
Those of us who knew Doug Palmer as a practising palaeontologist were rather sad when he gave up the subject and disappeared from the scene. However, he quickly surfaced again and now combines some teaching with his brilliant science writing for the Financial Times, New Scientist and BBC Wildlife magazine amongst others. His latest book carries the symbol of Discovery Channel, which, my colleagues with a modern TV tell me, runs superb natural history programmes. It is not clear whether the book is based on these programmes or vice versa, but it is excellent.

The illustrations are beautiful and ideal for lecture slides, as are the time-sliced palaeogeographical maps drawn in both north and south polar projections with a key whole world projection. The maps are richly annotated and identify plates, margins, oceans, sediment type, together with comments specific to the time interval in question. They convey better than most I have seen, the realism of plate tectonics. Each geological time period is richly illustrated with double pages covering particular themes. It is especially welcome to see the Vendian included with two double pages including one on the emergence of multicellular life and five double pages on the Cambrian including the ‘explosion’, early marine life, the late Cambrian and the Burgess sea-world. This is then followed by a provoking double page on Pikaia with an exciting new reconstruction and a discussion of vertebrate relationships. These and each succeeding period contain new, colourful reconstructions of life at the time, together with the unexpected such as sections on mass extinctions and the opening of the North Atlantic. The colourful reconstructions are all excellent but some are better than others depending on which of the 12 illustrators was involved. My prize goes to the Burgess Shale (I am biased), but the Jurassic marine park shows amazing depth and perspective with all elements present in detail and giving the feeling of speed and action. No doubt the best illustrations were originally painted by hand, but I sense that computer graphics are entering the stage and when fully developed will change our entire view of past organisms as interpreted from the fossils. The coloured part of the book, covering 159 pages, is followed by the remaining 62 in sepia tones. These illustrate various themes in what is called the ‘Earth Fact File’, covering those such as the geological time scale, earth processes, sedimentation, evolution and molecular clocks, to name a few.

Particularly provoking is a chapter on future plate tectonics with scenarios for time periods from +50 to +200 million years ahead. Then follows a section dealing with biographies, places and websites to visit, a valuable glossary, hints for further reading and bibliography and finally a comprehensive index. None of these is totally complete, the choice of names in the biography list must surely be biased with Carolus Linnaeus the only Scandinavian! Likewise, the website list does not include my own institute (http://www.toyen.uio.no/palms) which, believe it or not, has at least 30000 net visitors a year! In an excellent introduction, Kevin Padian writes ‘One of the things that draws people to work in the field of palaeontology is thinking about the question of how things came to be’.

This book is so thought provoking, well written and beautifully illustrated that it must be a huge success. At the price one wonders how such a handsome product can be produced so cheaply. It should appeal to the non-specialist, biology and geography teachers at the high school grade, undergraduates and postgraduates at all levels and university teachers of all trades.

David L. Bruton


The cover of this book first caught my eye as I entered the British Museum bookshop in July. Richard Hoggart once talked of certain paperback covers as ‘Breast Sellers’, the breast in this case being an embossed Dicranurus, one of my own beloved odontopleurid trilobites. Most attractive on its blue background. Having spent many enjoyable hours in the field with the author, I can hear his enthusiastic ‘trilobite!’ and the title of this book is fitting. Whilst Dicranurus adorns the paper cover, it is another of my favourites, Phacops, that covers the inside of the hard covers and is something of a theme trilobite throughout the book. Not surprising considering that we probably know more about the hard and soft part morphology of Phacops than any other known trilobite. There are thousands of different trilobites ranging in size from the tiny Shumardia to the giant Paradoxides, a trilobite that started Richard Fortey off on his enormously successful career as a palaeontologist, and author.

Books of this genre are popular. All have a similar routine; first a setting, then a schoolboy inspiration, student life with those who inspired, those who did not, a mentor, colleagues you like, colleagues you hate and those whom you respect. Then comes the meat of the subject and finally a sombre look into the past and predictions for the future. This book has it all. It’s a fascinating read and the author writes with enormous flair and capacity.

Richard Fortey is a great raconteur, but like all raconteurs he sometimes goes over the top. Not so here. He surprised me with how low key some of his reminiscences are. I experienced the hornet story from China to be much more dramatic than he tells it, but then, he was perhaps almost comatose at the time to remember all the details. In Spitsbergen we spent 40 nights in the same grubby tent and there was much more drama in the camp kitchen than my speaking Norwegian ever since.

Now to the contents of the book. As a Cornishman I am flattered that he should choose my county for the introduction, but to use the north coast to set the scene is strange; all the time the rocks there are particularly difficult to interpret and are not known for their fossils let alone trilobites (those at Gorran, on the opposite coast, are a different story).

Having read some of Thomas Hardy’s work, I had no idea
he ventured so far west and there are better Cornish worthies, such as ‘Q’ or Daphne du Maurier, to describe the cliffs, rocks and nature. In his book, *The Dynasties*, Hardy was much inspired by Schopenhauer and had a rather fatalistic view of the world and its blind creation. Thus it is good to know that when he visited Boscawen and later wrote *A Pair of Blue Eyes*, a story which includes the tale of a fictional trilobite, he should provide the inspiration for the author of the present book to pursue the story of evolution from cover to cover. I must ready Hardy again!

We can all write of our first trilobite find. Mine was a *Calymene*, used in the book to illustrate morphological terms; the author’s was *Paradoxides* which he uses to ‘invest the trilobite with all the glamour of the dinosaur and twice its endurance’. He does just this and goes on to make them come alive, mentioning more than once the great contribution to their study by his mentor and mine. He pays tribute to Harry Whittington in many sections. Love and affection is there but is rather spoilt, unintentionally I am sure, by a story to illustrate the difference between authority and authoritarianism.

Richard Fortey is generous with his praise for those colleagues who have helped him in his career, have published jointly with him, or belong to the best in the trade. He is, however, unmerciful with those he dislikes and I find it sad that he and other British colleagues go all out to bash Steve Gould and the ideas he so elegantly laid out in his best-seller *Wonderful Life*. This book has made the career of more than one British palaeontologist and has done more to promote thought on evolution than any book since Darwin. So what lies behind the attack on Gould and why the sarcasm reserved for Simon Conway Morris in the present book? The author cites Darwin’s caution from Lyell concerning controversy: ‘it rarely did any good and caused a miserable loss of time and temper’ and then states himself that ‘trilobites demand it’. They most certainly do not, so what about a bit of live and let live?

Otherwise, the book overflows with detail both scientific, artistic and cultural. Most of it is not new, but one fascinating story is and it is told with great skill. It is the tragic story of the German palaeontologist Rudolf Kaufman who was unknown in the Anglo-Saxon trilobite world before Gunnar Henningsmoen told us about him in 1957. Kaufman worked on Scandinavian Cambrian trilobites and published in 1933 (in German), on what Niles Eldredge and Steve Gould called ‘punctuated equilibria’ in 1972. Kaufman’s life, work, romance and eventual death at the hands of the Nazis is a gripping tale and Richard Fortey’s storyteller flair comes out in full here.

The book contains some excellent glossy photographic figures and some not so glossy where printed in the text. The former will please those interested in the beauty of trilobites but I doubt whether the amateurs will find something they have not seen before and there are better books for them on the subject.

The leads me to ask for whom was this book written? It will appeal to those colleagues like myself who have had the privilege and enjoyment of working with the author, it will show critics how fascinating and scientifically rewarding the working life of a trilobitologist can be or, it will, as in the case of my wife, provide hours of enjoyment just reading a thoroughly well written and entertaining book.

To end, I must relate a story that happened on August 15th, 1971. While measuring a shoreline section along the coast of Ny Friesland at 79°N latitude, with ice floes offshore, Richard Fortey with rucksack full of rocks slipped quietly but suddenly into the sea. My outstretched hand grabbed him before he went under. Wet and freezing he could hardly walk but he mercifully made it back to camp where he dried out. That evening we later drank to life!

David L. Bruton

This hefty volume in the series (435 pp.) covers some of the most classic sites of Britain’s vast geological heritage. As the Cambrian and Ordovician systems were both founded in Britain, based on the pioneering work on these rocks begun as far back as the 1830s, this book has detailed descriptions of some of the most classic geological sites in the world, together with more recently discovered sites which are nevertheless important in understanding the nature of the Cambrian and Ordovician rocks and faunas of Britain. This is not a complete account of these rocks in Britain, since its purpose is to describe the sites selected for the Geological Conservation Review; and indeed does not include the important Ordovician volcanic rocks which are described in the preceding volume in the series.

After a general introduction and an introduction to Cambrian stratigraphy, there follows a description of the Cambrian rocks in their type area of North Wales. This is followed by a chapter on South Wales and then one on England. However, since the Cambrian and Ordovician rocks of the northwest of Scotland are difficult to divide, we have to wait for Chapter 12 for the Cambro-Ordovician of the Hebridean Terrane and Chapter 13 for Cambrian and Ordovician of the Grampian Terrane and Highland Border Sub-terrene.

For the Ordovician, this volume accepts, without question, the revisions of the Ordovician series by Fortey et al. (1995). Essentially these demote the Llandeilo Series by fixing the base of the Caradoc Series at the base of the *gracilis* Zone and retaining the thus-reduced Llandeilo as an upper stage (Llandeilian) of an expanded Llanvirn Series. In shelly facies the Llandeilo Series contains a readily recognizable series of faunas of organisms such as trilobites, brachiopods and conodonts, and its demise is not accepted by some Ordovician workers. Although the Geological Survey continued to place the Tremadoc Series at the top of the Cambrian for many years after it had been generally (and internationally) accepted as the basal Ordovician Series, there is by now no controversy. It is therefore odd that this book treats the Tremadoc Series in a separate Chapter 7, ‘The Tremadoc Series in Wales and England’. The justification that this is because the Tremadoc belongs in Woodcock’s (1990) Dyfed Supergroup, whilst the remainder of the Ordovician falls within his Gwynedd Supergroup, does not convince in a book volume where the emphasis throughout is on biostratigraphy and chronostratigraphy.

The following chapters, 8–11, treat the Ordovician stratigraphy, there follows a description of the Cambrian and Ordovician systems were both founded in Britain, based on the pioneering work on these rocks begun as far back as the 1830s, this book has detailed descriptions of some of the most classic geological sites in the world, together with more recently discovered sites which are nevertheless important in understanding the nature of the Cambrian and Ordovician rocks and faunas of Britain. This is not a complete account of these rocks in Britain, since its purpose is to describe the sites selected for the Geological Conservation Review; and indeed does not include the important Ordovician volcanic rocks which are described in the preceding volume in the series.

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We have here an excellent reference book on the Cambrian and Ordovician sedimentary sites selected for the Geological Conservation Review, marred by often unsatisfactory half-tones and a lack of grid references on the maps. It is, however, essential reference material for local authorities on whose ground these sites lie, and a major library reference. Its £70 price tag, however, will preclude many others, academics and students from access to it. This is a pity as it contains a wealth of important material, well edited and garnered in such a way as to make it very readable.

John C. W. Cope

References


Ken Hsü claims that this book ‘is not a book for reading, it is an encyclopedia of information’. Most people will draw the same conclusion from the title alone. However, much of this very personalized volume makes surprisingly interesting reading, because in addition to providing the first comprehensive English synthesis of the geology of China, the book is also a platform for Hsü to promote his own tectonic philosophies and to recollect on his own unique career straddling eastern and western scientific cultures. Despite having a co-author, Hsü calls the book his swansong and it is very much his voice throughout. His synthesis is dominated by four major themes (some might say, campaigns): (1) to introduce his concept of regional tectonic analysis by tectonic facies mapping; (2) to promote his archipelago model of orogenesis; (3) to establish a new framework for China’s Phanerozoic geological evolution for the benefit of future workers; and (4) to describe his own evolution of thought and personal triumphs in overcoming traditional and constractive tectonic models.

The book is divided into seven parts. Part 1 is essentially a long introductory section where Hsü summarizes the evolution of geologic thinking on orogenesis and the shortcomings of past tectonic paradigms. Arguments are presented on various subjects ranging from rejection of orogenic phases in favour of continuous mountain belt development, to viewing plutonism as partial dissolution of country rocks and not actual melting, and the difficulties in assigning palaeogeographical or tectonic significance to a particular sedimentary facies. Hsü implores us to look at Indonesia and the western Pacific for actualistic analogues of how continents and mountain belts form by arc magmatism, melange growth, and backarc basin opening and collapse. These arguments are not necessarily new, but they are well presented. By comparison with tectonic units that were identified to understand the evolution of the Alps, Hsü presents arguments for using the tectonic facies concept to subdivide the geology of China. Hsü argues that there are three basic tectonic facies of all mountain belts: a steamroller or ‘bulldozer’ which he calls a ‘rheatide’, which is the overriding

sions. In addition to notified GCR sites, some potential supplementary sites are also included. All the descriptions are well written and they benefit from a thorough and up-to-date literature review that increases their value significantly. Although this volume is not a field guide, the information that is included is that which would be found in any good field guide and it appears, moreover, to be accurate throughout. The introductory pages rightly stress that many of the sites described are in private ownership and that access cannot be guaranteed to any site.

The book is commendably accurate throughout. It is remarkably free of typographical errors (I spotted a mere handful). The fossil names are also fully updated (with one or two exceptions only). Other minor errors include omission of necessary brackets around authors’ names and a map with an incorrect key.

There are some problems with the book production. The most serious concerns the many half-tone photographs that illustrate many of the sites and their fossil content. The standard of reproduction varies considerably; the best are not really crisp and the worst have poor contrast and are fuzzy; the result detracts from the appearance of the volume. Comparison with the reproduction of half-tones in the preceding volume, no. 17 in the series, on the Caledonian Igneous Rocks shows that to be of far better quality.

In contrast, the maps and other line diagrams in the present volume are reproduced admirably, although here another problem arises. Most of the sites have eight figure National Grid references; however, as none of the maps has any grid markings, it will be necessary for the user to refer to the Ordnance Survey 1:25 000 or 1:10 000 maps and then identify the features shown in the diagrams. It cannot be overstressed how this detracts from the usefulness of the maps. Comparison with the latest volume in the series, no. 20 on the Precambrian of England and Wales, shows that those maps have the necessary National Grid references.

Another annoying problem is that caused by word-breaks. In a two-column format the occasional hyphenation is to be expected. Here though, they often abound and unacceptably the word-breaks go from one column to the next and, totally inexcusably, they even go overleaf from one page to the next. Some of the selected word-breaks are odd: bra-chiopod; en-vi-ronments; tran-sition; blea-ched; peri-odic; expo-sures; medi-um, etc. A good editorial hand should have sorted these out.

There are some word-breaks that may puzzle some lay readers (e.g. atheloptic, aphyric, quartzite). There is apparently exclusively a metamorphic rock. There are also some omissions, and terms used in the text that may puzzle some lay readers (e.g. atheloptic, aphyric, feldsparphyric or spilitic) do not appear in the glossary.
block during deformation (usually crystalline ‘basement’); a deeply underthrust, ductilely deformed and metamorphosed complex called the ‘detide’ (melange, sphyolite, regionally metamorphosed strata); and sedimentary rocks in the external frontal zones of the orogen that are affected by thin-skinned folding and thrusting, called an ‘allemande’. When I first saw these terms, I felt weary. We are all tired of new jargon and skeptical of the need to introduce new terms for ordinary concepts. However, if one accepts these three terms, then the rest of the book and maps make sense, and one begins to appreciate Hsü’s way of thinking.

Parts 2–6 are regional syntheses for the Tibetan Plateau, Northwest and North China, Central China, South China, and Pacific China. Workers interested in these regions will find these sections useful. Hsü’s ideas on the origin of Tibet and the Himalayas as a series of arc–continent collisions are particularly interesting. Part 7 is a short chapter summarizing the overall tectonic evolution of China and includes Hsü’s personal farewell to geology.

Some readers may be put off by Hsü’s self-congratulatory tone. He likens himself to a tornado, ‘rebelling against classical theories of orogenesis’ with his ‘daring postulates’. I am not convinced that his ideas are so pioneering, nor are his personal triumphs over confining traditional orogenic models common experiences for many of us. Most younger generation geologists have never been stuck in the geosyncline and the Himalayas as a series of arc–continent collisions are particularly interesting. Part 7 is a short chapter summarizing the overall tectonic evolution of China and includes Hsü’s personal farewell to geology.

The maps are in individual sheets and are useful for stratigraphic information but, unfortunately, are devoid of faults. There is little information on the nature of any boundaries between tectonic facies. I feel this is a major flaw of the Atlas. Much of the synthesis discussed in the text is difficult to follow because there is no information on the maps about transport direction of the tectonic units (and many place names mentioned in the text are also not shown on the maps). In addition, much information in the text is not referenced, but apparently is derived from Chinese sources that are referenced in the Chinese edition, but not the English edition. I found this frustrating for areas that I am personally interested in. Other comments which are stated as factual, may not be, and supporting references are not always given (e.g. claiming that the Junggar and Qaidam basins are underlain by oceanic crust). Thus throughout the book the reader is left to trust that Hsü’s referencing is complete, his field observations and interpretations correct, his overall synthesis is sound, and the boundaries of his tectonic facies are correctly drawn. This trust is possibly compromised by his obvious desire, throughout the volume, to promote his all-encompassing archipelago model of orogenesis.

Ken Hsü has been visiting China every year since 1983 and has traveled more than 100 000 km to investigate almost all major regions in the country. This book draws upon his vast experience and knowledge and that of his Chinese collaborators. It is truly ambitious in scope and he should deservedly feel triumphant for completing the first major western synthesis of Chinese geology. This work will complement Celal Şengör’s (and co-workers) previous synthesis of northern central Asia (Altaids), so that comprehensive regional frameworks now exist for a very large part of Asia that other workers can test, refine and debate. This book is thus a huge contribution for all geologists interested in the Phanerozoic evolution of Asia. It is expensive (US $251) but should at least be in every major geology library. It will serve as a useful starting point for investigating the geology of any part of China. In addition, with time and much further study, the Geologic Atlas of China may prove to be a classic of modern tectonic thinking and synthesis.

DICKSON CUNNINGHAM


A curious title, you may say, ‘Magnetism; what does that have to do with climate anymore than, as 19th-century quacks claimed, it had to do with human health?’ As it turns out, the book dwells rather less on the relation between earth magnetism and climate and environment than on its function as a stratigraphic and even a chronometric tool. Not a trivial subject then, and quite widely applied today, but as a separate sub-field it is not particularly well known today even now. A systematic introductory treatment with examples would therefore be most welcome and, if at the right level, might well have a future as a supplementary course text. It is not to be; for those who wrote this book the desire to enlighten beginners on its subject matter takes a clear second place behind the desire to honour a distinguished colleague in the traditional but now rare manner of a ‘festschrift’. About which more later.

To me the first names that come to mind when mention is made of magnetic processes in the earth sciences are those of K. M. Creer, Allen Cox, or Keith Runcorn, but this book has quite a different perspective on magnetic studies of rocks and on what the editors call the field of the ‘environmental magnetist’. For them this began with Gustav Ising early in the 20th century and culminated late in the same century with the career of Frank Oldfield, to whom the book is dedicated.

Having myself come into rock magnetism from the side of magnetic polarity reversals and plate tectonics, I found much here that was new to me and of considerable interest. The Introduction alone (by Maher, Thompson and M. W. Hounslow) is, for a relative outsider, an eye opener as it manages to slide in 48 pages with great clarity from the climatic history of the last 50 million years, by way of oxygen isotope stratigraphy and magnetic minerals, to a concise but comprehensive précis of the theory and practice of magnetic mineral studies in sediments. An 18-page ‘Atlas of Micrographs of Magnetic Grains’, well reproduced but somewhat oddly inserted in the middle of this chapter, is not the least of its values handed to us right at the outset of the book.

The nine chapters that follow reach wide across the spectrum of palaeoclimatology, sedimentology and environmental studies, so wide that a simple, and partial, list must suffice here. Chapter 2 (J. S. Stoner and J. T. Andrews) views the North Atlantic Ocean sediments as a ‘magnetic archive’, and focuses on the now famous ice-rafterd Heinrich layers and their stratigraphic role through a magnetic susceptibility lens. Maher and Thompson, in Chapter 3, and Maher and Hounslow in Chapter 4 exploit the same properties to obtain insights in the Quaternary record of the Indian Ocean monsoon as it is reflected respectively in Chinese loess deposits and aeolian dust in Indian Ocean pelagic sediments. All three papers are significant contributions to late Quaternary palaeoclimatology.
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Next follows a series of what are in essence state of the art reviews. Chapter 5, by P. Hesse and J. F. Stolz, introduces ably and in fair detail the topic of bacterial magnetite in sediment but, notwithstanding its title, says little about its role in the Quaternary record, perhaps because an assortment of eight inserted colour plates of somewhat dubious relevance broke their train of thought. In Chapter 6 I. Snowball and M. Torii hold forth on iron sulphides in Quaternary sediments, and in Chapter 7 J. A. Dearing writes at length about Holocene environmental histories inferred from magnetic proxies in lake sediments. This chapter by itself, backed by arguably the best bibliography in the book, would for me be sufficient cause to take it off the library shelf.

Chapter 8, on magnetic monitoring of air-, land- and water-pollution by E. Petrovsky and B. B. Ellwood, although unquestionably important for its applied science objectives, is none the least somewhat outside the main flow of the book. The basic science theme returns in Chapter 9, written by S. P. Lund and M. Schwartz, who deal interestingly and lucidly with the key issue, that is the impact of environmental forces on geomagnetic intensity measurements. Finally, C. G. Langereis and M. J. Dekkers talk about ‘magnetic cyclostratigraphy’ in the sort of ‘grand view of everything’ manner which is these days quite the fashion. This is perhaps the weakest chapter because the authors either fail to present rigorous evidence that there are magnetic cycles rather than mere magnetic oscillations or define ‘cycles’ in an unusual manner.

A striking feature of the book is the great length of most chapters, 40–60 pages being quite routine, a luxury which in most seems to stem more from a sense of freedom from the usual parsimony of journal editors than from a real need in covering the subject. Working one’s way through even only a fair part of the book is therefore time-consuming. The production by the Cambridge University Press is very high quality.

It seems to me fair, to ask at the end of a symposium or festschrift in honour of a distinguished colleague whether in the aggregate the contents have achieved more than would have been accomplished by separate publication of its components in various journals. This is a particularly pertinent question here because the diversity of chapters makes it unlikely that any given reader will be interested in reading more than two or three contributions. Thus the price, although at £70.00 alas fairly routine these days, pretty much restricts the book to library shelves.

My answer to this question would be that a greater good for the progress of Quaternary science would have been achieved by separate journal publication of Chapters 3–5, which then would have made their mark by now whereas I have yet to see one of them cited. In quite a different area, Chapters 5, 6, 7 and 9, if combined into a slim, much lower priced volume would have been of great value for advanced undergraduate and graduate courses in Quaternary science, but at £70.00 per copy one could hardly ask them to buy the whole book.

There is no doubt that Frank Oldfield deserves the tribute paid to him by a few of his friends and students, but the price libraries must pay for this honour in terms of shrinking budgets is too high. Actually, festschriften and symposium proceedings belong to an earlier day when the scientific community was small, its members were often generalists and time was available for solid reading, long before when career pressure and research quality assessments began to force us to read only the essential bits, and rarely if ever a whole book. It is probably inevitable that commercial publishers will continue to produce books at prices that are utterly out of proportion to the value of their contents, but I do wish that our own university presses would focus on more coherent treatises of more durable interest.

Tjeerd H. van Andel


The second German edition of Werner Massa’s crystallography textbook appears in English for the first time, in a highly readable and lucid translation by Robert Gould of Edinburgh University.

This book presents a high level and quite specific treatment of crystallography, aimed at advanced students or researchers who wish to learn more about what lies beyond automated ‘black box’ laboratory techniques. Essentially, the book is in two parts: a general introduction to crystallography and single-crystal X-ray diffraction in particular (i.e. data acquisition), followed by more detailed chapters on processing diffraction data in order to ‘solve’ a crystal structure.

We begin with some basic crystallographic concepts: unit cells and lattices. Diffraction of X-rays from a virtually infinite lattice ‘grating’ is analysed using the Laue equations and the Bragg equation. A full three-dimensional treatment inevitably leads into a discussion of the ‘reciprocal lattice’ and Ewald Sphere construction. This section is very chatty and not too mathematical, but slightly laboured (personally, I feel that it is best to introduce these concepts by analogy with optical diffraction). Having considered diffraction from point scatterers in an idealized lattice, we next focus on real atoms (more specifically, their electrons) in the unit cell. This introduces concepts of atomic scattering factors (‘form factors’), atomic displacement factors and structure factors.

Crystal structures can be simplified (or made more complex, depending on your perspective!) by considering symmetry relationships between groups of atoms inside a unit cell. Professor Massa includes a good overall summary of point and spacegroup symmetry – essential background for macroscopic symmetry and understanding systematically-related reflections in diffraction patterns. A discussion of group/subgroup relationships is also included, which is useful when considering phase transitions.

An extended chapter on experimental methods covers single-crystal techniques that one might encounter in a modern X-ray lab, including helpful tips on choosing and mounting a suitable crystal. Film methods (oscillation, Weissenberg, precession photographs) are, thankfully, still included, the author rightfully stressing their importance in crystal alignment and as an overall guide to assessing crystal quality. Actual structure determination is generally carried out using automated single-crystal diffractometers, and these are covered in some detail, with a new section on area detectors (fast becoming standard on newer systems).

Having established how to collect diffraction data from a single crystal, the author now turns his attention to how such data should be processed in order to ‘solve’ the crystal structure. Patterson synthesis, so-called ‘direct methods’ and general strategies are discussed, before embarking on a detailed description of least-squares methods. Whilst such methods are described in many other crystallography text-
The first is a presentation of a novel technique to determine oil charge histories using fluid inclusions in mineral grains, and the other two are the results of modelling fluid flow in porous media, a technique which is applicable to fluids other than hydrocarbons.

The final two chapters are grouped together under the heading 'Dating of Quaternary flow events'. The first of these is a useful review article of the available methods, whereas the second is a case study using electron spin resonance to date a fault gouge.

In common with most of the Geological Society's excellent series, this volume, which contains much which is new, is aimed at those actively working in the field and presents a broad overview of the subject as it was in 1997. However, the abundant material on basic techniques combined with the results of constraining fluid flow events in a wide variety of, albeit generally low-temperature, environments means that there is sufficient of interest here to recommend this book to a wide audience of geologists, including metamorphic geologists interested in the general problem of fluid flow in rocks.

Marian Holness


This book contains 19 papers originally presented at a meeting at Burlington House in July 1996 called 'Carbonate Ramps: oceanographic and biological controls, modelling and diagenesis'. The volume provides a comprehensive set of case histories dealing with the major controls on the patterns of sedimentation on carbonate 'ramps' – defined by the editors as 'carbonate platforms which have a very low gradient depositional slope (commonly less than 0.1°) from a shallow water shoreline or lagoon to a basin floor'. The case histories effectively deal with (3D) facies patterns and their oceanographic and biological controls, there is some modelling, but the diagenesis has failed to make it from meeting to book!

The volume starts with an extremely useful review, of the book and the subject, by the editors and a valiant historical account of the development of 'ramp' terminology and sedimentology by Wayne Ahr who originally coined the term in the early 1970s. The case studies themselves are arranged by geological age, from Recent back to the Ordovician. Several themes emerge. The relationships between ramps and other carbonate settings are discussed by several authors. Are ramps stable depositional environments; or does carbonate accumulation inevitably lead to flat-topped, steep-margined shelves? The consensus seems to be that although the stratigraphic transition to flat-topped shelves is common in the geological record, and that many modern analogues are likely to be transient phenomena resulting from Holocene sea-level rise, ramp sedimentation can persist for long periods and result in thick sedimentary successions. The interplay between biological processes (with the locus of sediment production changing with the evolution of faunas) and physical reworking – onshore and alongshore – by wave, storm and tidal currents is highlighted by several authors. The debate about cold water versus tropical water origins is likely to persist for some time; although most modern carbonate ramps or shelves dominated by grainy, mobile sediments are in temperate seas, their ancient counterparts seem
to have formed at a wide range of palaeolatitudes. The roles of sea level and tectonics in controlling sedimentation and facies architecture are recurrent themes.

The book is well illustrated and appears to have been edited both consistently and carefully. It has been produced in the familiar, hard-back format of Geological Society Special Publications. It will have international appeal; although there is a pronounced European bias in the case histories (and authorship), there are also examples from North and South America, Asia and Africa. In summary, I would recommend this book to all those with an academic or industrial interest in carbonate sediments—it will be a valuable resource for advanced undergraduate teaching as well.

J. D. Marshall


Introduction to Seismology, by Peter Shearer, is a readable, concise introduction to the quantitative aspects of modern seismology specifically designed for student instruction. The book clearly explains the fundamental physical concepts used in seismology but, unlike other seismological texts, Introduction to Seismology emphasizes an intuitive understanding of seismology rather than presenting lengthy, detailed derivations. For example, surface wave dispersion and the concepts of phase and group velocity, ideas often difficult for beginning students to comprehend, are given by Shearer in terms of the travel-time curve, a relatively simple concept for beginning students. Shearer then builds on this, giving a more conventional discussion. All of the topics required for a first course in seismology are present; these include stress and strain, the derivation of the seismic wave equation, ray theory, travel-time inversion, reflection seismology, surface waves, and earthquake source mechanisms. Many results are presented without lengthy derivations and proofs, but in these cases the author refers the reader to more advanced sources for an extensive explanation of the topic.

The book assumes a certain level of knowledge of physics and vector calculus, but most of the key mathematical concepts required in the text are summarized in an appendix. Each chapter is followed by a set of imaginative exercises which emphasize the application of the seismological principles and techniques explained in the text. These exercises give the student practice in computing interesting results which illustrate various seismic properties of the Earth. A number of these are computer-based exercises which require only a moderate level of programming ability but which give a feel for real seismological research. Subroutines to assist with the computer exercises are included in an appendix. In addition to the hands-on exercises, the book provides practical descriptions of the main concepts and how they are used to study Earth structure and earthquake source mechanisms.

The practicality of this book is its key strength; and although a number of excellent seismological textbooks are currently available, Introduction to Seismology is the only one which is designed specifically for student instruction. It is ideal for a comprehensive first course in seismology, and it is well suited for teaching an overview of seismology within a limited time period.

Keith Priestley


Caledonian Igneous Rocks of Great Britain is the seventeenth volume to be published in the Geological Conservation Review Series. It has been edited by a team of internationally recognized igneous petrologists and contains accounts from a further 26 contributors. The aim of this (and previous volumes in this series) is to document key Earth Science sites in Great Britain; all of the localities discussed in this 648-page volume have been proposed for notification as Sites of Special Scientific Interest. The book is not intended as a field guide (it’s far too bulky!) but provides a detailed account for each locality, together with scientific interpretations and conclusions. These accounts are accompanied by excellent location maps, field photographs and photomicrographs. The volume has been organized into the following nine chapters.

Chapter 1 (by D. Stephenson) discusses both the historical importance and present-day international significance of Caledonian igneous rocks from the British Isles. It also provides an introduction to the tectono-magmatic evolution of Great Britain during the Caledonian, which sets the scene for subsequent chapters.

Chapter 2 focuses on the Early Ordovician igneous rocks of Scotland. It contains well-documented accounts by D. Flinn and P. Stone on the Shetland and Ballantrae oceanic rocks and also volcanic rocks of the Southern Uplands. The Highland Border Complex is reviewed in detail by D. Bevins, R. Mendum and C. W. Thomas. Chapter 3 contains contributions by W. J. Wadsworth and D. Stephenson on the diverse range of Mid-Ordovician intrusions of the Grampians. Detailed site descriptions highlight the morphosed and deformed nature of some of the intrusions and also the primary igneous features, such as layering and cumulate textures.

The following three chapters examine Ordovician volcanism in England and Wales. Chapter 4 focuses on the Lake District and northern England. D. Millward, B. Beddoe Stephens and M. Branney have compiled thorough accounts of the calc-alkaline volcanic rocks of the Eyett and Borrowdale Volcanic Groups. Stratigraphic columns and schematic illustrations enable the reader to build up a detailed picture of the explosive volcanism that dominated this region during the Ordovician. The Lake District granites (Threlkeld, Ennerdale, Eskdale, Skiddaw and Shap) and gabbros (Carrock Fell and Haweswater) are described in additional contributions by S. Loughlin, D. Fettes and B. Young. In Chapter 5, J. Carney and T. Pharaoh focus on the rarely exposed Ordovician calc-alkaline plutonic (diorites) and minor intrusive (lamprophyres) rocks of central England. Chapter 6 is devoted to Mid-Ordovician, subduction-related igneous rocks from Wales and adjacent areas. It contains accounts of the subaqueous and subaerial volcanism (and associated intrusions) that dominated the margins of the Welsh Basin. R. Bevins provides site descriptions for the volcanic rocks of Pembrokeshire (Trefignare, Fishguard and Skomer Volcanic Groups) and P. Brenchley discusses the subaerial pyroclastic deposits in the Welsh borders. The volcanic rocks of Mid and North Wales are dealt with by D. Woodhall and M. Smith. They have produced comprehen-
sive site descriptions for the predominantly short-lived, volu-
minous subalkaline rocks in the Llewelyn and Snowdon
Volcanic Groups and also for the Aran and Buiith Groups.
The contrasting alkaline igneous rocks that constitute the
Llanbedrog Volcanic Group on the Llyn Peninsula are dis-
cussed by T. Young and W. Gibbons.

Chapter 7 is concerned with the Late-Ordovician to Mid-
Silurian alkaline intrusions of the Northwest Highlands.
This contribution by I. Parsons provides accounts of the
exotic and distinctive alkaline igneous rock types (e.g. groru-
dite) from the Lock Boralan and Loch Ailsh intrusions and
extensive suites of dykes and sills. Chapter 8 is devoted to the
Late Silurian and Devonian granitic intrusions of Scotland.
Site descriptions of these calc-alkaline ‘granites’ are pro-
vided by A. Highton (Strontian, Ross of Mull, Etive), J.
Soper (Rogart), S. Robertson (Glen Doll), D. Stephenson
(Glen Tilt), E. Stephens (Ratagain, Comrie, Glen Fyne,
Fleet, Loch Doon, Criffel) and I. Platten (Appin, Kentallen).
Chapter 9, the final one in the volume, deals with the volumi-
uous and widespread Late Silurian and Devonian volcanic
rocks of Scotland. This chapter includes igneous rocks from
as far apart as the Shetlands and the Southern Uplands
together with site descriptions from the Ben Nevis Igneous
Complex, Glen Coe volcano, Ochil Volcanic Formation and
the Lorn Plateau lavas. These contributions on late-stage
Caledonian igneous activity are provided by D. Stephenson,
G. Durant, D. McGarvie, R. Smith, M. A. E. Brown, P.
Stone and N. Odling. An extensive (43-page) reference list,
glossary of igneous rock nomenclature and IUGS classifica-
tion, together with a comprehensive index are presented at
the end of the volume.

In summary, Caledonian Igneous Rocks of Great Britain is
a welcome reminder of the diverse range of igneous rocks
that are to be found in Great Britain. The contrasting
tectonic environments (subduction, continental accretion,
collision and extension) that characterized the Caledonian
ensure that the book will be of interest to a wide range of
Earth scientists. It is an invaluable source of reference mater-
ial that, once discovered, will be frequently referred to. At
£78 (hardback) this is an extremely useful addition to any
institutional library.

Sally A. Gibson