on the Borrowdales, the underlying Skiddaw Slates and overlying Caradocian and Silurian sediments is not neglected and there is a very brief chapter on igneous intrusions. As is characteristic of this book, these are illustrated by well chosen photographs and line drawings all of which are comprehensively annotated.

Two thirds of the book, however, is devoted to detailed itineraries and it is this section which will be most used. The itineraries are more flexible and better illustrated than in any other comparable guide. The reader is often left to choose from a variety of possible outward and return routes. Dr. Mosley does not insult his reader by expecting him or her to slavishly follow every excursion in the order stated. Nor does he resort to the crude device of smaller print for more difficult exposures. He simply states the problems of interpretation, suggests possible alternative explanations and cites references which the reader can investigate if he so wishes. Each itinerary is profusely illustrated and among the variety of annotated figures are photographs of close-ups and landscapes, line drawings explaining the latter, pen and ink sketches with added geological detail and Frank Mosley's inimitable maps. All the ground described has been walked over by the writer and most of the itineraries are selected from more extensive areas which he has mapped. The many panoramas allow the reader to see the main features of the area (given good weather) before he actually sets foot on the ground. The seven excursion areas are illustrated by no less than 56 text figures, including photographs. This statistic is, however, misleading since many of the figures are composite consisting of various combinations of photographs, pen and ink

sketches, interpretive line drawings, maps and sketches. A rapid count gave 33 panoramic views 14 of which are photographs and 19 field sketches. Almost all have superimposed geological information or are accompanied by interpretive line drawings. In addition to 16 of the latter there are 18 photographs of rock structures and textures, 15 maps and 12 horizontal sections in the excursion guide part of the book. It must be a matter of regret to the author as well as the reader that in some print runs the printer has produced several unacceptably dark, though still usable, reproductions from the writer's photographs.

In such a profusely illustrated book it is perhaps inevitable that some mistakes and ambiguities should occur. For instance on page 25 the reader is referred to figure 65 instead of 66 and similarly on page 29 a reference to figure 34 should read 36. The annotation to figure 29, a composite figure with plates A, B and C, would have been less confusing if lower case (b) for bedding and (c) for cleavage had been used instead of upper case (B) and (C). The reference to (Holland, 1981) on figure 37Y appears to be irrelevant since Holland wrote on the Coniston Copper Mines and figure 37Y depicts the panoramic geology of the Bramcrag intrusion 15 miles north of Coniston. The annotations to all text figures are excellent and where necessary detailed. The author's style is racy and eminently readable but it does occasionally lead him into shades of meaning which I suspect he does not intend. Does he really believe with reference to the Coniston Limestone Group at Coniston that, "only a pervert would immediately think of it as limestone"? I also enjoyed his advice to his readers to buy "walking maps" before setting out on an excursion. I too have maps that "walk" but find them less useful than those that don't!

The triviality of such criticisms perhaps illustrates the true value of this book. At £4.95 it must be one of the geological bargains of the year and an indispensable guide to all with even the slightest interest in geology who visit the Lake District.

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RITSEMA, A.R. and GÜRPINAR, A. (Eds.) *Seismicity and seismic risk in the offshore North Sea area*. 1983. D. Reidel, Dordrecht, The Netherlands. 420 pp., index. Dfl. 135, hardback.

This volume is a report of the proceedings of a NATO Research Workshop, held in 1982, to assess the seismic risk to offshore platforms and submarine pipelines in the North Sea. It comprises 34 contributions from a wide variety of disciplines, ranging from structural geology, through oceanography to soil mechanics and risk analysis.

The North Sea forms part of the intracratonic Northwest European Basin and as such, is an area of low seismic activity. Why, therefore, was such a workshop organised? The answer lies in the fact that *risk* is defined as the product of *hazard*, *vulnerability* and *value*. As the *value* of investment in the North Sea (both in terms of capital and personnel) has increased dramatically over the past two decades, so the seismic *risk* has also increased; despite the low probability of a devastating earthquake in the area. A major difficulty in trying to estimate the seismic risk in the North Sea is the apparent absence of evidence for any such earthquakes in the recent geological past and the fact that what data we do have was obtained largely from onshore monitoring stations. Consequently, in the absence of direct observations of major quakes in the area, the workshop adopted a multidisciplinary approach to estimate seismic risk by attempting to predict seismic *hazard* and *vulnerability*.

The first two sections of the book deal with the tectonic structure of the area and observations of seismicity in the North Sea and adjacent land areas. Exploration for oil and gas in the North Sea has resulted in the structure of the basin being mapped in great detail, yet it is still not possible to assess the precise way in which these structures have affected neotectonic activity and associated seismicity. The difficulty of precisely locating earthquake foci from seismic data collected onshore has resulted in uncertainty as to whether recent earthquakes have originated by reactivation of basement faults at shallow depths or at great depths (possibly from within the mantle). As a corollary two papers consider the relevance of seismicity in the better known Rhine Graben as a possible onshore analogue, whilst a subsequent section deals with improved instrumentation for acquisition of seismic data from offshore.

Section 3 briefly reviews various oceanographic effects relevant to hazard assessment in the North Sea but the largest section of the book (109 pages) is devoted to determination of the *vulnerability* of offshore installations. During earthquakes, poorly consolidated sediments may liquefy, with subsequent catastrophic settlement. In the North Sea a wide range of engineering 'soils' (sediments which act as foundation materials) are encountered and an assessment of their geotechnical properties and likely reaction to seismic shock is of vital

importance to offshore design. A variety of papers in this section consider the liquefaction potential of sediments, engineering design and potential hazards during and after a seismic event. To assess these dangers a diverse pool of expertise is drawn from such disciplines as engineering geology, soil mechanics, fluid mechanics, engineering and stratigraphic geology.

The final section of the book attempts to synthesize the foregoing themes to establish the level of the seismic risk in the North Sea and to establish zones of higher and lower risk within this area. Statistical analyses are thus added to the range of techniques employed by the workshop. The specialised nature of the book and its high price will probably combine to deter most members from purchasing their own copy. The book will, however, be welcomed by those in the oil industry and involved in offshore site investigation as a valuable state-of-the-art summary. (The book's value in this respect is enhanced by the expediency with which the publishers have managed to produce the volume.) The text also represents a fine example of a multidisciplinary approach to problem-solving and illustrates just how much common ground there is between what are frequently believed to be widely disparate disciplines. Finally, perhaps the greatest value of this volume lies not in its summary of existing knowledge, nor in its necessarily tentative conclusions but in identifying major gaps in our knowledge of seismicity in intracratonic areas of the crust and the engineering behaviour of sediments. It is as a guide to profitable areas of further research that this text deserves to reach its widest audience.

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