BOOK REVIEWS

PE-PIPER, G. & PIPER, D. J. W. 2002. *The Igneous Rocks of Greece. The Anatomy of an Orogen*. Beiträge zur Regionalen Geologie der Erde (Series). xvi + 573 pp. Stuttgart: Gebrüder Borntraeger. Price Euros 98.00 (hard covers). ISBN 3 443 11030 4.
DOI: 10.1017/S0016756803218021

This comprehensive 450-page volume (including references, appendices and index) would normally be expected to be produced as an edited volume with a variety of authors handling their own areas of expertise. Yet this has been produced by a Canadian 'wife & man' team alone (the first author being a Greek national), so it is quite a remarkable feat, considering the amount of ground they have had to cover, but eased I suppose by frequent summer visits to Greece.

Greece may have been home to one of the oldest civilizations in Europe, but geologically it was one of the last pieces of continental Europe to accrete – and it is still accreting. Igneous rocks, dominantly of Mesozoic to Recent age, but including pre-existing fragments, form an important part of the accretion process. These igneous rocks, the associated metasediments, plus the intriguing tectonics, have attracted researchers from many parts of Europe and further afield, seduced by the excellent exposures. In fact Greece has probably one the highest proportion of foreign researchers of any European country; now these researchers will *have* to read this book just to summarize the geology adequately – or synthesize many of the 1240 references themselves!

After a brief introduction culminating in a summary of the plate-tectonic evolution of Greece, the rest of the book is divided into age-related chapters: (2) Late Palaeozoic plutonism and volcanism, (3) Triassic rifting and volcanism, (4) Jurassic Pindos ophiolites and melanges, (5) Mesozoic ocean crust in NE Greece, (6) Cretaceous ophiolites and subduction complexes in central and southern Greece, (7) Early Tertiary igneous rocks of Macedonia and Thrace, (8) Early Miocene volcanism in the NE Aegean, (9) Miocene plutonism in the Cyclades, (10) Miocene–Quaternary volcanics of central and northern Greece, and (11) the modern South Aegean Arc. In each case the individual regions or islands are discussed, and on the whole due weight is given to the ideas and concepts of the initial researchers on the subject, backed up by a collection of nearly 330 representative major, trace and REE analyses and isotopes and supported by over 280 maps and geochemical plots. At the end of each chapter is a synthesis section where the authors try to offer a coordinated viewpoint of the igneous evolution of Greece (mostly in a plate-tectonic framework at each stage), and try to develop their own viewpoint.

If you wanted a condensed view of the last 25 Myr history of Greece in petrological/geochemical terms, you could consult the authors' 2001 paper in the *Geological Magazine*, and that's the long and the short of it – of course, the long story is much more interesting. The book is subtitled 'The anatomy of an orogen', but the history of Greece is different from an orogen such as the Alps, in having appreciable amounts of magmatic accretion and tectonic accretion of subducted sediments in the overall process, in addition to one of the best examples of crustal back-arc extension in the Aegean itself. It's the interplay between these processes that makes Greece a fascinating place to work in, to try and unravel them.

John Tarney

Reference

PE-PIPER, G. & PIPER, D. J. W. 2001. Late Cenozoic, post-collisional Aegean igneous rocks. Nd, Pb and Sr isotopic constraints on petrogenetic and tectonic models. *Geological Magazine* **138**, 653–68.

DOYLE, P. & BENNETT, M. R. (eds) 2002. *Fields of Battle. Terrain in Military History*. The GeoJournal Library Series. ix + 387 pp. Dordrecht, Boston, London: Kluwer Academic Publishers. Price Euros 130.00, US $120.00, £82.00 (hard covers). ISBN 0 4020 0433 8.
DOI: 10.1017/S0016756803228028

To my surprise I found myself gripped by the tale of Bagnold and the Long Range Desert Group (LRDG), the battle of Monte Cassino and Cathers' discourse on the 'I'm here come and get me' approach to warfare in medieval times – to cite but three of the 21 chapters. This book forms the fourth, valuable contribution, in a series of publications in recent years dealing with the interaction of terrain, specifically geology, and warfare (Underwood & Guth, 1998; Rose & Nathanail, 2000; Ehlen & Harmon, 2002).

Blake recognizes the fortuitous coincidence of airfield-friendly ground on the side of the UK facing the enemy – would the Battle of Britain have been won if the geological map of Britain was a mirror image? Halsall, using Blake's statistical analysis method, concludes that the Upper Carboniferous, Permo-Triassic and Middle & Lower Jurassic hosted a disproportionate number of battles during the Middle Ages.

Kimble & O'Sullivan claim an Iberian provenance for the term 'guerrilla' and define such action as 'radical, undisciplined and chaotic fighting – just how *do* you defeat such a force (a burning question in these times of war against terrorism)? 'All's fair in ... war' is evidenced by guerrillas ambushing French couriers and rewriting their missives, the use of dummy airfields during the Battle of Britain (Blake) and the use of the southern Libyan desert as a hiding place by Bagnold's LRDG.

Ehlen & Abrahart marry contemporary photographs and modern digital elevation models to illustrate the battle of Fredericksburg – seeing truly is believing. Pittman sings the praises of William Rosecrans who, despite creating an effective mapping system during the US civil war, managed to pluck a position of defeat from an initial position of great superiority. Pollard focuses on the cultural heritage aspects of the Anglo-Zulu war of 1879, made famous by the film *Zulu* and infamous by the British defeat at Isandlwana.

Doyle & Bennett, the book's authors, rerun the Gallipoli campaign, a catalogue of disasters masterminded by one Winston Churchill while First Lord of the Admiralty. The aim was to deliver a knock-out punch to Turkey, the present-day ally but erstwhile adversary who instead meted out a severe punishment on the Allied troops. As a teenager, the images of ANZAC bravery depicted in the film *Gallipoli* etched themselves on my mind. The paper does full justice to the horrors of the campaign: a consequence of the effects

of terrain and terrain analysis. Bostyn's paper on mine (in the underground excavation sense) warfare is well illustrated with images of flooded craters and contemporary explosions. The interaction between practice and research is brought out though the use of surrogate terrain to enhance understanding of the effects of explosions.

Rose, Ginns & Renouf describe the German fortification of Jersey. They demonstrate how well planned but still fatally vulnerable the 'Atlantic Wall' was. The most gripping chapter describes the battle of Monte Cassino. Ciciarelli conveys the horror of battling against both terrain and a well-located enemy. Monte Cassino guarded the only way to Rome and the battle for it accounted for most of the 350 000 casualties in the war for Italy. Ciciarelli's detailed diagrams show how the soils of the valley of the Liri River, and site of the former Lake Lirino, hindered the Allies while the limestone cliffs provided the Germans with good protection. That limestone also caused a high percentage of head, face and eye injuries as it shattered when hit by shells of the exploding variety. Badsey presents a military analysis of the Battle of Normandy and suggests that most of the Allies' problems were a result of the terrain rather than an inadequate command.

Underwood & Giegengack tell the story of Brigadier Bagnold and the formation of the LRDG – a clear case of the man for the moment. By turning apparently impassable desert terrain into his personal autobahn the LRDG gathered invaluable intelligence and meted out regular punishment to Italian and German forces and showed how such a group can be used for high level strategic purposes. Bagnold's use of a daily rum ration betrays a rare gift for knowing how to push his men to just before the limit.

The book suffers from poor copy editing but benefits from a stout binding and good quality paper. Photographs and diagrams are clearly reproduced. This is a book for the historian, the military adviser and for the geologist interested in seeing how ground influences and sometimes dictates the course of history – if you fall into any of the above categories then read it and enjoy it !

Paul Nathanail

References

EHLEN, J. & HARMON, R. S. (eds) 2002. *The Environmental Legacy of Military Operations.* Geological Society of America Reviews in Engineering Geology 14, 238 p.

ROSE, E. P. F. & NATHANAIL, C. P. (eds) 2000. *Geology and Warfare. Examples of the Influence of Terrain and Geologists on Military Operations.* xiv + 498 pp. London, Bath: Geological Society of London.

UNDERWOOD, J. & GUTH, P. (eds) 1998. *Military Geology in War and Peace.* Geological Society of America Reviews in Engineering Geology 13, 245 p.

WYSE JACKSON, P. N., PARKES, M. A. & WOOD, R. (eds) 2002. *Studies in Palaeozoic Palaeontology and Biostratigraphy in Honour of Charles Hepworth Holland*. Special Papers in Palaeontology no. 67. 260 pp. London: The Palaeontological Association. Price £66.00 (paperback). ISBN 0 901702 77 3.
DOI: 10.1017/S0016756803238024

Despite the amalgamation, contraction, closure (and even occasional murder) of Departments of Geology and Earth Sciences in the United Kingdom, it is noteworthy that palaeontology continues to flourish. In large part this is due to the Palaeontological Association where shrewd financial management, selfless service by excellent editors, and an enthusiastic membership combine to produce a cheerful and dynamic organization. The long-standing series of Special Papers understandably has largely dealt with those monographic aspects of the subject that are the sinews of the discipline but have elsewhere fallen almost entirely by the wayside as journals burgeon in length, but shrink in page allowance. Occasionally, however, the Special Papers take a thematic approach, as the highly influential numbers 12 (*Organisms and Continents through Time*) and 23 (*The Devonian System*), or occasionally as a Festschrift. So it was that Oliver Bulman was honoured in number 13, while Harry Whittington and Norman Hughes were rightly honoured in numbers 30 and 35 respectively. Now it is the turn of Charlie Holland, long established at Dublin and a significant figure in Lower Palaeozoic biostratigraphy. Thus it is appropriate that the fifteen papers reflect this expertise, as well as the volume providing a brief encomium to Charlie Holland and an impressive bibliography.

For the most part the papers are very much in the tradition of *Palaeontology*, the sister journal to these Special Papers, Here it is only necessary to draw brief attention to some highlights. One such is the description by Patrick Orr and colleagues of radiolarians from the Wenlock Herefordshire fossil-Lagerstätte, which in recent years has yielded several extraordinary insights into Silurian life. The preservation of the radiolarians is remarkably complex, and both their extraction and analysis required careful thought. So too the quality of preservation that awaits the palaeontologist, or more specifically palaeobotantist, is apparent from the appropriately named *Hollandophyton* which gives fascinating details into an early land plant with remarkably preserved sporangia and stomata. This paper, by Catherine Rogerson and others, is a timely reminder that even simple/primitive land plants may harbour hitherto unexpected ranges of diversity. So too, perhaps, may the Indian Precambrian record of possible trace fossils, which is ably reviewed by Nigel Hughes as an afterword to an interesting analysis of Cambrian traces from the Zanskar Valley of northern India. Concerning this his comments on the validity of some existing ichnostratigraphic schemes should not be overlooked by anyone with an interest in the Cambrian 'explosion'. These and a variety of papers on groups as diverse as conodonts, crinoids, graptolites, nautiloids and trilobites, will make this both a valuable addition to any palaeontological library and a fitting tribute to both Charlie Holland and the undiminished energies of the Palaeontological Association.

Simon Conway Morris

STEWART, A. D. 2002. *The Later Proterozoic Torridonian Rocks of Scotland: their Sedimentology, Geochemistry and Origin*. Geological Society Memoir no. 24. vi + 130 pp. London, Bath: Geological Society of London. Price £70.00, US $117.00; members' price £35.00, US $58.00; AAPG members' price £42.00, US $70.00 (paperback). ISBN 1 86239 103 3.
DOI: 10.1017/S0016756803248020

The Torridonian sediments of the northwest seaboard of Scotland provide some of the most dramatic scenery of Europe, and some of its most dramatic controversies. From the earliest days of highland geological exploration the Torridonian was a source of controversies, some now resolved, others still debated. The mystery of the exotic pebbles, according to palaeocurrent data derived from the Atlantic Ocean, is now resolved, thanks to comprehension

of continental drift. The Torridonian has been attributed to every environment of deposition known on Earth, and even to derivation from the Moon (Parkes, 1963). The climatic conditions under which Torridonian sediments were deposited have been debated for over a century. Glacial, arid and humid climates have all been suggested. Geikie (1880) and Davison & Hambrey (1996, 1997) argued for a glacial climate, based, in part, on *roches moutonnées* on the underlying Lewisian, deemed to have been exhumed from a pre-Torridonian landscape. By contrast the Duke of Argyll (1880) and Stewart (1997) argued that these are of Pleistocene age. Indeed, His Grace acidly commented that the *roches moutonnées* in Geikie's published field sketch looked like 'Kaffir kraals'. The genesis of the fossilized quicksands, ubiquitous through most of the Torridonian sequence, is still debated, with seismic activity, hydrostatic head and current turbulence still considered as possible triggers.

Memoir 24 presents the data for these various controversies and critically analyses them within their historical context. Dr Stewart is uniquely qualified to write this book. The author has spent a lifetime studying the Torridonian, from Cape Wrath in the north down past the jebels of Wester Ross south to Rum in the Inner Hebrides. The book opens with an historical review of Torridonian research, follows this with a stratigraphic account, an overview and a directory of localities, and concludes with references and an index. The abundant illustrations, field sketches, sedimentological logs, maps, graphs, and concluding foldout map, are all handcrafted in the author's elegant personal style. Appropriate monochrome photographs and photomicrographs also illustrate the text. This is an excellently written and illustrated memoir of these fascinating rocks. It presents a catholic account of research to date, and will be an essential reference for future researchers who follow Dr Stewart's sodden footsteps through the midge-misted mountains of Torridon. Memoir 24 is a monument to his physical endurance and intellectual achievements.

R. C. Selley

References

ARGYLL, His Grace the Duke of. 1880. A fragment of primeval Europe - a reply. *Nature* **22**, 407.

DAVISON, S. & HAMBREY, M. J. 1996. Indications of glaciation at the base of the Proterozoic Stoer Group (Torridonian), NW Scotland. *Journal of the Geological Society, London* **153**, 139–49.

DAVISON, S. & HAMBREY, M. J. 1997. Discussion on indications of glaciation at the base of the Proterozoic Stoer Group (Torridonian), NW Scotland. *Journal of the Geological Society, London* **154**, 1087–8.

GEIKIE, A. 1880. A fragment of primeval Europe. *Nature* **22**, 400–3.

PARKES, L. R. 1963. The Origin of the Moon. *New Scientist* **20**, 365–404.

STEWART, A. D. 1997. Discussion of the evidence for glaciation at the base of the Proterozoic Stoer Group (Torridonian), NW Scotland. *Journal of the Geological Society, London* **154**, 375–6.

SCHICK, R. 2002. *The Little Book of Earthquakes and Volcanoes*. xi + 164 pp. New York: Copernicus Books (Springer-Verlag). Price Euros 19.95 (+ VAT at local rate), SFr 34.50, £14.00, US $20.00 (hard covers). ISBN 0 387 95287 X.

MEISSNER, R. 2002. *The Little Book of Planet Earth.* xiii + 202 pp. New York: Copernicus Books (Springer-Verlag). Price Euros 22.95 (+ VAT at local rate), SFr 39.50, £16.00, US $20.00 (hard covers). ISBN 0 387 95258 6.

DOI: 10.1017/S0016756803258027

Science publishing in the last ten to fifteen years has breathed life into tired old disciplines by the increasing number of books that aim to convey topical and basic science to that elusive beast, 'the interested lay reader'. These 'trade' books now outweigh textbooks in publishers lists, and one welcome outcome is that they have forced didactic authors to write far more accessibly than they once did. This revolution in public communication of science is partly driven by increasing excellence of television series that are truly informative rather than trivial. The growing interest aroused by science broadcasters creates the trade-book market, but that market becomes daily more discerning. The *Observer's Book of Geology* and its *Teach Yourself* counterpart are no longer good enough.

Beginning with Weidenfeld and Nicolson's 'Science Masters' series, several publishers have launched jaunty collections of slim volumes that convey the nitty-gritty to all who take an interest; few better or more timely than Peter Atkin's *The Periodic Kingdom*, which brings chemistry to life, perhaps for the first time since Priestley and Lavoisier. Springer-Verlag have entered the lists with these two 'Little Books' on Earth science; maybe the start of another series. Both ought to be welcome, for our discipline is heavily handicapped in the popularization stakes – our own fault for being so introspective and specialized, with a few exceptions. But both are translations from German first editions. Even with excellent translators, crossing a language barrier risks losing the authors' style and failing to match a potential readership's expectations. That is no great problem for authoritative works that express new concepts and observations to an eager and patient academic audience (they will read anything if it is new or insightful), but it is for books aimed at non-specialists. Not only do they require plain language, but an enthusiastic, witty style and a structure that draws the reader on, hopefully to deeper involvement in the topic. Sadly, both these books fail to meet those demands.

Meissner's *The Little Book of Planet Earth* reflects his interests as a geophysicist, so that Earth processes and evolution are covered very briefly. In a sense, his scope is complete, but with little sense of a unifying theme. The book's failings are too many facts and too much jargon, rather than attempting to cajole his readers with something inspirational by way of connections within the Earth system. Astonishingly, the reader is referred to a glossary at the publisher's web site, to wade through technicalities. There are many gross errors, especially in those short parts dealing with process and history. The Phanerozoic did not begin at 600 Ma; the collision of eastern Avalonia with Baltica did not create the mountains of Scotland; there is no tangible evidence that hominid migration coincided with 'strong ice advances' at 800 ka, 460 ka and 230 ka; the Milankovitch cycle was not verified by temperature studies in boreholes; stromatolites did not form in the early Precambrian from the activity of algae (eukaryotic); komatiitic lavas are not well known for containing diamonds; and similar throughout. By trying to cram every concept and many technical terms into 188 octavo pages, without grasping the actual background, interests and needs of readers at this level, and without a theme from which to 'hang' factual matter, Meissner lost me very early on. *The Little Book of Planet Earth* does little to serve either Earth science or people interested in knowing more about their home world.

Schick's *The Little Book of Earthquakes and Volcanoes* is not so error-prone, and by limiting its scope he has room to convey many aspects of seismicity and volcanism to a more

satisfying depth. Both topics move from a brief history of ideas into technicalities backed by modern empirical studies. Yet again, an attempt at completeness in a tiny volume, particularly in terminology, stifles the excitement of these two immediate and dynamic aspects of the Earth system. This is another compendium, but one unlikely to become a *vade mecum*. Earthquakes reflect the means whereby continents are assembled and broken apart, sometimes involving slivers migrating vast distances, and colossal rejigging of surface environments. Volcanism is the perpetual repaving of that surface, and the source of all elements that are continually interwoven in biogeochemical cycles, particularly as regards the climate. Dangerous as they are now, awesome volcanic events in the past have contributed to extinctions, to changes in the continental freeboard and much more. Flood volcanism's episodic role in challenging the entire surface environment, and its implication of processes not shaped by plate tectonics, have no place in Schick's account, although Mary Shelley's writing *Frankenstein* during the depressingly poor summer of 1816, after Tambora's catastrophic eruption, does. Likewise, the way seismic tomography has revolutionized our understanding of the deep Earth's dynamics is simply ignored. Magma genesis is not the author's *forte*. As well as getting mired down in his treatment of decompression melting, I heard alarm bells ringing when I read that subduction zone magmas form by slab melting.

Neither book lives up to the dust-cover puff. Has something been lost in translation? Not a lot, I reckon.

S. A. Drury

NORTON, O. R. 2002. *The Cambridge Encyclopedia of Meteorites*. xx + 354 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £35.00, US $50.00 (hard covers). ISBN 0 521 62143 7.
DOI: 10.1017/S0016756803268023

In recent years, interest in space science has heightened. Not surprisingly, so also has interest in meteorites. As samples of early planetary materials, meteorites hold the key to our understanding of the origin and evolution of the Solar System. Three decades ago there were only about 2000 meteorites known to science. Through the serendipitous discovery of concentrations of meteorites bound in Antarctic ice, and a gradual realization that other dry places of the world also contain abundant meteorites that have accumulated with time, today the figure stands at around 30 000. Along with the more widespread availability of meteorites and a better understanding of their importance to planetary science, a lucrative market in meteorites has developed. These are not mutually exclusive since education frequently brings commercial opportunity, whether it is desired or not.

The impressive title of this book promises much. Indeed, it is richly illustrated with many quality colour plates and illustrations. However, the book does not match any definition of an encyclopaedia that I know, and the content is disappointing. Unlike an encyclopaedia, the organization of the book is generally disjointed. Neither can the book be described as encyclopaedic, since it does not deal comprehensively with the subject.

Twelve chapters and eight appendices attempt, ambitiously, to cover the nature of meteorites and micrometeorites, their fall to Earth, their appearance, taxonomy and possible sources, their impact with the Earth, and statistics pertaining to their recovery. My main criticism of the book is that it does not seem to be able to decide whether it is a 'popular' or a more scholarly 'text' book. As the former, the writing is generally too complicated for a lay readership; as the latter it does not quite meet the standards of scientific rigour.

I tried to place myself in the position of someone (scientist or non-scientist) who knows nothing about meteorites. Reading the text and encountering words that I might not know, I searched the glossary. On many occasions, I could not find a satisfactory explanation. I looked elsewhere in the text (via the index) for illumination, while continually remaining in the dark. The tendency to introduce complex topics and details without proper explanation or background pervades the text. Frequent discussions of old, and now outdated, classifications of meteorites serve only to confuse the uninformed reader.

Throughout the book there is strong emphasis on detailed description of meteorite classification and systematics. Sadly, there is less regard for the Solar System processes that led to the existence of different groups of meteorites, and the possible relationships between seemingly disparate groups. Attempts to be didactic are generally difficult to follow and, most importantly, there are some omissions and errors of fact.

One of the stated aims of the book is as a 'guide to assist searchers in the field to recognise the many classes of meteorites'. From this I gather that the book was written partly as a kind of 'DIY guide' to classifying meteorites for amateurs. Another aim is as 'a reference source for students, teachers and scientists'. However, I do not think that this book succeeds in serving the ends to which it was directed.

Alex Bevan

RAWSON, P. F., ALLEN, P. M., BRENCHLEY, P. J., COPE, J. C. W., GALE, A. S., EVANS, J. A., GIBBARD, P. L., GREGORY, F. J., HAILWOOD, E. A., HESSELBO, S. P., KNOX, R. W. O'B, MARSHALL, J. E. A., OATES, M., RILEY, N. J., SMITH, A. G., TREWIN, N. & ZALASIEWICZ, J. A. 2002. *Stratigraphical Procedure*. Geological Society Professional Handbook Series. vi + 57 pp. London, Bath: Geological Society of London. Price £16.00, US $27.00; members' price £8.00, US $13.00; AAPG members' price £10.00, US $17.00 (paperback). ISBN 1 86239 094 0.
DOI: 10.1017/S001675680327802X

Any book entitled *Stratigraphical Procedure* is unlikely to top the best-sellers' lists. But this book deserves to, at least amongst its target readership of UK-based geologists. Stratigraphy provides the fundamental space–time framework in which we place rock units. As the process model derived from or tested against this geological record become ever more rigorous and quantitative, so the need to appreciate the strengths and limitations of this record becomes more rather than less important. Too many sophisticated models are rendered inappropriate or naive if problems of stratigraphical calibration or correlation are misunderstood.

This book is effectively the sixth edition of the Geological Society's '*Concise Guide* . . .', and later simply '*Guide to Stratigraphical Procedure*' that first appeared in 1967. The guide has got longer as its title has got progressively shorter, reflecting both the increase in stratigraphical methodology available and the attempts to formalize ever more complex

rock bodies. Igneous and metamorphic rocks are tackled seriously for the first time in this edition with the description of lithodemic units. There is also discussion of allostratigraphical, morphostratigraphical and tectonostratigraphical units, whilst retaining the clear treatment of lithostratigraphy that dominated previous editions.

In the sections on calibration and correlation, climate stratigraphy, isotope stratigraphy and chemostratigraphy are added in this edition. Seismic and sequence stratigraphy receive the expanded treatment that their increasing importance deserves. Updated discussions are given of biostratigraphy, graphic correlation, geophysical log stratigraphy, cycles, and of climate, event and magneto-stratigraphy. Sections on chronostratigraphy, geochronometry and holostratigraphy round off a well-balanced book.

Each of the sections recited above could have been a book in itself and the many co-authors have resisted the temptation to include more than the absolutely essential. The compact well-edited text is augmented by a bare minimum of figures, but nevertheless answers most of those stratigraphical queries that we all have intermittently. What is the chronostratigraphical equivalent of an epoch? What exactly is backlap, or the formal difference between an igneous suite and an igneous complex? What is an FDO, an LDO or an LOC?

Stratigraphical Procedure explicitly reflects UK practice and uses UK examples. However, it would also be a reliable guide to most aspects of international procedure. It deserves to be widely available through sales to libraries and individuals. It might even be worth the Geological Society foregoing some sales revenue, and making an on-line version available for the good of geological science in general.

Nigel Woodcock

MARTIN, A. J. 2001. *Introduction to the Study of Dinosaurs*. xiv + 426 pp. Oxford: Blackwell Science. Price £37.50 (paperback). ISBN 0 632 04436 5.
DOI: 10.1017/S0016756803288026

This book is intended by the author to be a teaching guide at 'the college undergraduate level for non-science majors', but also has an eye to those of the general public at large with an interest in dinosaurs. Over the past few years a considerable number of these books have been produced, either as multi-author compendia (*Encyclopedia of Dinosaurs*, eds Currie & Padian; *The Complete Dinosaur*, eds Farlow & Brett-Surman) or more specifically targeted texts (*The Evolution and Extinction of Dinosaurs* by Fastovsky & Weishampel; *Dinosaurs, the Textbook* by Lucas). So there are two questions to be addressed: do we need another such book? and, how well does it compete in this rather crowded field?

The answer to the first question is 'probably yes' in the sense that the information available concerning dinosaurs, their discovery and interpretation changes year on year so an inevitable component of updating is necessary. However, whether this book fills a specific niche, or does the job better than other books in the field is a much more difficult and inevitably subjective matter, tainted in my case by my own (UK-based) perceptions of its qualities.

It is very clear that this book is entirely focused on US undergraduates and that very specific teaching system. I know for a fact that 'non-science major' courses on dinosaurs are taught extremely widely across the US and are consistently heavily subscribed (which accounts for the rapid rise in the number of texts aimed at this market niche). These circumstances dictate the overall style of the book, which is highly structured and yet open and accessible. The chapters, in part at least, read like a list of lecture titles in a published lecture course on the subject and each ends with its 'Dino Afterthoughts', a series of questions that are clearly intended to form the focus for discussion groups with TAs in class (the same format as used by Lucas in *Dinosaurs, the Textbook*). The contents in summary provide, as the author clearly intended, an overview not only of dinosaurs but more particularly tries to reveal, in passing, the scientific principles that underlie this field of scientific research. I regard this as an entirely laudable aim. It seems very probable that 'non-science majors' need to be guided through the subject with some care in order that they find it both palatable and unthreatening. Indeed the air and grace of the gentle and kindly professor pervades the book.

I have a couple of quibbles with the book. Firstly it seems to represent a 'beta version' in modern parlance, and needs a second edition to sort out errors that were not identified during copy-editing. Secondly, the contents are simply too self-contained, there are no references whatsoever in the text and no bibliography – for a teaching document this is to my mind unforgivable. This must have been a conscious decision, and I fear that the answer to this criticism will be something along the lines of 'undergrads don't have time for all that stuff'; if this is the case then I disagree most strongly.

In summary, this book is probably exactly what the intended audience wants. I am sure it will prove popular as an additional course reference for undergraduate courses in the US and will no doubt improve through a series of editions in the future. Whether this is the sort of book that the general public would want remains to be seen. I am not particularly convinced that the latter audience is appropriate for this style of presentation, but kids will try and get 'Mom & Pop' to buy it because of the 'cool' dinosaur picture on the front. The marketing people obviously know a thing or two!

David Norman

HARPER, E. M., TAYLOR, J. D. & CRAME, J. A. (eds) 2000. *Evolutionary Biology of the Bivalvia*. Geological Society Special Publication no. 177. vii + 494 pp. London, Bath: Geological Society of London. Price £99.00 (hard covers). ISBN 1 86239 076 2.
DOI: 10.1017/S0016756803298022

This symposium volume resulted from a successful meeting held in Cambridge in 1999. It is immediately clear that anybody seriously interested in the evolution of bivalves should study it. Its contents are remarkably diverse, ranging from the phylogeny of the Class as a whole to considerations of diversity gradients, biomineralization and conservation biology. They are admirably summarized by the editors in their introduction. I can only offer a few reflections from a palaeontologist interested in bivalves who for many years used them in undergraduate courses to illustrate principles in palaeontology.

The obvious point of comparison is with a similarly-titled symposium published by the Royal Society in 1978. That volume contains fewer but generally longer papers than the present one, including several that have become classics in the intervening years and have, besides stimulating research, informed teaching. The present volume includes results

from striking new technical advances, notably in molecular phylogeny. The use of cladistics in deriving phylogenies, pioneered for bivalves by Waller in one of the classic papers in 1978, is now routine, though in a review of bivalve systematics published after the Harper *et al.* volume Schneider (2001) chides bivalve researchers for being slow to adopt this methodology.

Despite this, we are still far from a consensus on relationships between the higher taxa among the bivalves, even for a 'group' like the Pteriomorphia, most of whose families have extant representatives which have been well studied, as well as an excellent fossil record. The situation is worse for more basal relationships. On page 5 there is a reference to the Palaeozoic subclass (no less) Cryptodonta. Having forgotten how this was defined, I searched the index and the other papers. It is nowhere else mentioned. Obviously, molecular phylogenies don't help for long-extinct taxa, and the oft-lamented prevalence of convergence in bivalve shell characters is still a serious hindrance. This is illustrated by Harper *et al*.'s cladistic paper on extant Anomalodesmata, in which their total-evidence tree differs considerably from that based on shell characters alone. On the other hand, in the paper by Skelton & Smith on the extinct rudists, in which the reader is helpfully presented with pictures as well as names and lists of character states, a cladistic analysis does result in clarification of their phylogeny. Perhaps this is because rudists are exceptionally rich in rather extreme morphological characters. A more subtle point about convergence is made by Thomas *et al*. in their paper on noetid ligaments, that apparently profound changes in form can result from small changes in the regulation of development. As they say, the implications for evolutionary systematics may be quite provocative. What seems to be a shared derived character, in this case a distinctive ligament pattern, may not be one.

Apart from biological papers on living bivalves, evolutionary biology in this volume mostly seems to mean phylogeny. There is little on evolutionary aspects of functional and constructional morphology. The stimulating and provocative paper by Seilacher (1982), on the evolutionary pathways of primary versus secondary soft-bottom dwelling bivalves, is nowhere referred to. Although he places his examples in conventional taxonomic categories, Seilacher is interested primarily in the bivalves' remarkably flexible adaptations to life strategies, constrained but not determined by their descent. You do not have to accept all of his proposals to feel that this should form part of the broad science of evolutionary biology. The animals concerned needed to have these adaptations and constructional patterns to live their lives, and we need to understand them to have a full appreciation of the group's long and successful geological history. However, even if we might wish for more on some aspects, this volume presents much. Bivalves continue to provide plenty of food for thought.

J. D. Hudson

References

SCHNEIDER, J. A. 2001. Bivalve systematics during the 20th century. *Journal of Paleontology* **75**, 1119–27.

SEILACHER, A. 1982. Constructional morphology of bivalves: evolutionary pathways in primary versus secondary soft-bottom dwellers. *Palaeontology* **27**, 207–37.

YONGE, SIR M. & THOMPSON, T. E. (organizers) 1978. Evolutionary systematics of bivalve molluscs. *Philosophical Transactions of the Royal Society of London* **B284**, 199–436.

TAWADROS, E. E. 2001. *Geology of Egypt and Libya*. xii + 468 pp. Rotterdam, Brookfield: A. A. Balkema. Price Eur 95.00, US $95.00, £63.00 (hard covers). ISBN 90 5809 331 X.
DOI: 10.1017/S0016756803308027

Books on the geology of northern Africa are not that common; to be asked to review two books in a 2–3 month period is exceptional! In my review of the *Geology of Northwest Africa* by Alain Piqué (*Geological Magazine* **139**, 2002, pp. 597–8), I wrote that 'Picqué must be praised for his magnificent effort in bringing together so much information on Northwest Africa. The book is a must for both researchers and explorationists'. The same is true for Dr Tawadros, whose book also benefits somewhat from a softer, less intense prose. Both books are comprehensive in their treatment of the geology of northwest and northern Africa and they make excellent companion works for anyone interested in the region.

The Geology of Egypt and Libya is divided into five parts with the introduction serving to provide a tectonic framework for the constituent geological elements including the offshore. Areas such as the Mediterranean Basin and the Cyrenaica Platform are essentially presented as separate essays which include a considerable amount of useful data. However, there are obvious omissions, with the relevance of Cretaceous volcanics in the structural outline of the Pelagian area and of synsedimentary faulting during the Late Cretaceous–Palaeogene of Al Jabal Al Akhdar being examples. More maps would also have been helpful in this section and some reference to the excellent research on the evolution of Tethys by Stampfli and co-workers at Lausanne would have given the section greater depth. Figure 7, depicting the evolution of the Sirte Basin, also does the book a disservice.

Part 2, The Nubian–African Shield, provided a severe test for a soft rock geologist, and again the use of more maps and diagrams would have helped considerably. Sadly this is a weakness throughout this formidable compilation in which the illustrated component is heavily weighted towards stratigraphic charts. In themselves these are extremely important for geologists new to the area but illustrating rocks in a regional context is just as useful.

Parts 3 and 4, The Phanerozoic Geology of Egypt and Libya, are the backbone of this work. Each part is divided on a chronological basis and the great personal knowledge acquired by the author, on both areas, is clearly expressed. Interestingly Dr Tawadros places emphasis on the use of fossils in the dating and correlation of specific units across country; his efforts represent a minor victory for biostratigraphy and the value of a more holistic approach to our science! Anyone involved in the geology of North Africa is conversant with the problems of local and regional correlation and the relevant abundance of stratigraphic terms and interpretations. *The Geology of Egypt and Libya* is a valiant effort to resolve many of the problems that have arisen over the last 100 years or more and the two parts dealing with the Phanerozoic will warrant the appearance of the book on the bookshelves of most oil companies and universities.

The flyers advertising this book claim that it is the 'most comprehensive work of the geology of Egypt and Libya, written by a single author, in one volume'. There is little doubt that the book does present a detailed review and that it will be standard in terms of accessible information for years to come. However, it is Part 5, Phanerozoic

Geological History, that will mark the originality of Dr Tawadros's contribution to our knowledge of the area. It deals with the geological history of Egypt and Libya in terms of three megasequences, spanning three time-stratigraphic units. Notably these cover the intervals of the Palaeozoic–Albian, Upper Cretaceous–Upper Eocene and Oligocene–Recent. One could argue that these are somewhat superficial divisions of the Phanerozoic but they are justified in regional terms as long-lasting regressive, transgressive, regressive sequences associated with specific tectonic events and sea-level changes. Each megasequence is divided into sequences or major time-stratigraphic units. The individual chapters that deal with these units provide the reader with more detail on the distribution of facies and their environments across the region. They also reveal the influence of palaeotopography and tectonics at the local and regional scale, serving to integrate the vast amount of data that exist as a result of decades of detailed research and exploration over two of the largest countries on the African continent.

Dr Tawadros is to be congratulated on his dedicated work; his grateful thanks to his wife and sons reflect the compromise faced by so many geologists who share their love of 'rocks' with that of the people who often sit and wait outside quarries for a committed parent. I sincerely hope that his sons become geologists showing the same amount of commitment as their father to a task well done.

Richard T. J. Moody

Reference

PIQUÉ, A. 2001. *Geology of Northwest Africa*. Beiträge zur Regionalen Geologie der Erde, Vol. 29. Translated by M. S. N. Carpenter. xiv + 310 pp. Berlin, Stuttgart: Gebrüder Bomtraeger.

SCHWARTZMAN, D. 2002. *Life, Temperature and the Earth. The Self-Organizing Biosphere*. First paperback edition; first published in 1999. xxi + 241 pp. New York: Columbia University Press. Price US $27.50, £19.50 (paperback). ISBN 0 231 10213 5.
DOI: 10.1017/S0016756803318023

In principle evolution ought to be a runaway process. The constant scrutiny of selection and the pressure of adaptational advantage, be it ever so slight, should in principle lead to the emergence of a complex biosphere during a geological period far less than it actually took. One famous example that drives this point home is an estimate of the time needed for a complex camera-eye to evolve from a simple eye-spot (see Nilsson & Pelger, 1994). On the basis of rather modest assumptions these workers show that the process should take less than half-a-million years. What applies to complex eyes should apply to anything similar, so in the wider context why weren't humans present by the end of the Archaean, two and a half billion years ago?

Here David Schwartzman, in a newly issued soft-back version of his book (2002, with an author's update at the beginning), develops a broad and exciting theme that posits a dramatic thermal history of the Earth, from temperatures near to boiling early in the history of the biosphere to our present-day values that average about 15 °C. Both consequences and mechanisms are intriguing. If indeed surface temperatures were very high during much of the Precambrian, only dropping below 50 °C about a billion years ago, then this would neatly explain the paucity of evidence for complex life, especially with multicellular organization, much before that time. At temperatures much above 50 °C eukaryotic organisms are effectively prohibited, probably because of such effects on the sensitivity of cellular membranes, including those around the respiratory organelles known as the mitochondria.

Why then did temperatures begin to fall in the early Precambrian, and then precipitously decrease from about a billion years BP? Schwartzman argues that the key lies in the concentration of atmospheric carbon dioxide, most famous of the greenhouse gases, which in turn was governed by the extent of chemical weathering and the development of a land biota, especially of lichens, algae and plants that had a dramatic effect on soil and regolith chemistry. It is an appealing hypothesis, but Schwartzman is candid about what we don't know. To start with the main biogeochemical cycles are fairly well known in outline, but many of the details are still elusive. Even worse, a uniformitarian stance will almost certainly be misleading. So too popular ideas on rates of chemical weathering connected to major episodes of mountain building, famously the rise of the Himalayas and the uplift of the Tibetan plateau, may need reconsideration. Geological evidence can often be contradictory: are, for example, the striated pebbles of the Huronian deposits glacially derived, as popularly assumed and thereby difficult to reconcile with a hot early Earth, or could they (as Schwartzman suggests) actually represent giant impact breccias? So too hard evidence, such as temperature determinations of the Archaean oceans or the extent of land vegetation before the Ordovician, is very difficult to obtain and nearly always controversial.

Not so deeply hidden in this book is a series of philosophies that resonates with both some European traditions (Hegel, for example) and also the idea of Gaia as a supreme example of self-organization. Schwartzmann puts an extra twist on the idea by appealing to a co-evolutionary scenario whereby biotas and biosphere both continuously interact and by so-called homeorrhetic behaviour move through a series of steady states that make the concept of optimization more or less meaningless. All these ideas are controversial, but the final chapter on the possible nature of alien biospheres is an important reminder that if we hardly understand our own biosphere, then we may not be in a better position to understand anyone else's.

This is a thought-provoking, wide-ranging, discursive, and sometimes irritating book that should be in the libraries of both individuals and institutions.

Simon Conway Morris

Reference

NILSSON, D.-E. & PELGER, S. 1994. A pessimistic estimate of the time required for an eye to evolve. *Proceedings of the Royal Society of London, Series B* **256**, 53–8.

BUFFETAUT, E. & KOEBERL, C. (eds) 2002. *Geological and Biological Effects of Impact Events*. xiv + 295 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 69.95 (+ VAT at local rate), SFr 116.50, £49.00, US $79.95 (hard covers). ISBN 3 540 42286 2.
DOI: 10.1017/S001675680332802X

It is now generally accepted that catastrophic impact events in the geological past have, at various times, greatly perturbed global environments and the biosphere. Painstaking research over more than two decades has established a chronological coincidence between some recognized impact structures and extinction events as revealed by the fossil record, notably Chicxulub and the K/T boundary. However, many fundamental questions remain to be answered about the

actual causal mechanisms of impact-related extinctions. Some impact events, such as the Miocene Ries/Steinheim impacts, are not linked with extinctions, even though these might have generated a combined explosive power equivalent to around 250 000 atomic bombs. These events provide evidence of a threshold in the scale of impact below which global effects are not detected. Moreover, the greatest extinction of Phanerozoic time at the end of the Permian has not yet been aligned conclusively with any known impact event.

This book (edited by Eric Buffetaut and Christian Koeberl) is the first volume in a new interdisciplinary series on 'Impact Studies'. Thirteen peer-reviewed contributions report the results from a workshop sponsored by the European Space Agency Impact Programme, and held in France at Quillan in September 1999. The theme of the workshop, 'Geological and Biological Evidence for Global Catastrophes', brings evidence to bear from geochemical, stratigraphic, mineralogical, palaeontological and palaeogeographical studies of impact sites, distal ejecta and extinction horizons. Contributions cover an extended time-span from the Late Devonian (Frasnian/Famennian) extinction, to the Miocene, and papers on events at the Permian/Triassic, Triassic/Jurassic and Jurassic/Cretaceous, as well as the Late Eocene, are also included.

Contributions in the volume include detailed studies of invertebrate (ostracod and ammonite) and vertebrate (bony fish) extinctions, and petrographic and geochemical studies of boundary layers (notably, but not exclusively, the K/T boundary), together with more theoretical aspects of impact cratering, such as radiation and the dispersal and deposition of material after impacts into continental and oceanic targets.

In a fast-moving interdisciplinary area of research, compilations of papers such as this are a boon to researchers in the field, and an essential addition to libraries. Each contribution has a comprehensive and extremely useful list of references. Sadly, however, no index is provided. This is something that the editors of future volumes in the series should address.

This slim but very useful volume contains much valuable data, and points the way to a future multidisciplinary collaboration, which is essential to the solution of complex problems like the relationship between impacts and extinctions. I look forward very much to further volumes in the series.

Alex Bevan

JACKSON, J. B. C., LIDGARD, S. & MCKINNEY, F. K. (eds) 2001. *Evolutionary Patterns. Growth, Form, and Tempo in the Fossil Record*. xvi + 399 pp. Chicago, London: University of Chicago Press. Price US $85.00, £54.00 (hard covers); US $30.00, £19.00 (paperback). ISBN 0 226 38930 8; 0 226 38931 6 (pb).
DOI: 10.1017/S0016756803338026

Geologists and palaeontologists may be dismayed to hear that 'with all the recent advances in molecular and evolutionary biology, one could almost wonder why we need the fossil record'. As an antidote to this view one might consider the claim of Grasse (1977) that the only real evidence of evolution comes from the fossil record, not directly from biology. Of course we need not take either extreme view too seriously and, as the editors of this 12-chapter compilation point out, the fossil record gives us the deep-time perspective that cannot be observed in biological studies. The fossil record is what we've got.

The book is divided into three parts: the first on modes of development, hierarchies of morphological development, and adaptive significance of colony form; the second on recognition of species, and the tempo of speciation and extinction; and the third on macroevolutionary patterns and trends. This organization is a somewhat cumbersome attempt to pigeon-hole disparate and rather specialized contributions. The book, and title, should not be confused with *Evolutionary Trends* (McNamara, 1991), which benefits from a more coherent and straightforward organization, and which is likely to be of more interest to the general reader.

Thus, my concerns revolve around the utility of the book for the non-specialist. This is perhaps a little unfair because the book was conceived as a worthy tribute to Alan Cheetham and his work on cheilostome bryozoans, and so contains several papers on bryozoans and growth/development and evolution in corals and other sessile colonial species. Some of these chapters (e.g. those by Buss, Okumura *et al*., Pandolfi *et al*., and Hakensson & Thomsen, i.e. chapters 1, 3, 5 and 11 respectively) are sparsely illustrated with actual photographs of organisms. Many of the remainder are heavily theoretical and mathematical (e.g. Hayek & Bura on 'Taxon Range' and Foote on 'Evolutionary Rates' in chapters 8 and 9) leaving the book rich in data matrices and tabulations.

None the less there is some potentially useful synthesis hidden in this information overload, and we may be able to identify some emergent properties of complex systems (*sensu* Morowitz, 2002). For example, the paper by McShea (chapter 2) shows that internal cell and cell 'part' (i.e. organelle) diversity is less in larger multi-cellular/colonial (and sessile) organisms than in small free-living (unicellular and/or solitary) species, even though external clonal units (i.e. polyps) are more differentiated. McShea calls this the 'hierarchy hypothesis' where 'as organisms combine to form higher level wholes and as functionality emerges in those wholes, functional demands on the organisms decrease' (p. 48), leaving simpler cells. (It is rather obvious that a single-celled organism must have all its parts in one cell.) I prefer to think in terms of a type of compensation principle where microscopic complexity and macroscopic simplicity evolves into macroscopic complexity and microscopic simplicity. Such compensations or 'trade offs' are inherent in complex, heterochronic systems and resonate directly with the theme of the final chapter (12) by McKinney *et al*., that in the study of macroevolutinary trends 'perception depends on the measure used'. Thus, as in the previous case, simplicity and complexity are simultaneously identified in both solitary and colonial organisms.

Herein lies an important lesson. Evolutionary change 'cannot be characterized fully with only one class of data' (p. 373). Thus what appears progressive, derived or complex on one level may appear conservative, primitive or simple on another. One might apply a similar lesson to this book and argue that where it is over-specialized and information dense it looses is general utility, and that a less specialized, general or user-friendly approach might be of more utility to a broader audience.

M. Lockley

References

GRASSE, P. 1977. *Evolution of Living Organisms.* Academic Press, 297 p.
MCNAMARA, K. (ed.) 1991. *Evolutionary Trends.* University of Arizona Press, 368 p.
MOROWITZ, H. 2002. *The Emergence of Everything.* Oxford University Press, 224 p.

BEARDSMORE, G. R. & CULL, J. P. 2001. *Crustal Heat Flow. A Guide to Measurement and Modelling*. x + 324 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £70.00, US $100.00 (hard covers), £24.95, US $37.95 (paperback). ISBN 0 521 79289 4; 0 521 79703 9 (pb).
DOI: 10.1017/S0016756803348022

Thermal models of sedimentary basins provide a critical framework to understanding their evolution and the maturation of organic material. However to get the most out of these models a strong background in thermal geophysics is required. Beardsmore & Cull's new book, *Crustal Heat Flow: A Guide to Measurement and Modelling*, is directed towards providing this background. A primary goal of this book is to give users of sophisticated thermal models an understanding of basic thermal physics and measurement techniques. In this endeavour, I believe the book succeeds. The book starts with a review of basic thermal physics, builds into measurement techniques of temperature, thermophysical rock properties and ends with a discussion of models and modelling practices. The book is generally well written and presents numerous examples of applications. Mathematical concepts are reinforced through simple calculations. Key ideas are offset from the text to emphasize them and chapters conclude with useful summaries. The book contains a unique perspective and set of topics that I have not seen in other textbooks.

The book is divided into three sections. The first section contains background information on the thermal evolution and present thermal state of the Earth. Chapter 1 introduces basic thermal physics, units and vocabulary. Chapter 2 covers heat generation, radiogenic frictional heat on faults and metamorphic reactions. The strength of the book is the second section. Topics covered include techniques and considerations in the measurement of subsurface temperature (Chapter 3), thermophysical rock properties (Chapter 4) and thermal maturation (Chapter 5). Chapter 5 is particularly noteworthy for its comprehensive discussion of thermal maturation. Subjects include the generation of hydrocarbons from organic matter, and palaeotemperature indicators. The third section of this book introduces modelling techniques and covers potential causes of nonlinearities in temperature–depth profiles (Chapter 6), models of both oceanic and continental lithospheric heat flow (Chapter 7) and numerical modelling techniques (Chapter 8). Chapter 9 discusses the thermal histories of basins and nicely ties together concepts presented throughout the book.

A somewhat unique aspect of this book is its supplemental web site (http://www.earth.monash.edu.au/heatflow/) containing auxiliary material to supplement the chapters. I found the web site to be useful, containing colour versions of the figures in the text, links to global data sets, and other material not easily incorporated into the book. I particularly appreciate the ability to have simple spreadsheet programs available through the web site. Although this practice is likely to grow, some of the pitfalls are already evident as not all links to external sites work.

Overall, I think the book succeeds in its stated goal of making links between the underlying physical principles, data collection, and the use of sophisticated basin analysis models. At the same time it provides additional insight into thermal problems not limited to thermal basin analysis. While I do not foresee using this book as a primary text in my classes, I do plan on using it to supplement topics (thermophysical rock measurements, thermal basin analysis techniques) not adequately covered in the primary text. As such I anticipate that I will refer to this book often.

Robert N. Harris

MACLEOD, N. & FOREY, P. L. (eds) 2002. *Morphology, Shape and Phylogeny*. Systematics Association Special Volume Series 64. x + 308 pp. London, New York: Taylor & Francis for the Systematics Association. Price £70.00 (hard covers). ISBN 0 415 24074 3.
DOI: 10.1017/S0016756803358029

Shape is typically used as one of the primary ways of defining organisms and is at the root of the majority of systematic analyses at present. The rising number of systematic analyses using macromolecules to challenge or refine morphology-based analyses does give one pause for thought about the future role of morphology in phylogeny. However, media-inspired hype notwithstanding, molecular studies are outside the realm of systematic investigations in palaeontology and, as this set of essays demonstrates, morphology is very much alive and kicking. This book represents the 'state of the art' in the field of shape analysis and its role in phylogenetic studies, and the editors must be congratulated for encouraging a significant number of the leaders in the field to collaborate in the production of this book. The subject matter explores the way in which morphology can contribute to phylogenetic analysis, and conversely the way in which systematic patterns (simulating potential phylogenies) can be used as a framework within which to investigate morphological evolution.

One of the persistent themes (largely finessed from standard papers) within systematic analyses that rely on morphological data, is the coding that is applied to continuously varying characters. For example, if a character is described as short vs long, or round vs oval, what *precisely* are the limits of each character state, and to what extent are analyses simply masking a degree of arbitrariness on behalf the individual who is coding such characters? This inherent problem had led some to reject entirely the use of continuously varying characters, while others have devised methods for delimiting such characters. Elsewhere within the field of morphology methods for describing shape are being refined constantly, with mathematical geometry becoming increasingly important. However, complicating this mode of analysis is the essential background of homology: the need to recognize that refined geometric analyses should be undertaken only within the context of taxa that have already by 'sorted' using higher level phylogenetic principles. For example, homology in geometry would recognize the potential homology between the dorsal fins of a shark, dolphin and an ichthyosaur, while ignoring the fact that they have arisen independently in these three taxa.

The chapters of this book explore many of the fundamental issues that concern those interested in the use of shape in phylogenetic analysis and even the way in which shape studies and molecular studies might be integrated in the longer term. The book is a mine of useful information for those interested in systematics, phylogenetics and the mathematics, as well as the philosophies, that underlie these fields of research. Though excellent, this book is to my mind hideously expensive and will get neither the sales nor attention that it deserves.

David Norman

RAPP, G. 2002. *Archaeomineralogy*. xii + 326 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 79.95 (+ VAT at local rate), SFr 133.00, £56.00, US $89.95 (hard covers). ISBN 3 540 42579 9.
DOI: 10.1017/S0016756803368025

The use of rocks and minerals by early civilizations is a very human face to our science. The current volume aims to provide a systematic overview of minerals and rocks that have been used from prehistoric times though to the 17th Century. In the preface the author states that the book is aimed at scholars and students from both geological and archaeological backgrounds. The scope and content of the book are based on Professors Rapp's experience both as an active researcher in archaeomineralogy and also from teaching archaeogeology courses over many years. The book starts with an introductory chapter that provides an overview of the works of classical authors, such as Theophrastus, and mediaeval, Arab and Eastern authors. This is followed by introductory chapters that cover the elementary basics of mineralogy and geology. The rest of the volume is divided into eight chapters where the various human uses of rocks and minerals are discussed. These chapters are: Lithic Materials; Gemstones, Seal Stones and Ceremonial Stones; Soft Stones and Other Carvable Materials; Metals and Related Minerals and Ores; Ceramic Raw Materials; Pigments and Colorants; Abrasives, Salt, Shells; and Miscellaneous Geological Raw Materials (this last chapter is on building, monumental and statuary materials). This grouping, by use, enables Professor Rapp to trace the developments in for example stone tool making or metallurgy through time, moving smoothly between various civilizations. Although the author notes that the bibliography is not meant to be exhaustive, it is nevertheless comprehensive, listing over 800 references and provides an easy entry in the literature of this interdisciplinary field. The bibliography even includes the reviewer's only contribution in the field, a paper on the mineralogy of Aboriginal ochres.

I must admit that this was not the book that I expected it to be. I thought it would be either an introductory account of the various experimental and instrumental methods used on minerals, written for archaeologists (these methods are barely mentioned at all in the book), or a series of detailed case studies of various archaeomineralogical topics. Instead it is a very readable well-written overview of the subject. In addition to the extensive bibliography there is also a very useful glossary of mineralogical, geological and archaeological terms (terms listed in the glossary appear in bold in the text).

Overall this is an excellent volume that should appeal equally to those with a geological or an archaeological background. Highly recommended.

Allan Pring

KEAREY, P., BROOKS, M. & HILL, I. 2002. *An Introduction to Geophysical Exploration*, 3rd ed. ix + 262 pp. Oxford: Blackwell Science. Price £29.95 (paperback). ISBN 0 632 04929 4.
DOI: 10.1017/S0016756803378021

The first two editions of this book have become a standard text for introductory courses in exploration geophysics at many UK universities. The last edition was first published in 1991, so the time was ripe for an updated version. The book is clearly a mature text with good, clear, simple diagrams and a uniform style despite the three different authors. A particular strength is the inclusion of illustrative examples of the application of all the geophysical techniques discussed, and a set of questions at the end of each chapter provides the student with an opportunity to test his/her understanding. Perhaps, however, criticism is that the lists of 'Further Reading' at the end of each chapter are too long to be of use to most readers at the level at which the book is aimed. Since a full reference list is included at the end of the book, it would probably be more appropriate to include just two or three textbooks in these lists and to omit specialist journal articles.

The first chapter gives an overview of geophysical methods and their application. A chapter on data processing gives a good explanation of Fourier transforms and a variety of filtering operations. The mathematics is kept to a minimum, though unfortunately may still be beyond the grasp of many UK students at this level. The third chapter covers some of the basic principles of seismology, including field equipment and methods. One criticism I have here is that the time-average equation relating seismic velocity and porosity is presented as if it has equal validity as the relationship between density and porosity. This equation is presented again in Chapter 11, and in neither place are readers warned that this equation has no basis in theory and only very limited application.

The fourth chapter on seismic reflection is by far the longest, and the most difficult to write since the technology develops so rapidly. The chapter covers the basic principles well and has been significantly updated, with for example the inclusion of some nice examples of three-dimensional reflection data. However, several sections appear quite dated, including the discussion of migration by wavefront charts and the description of marine single channel seismic acquisition. Pingers, sparkers and boomers are mentioned, but there is no mention of swept-frequency marine profilers such as chirp. Three-component seismic reflection is covered, but there is no mention of seafloor cables, which are an important source of such data. The section on applications refers to BIRPS and COCORP as if they were still active. The example seismic profiles shown in the figures are not very representative of the quality of data acquired by modern surveys. Finally, the two paragraphs on sidescan sonar that are included in this chapter do not really do the topic justice. Perhaps this topic belongs in a short separate chapter along with swath bathymetry, which is not mentioned at all by this book.

A chapter on seismic refraction covers the basic principles well, though seismic tomography is discussed almost exclusively in the context of cross-borehole tomography. Reflection tomography is mentioned, but refraction tomography is omitted completely. The chapters on gravity, magnetics and electrical methods are in general very clearly written and comprehensive. A significant omission is the measurement of gravity from space, and the difficult topic of Euler deconvolution is poorly explained and may have been better omitted. Treatment of electromagnetic methods is difficult because of the plethora of methods with very specific applications. The descriptive approach taken is appropriate at this level, but perhaps more could be made of quantitative modelling and inversion techniques. Ground-penetrating radar is also treated rather briefly, with no description of field techniques. Short final chapters on radiometric methods and drilling and borehole logging complete the book.

The above comments have focused on a few minor weaknesses; overall, however, this is an excellent book and no doubt will continue to be recommended reading for many undergraduate courses.

T. A. Minshull

LE MAITRE, R. W. (ed.) 2002. *Igneous Rocks. A Classification and Glossary of Terms. Recommendations of the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks*, 2nd ed. xvi + 236 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £45.00, US $65.00 (hard covers). ISBN 0 521 66215 X.
DOI: 10.1017/S0016756803388028

Have you ever wondered what a 'viterbite' is or how you would recognise an 'ossipyte'? Perhaps, less obscurely, you may have wished how to establish if a rock is a syenite or a gabbro. If so, *Igneous Rocks: A Classification and Glossary of Terms* is the book you need to refer to. The book is the culmination of over three decades of discussions by the International Union of Geological Sciences (IUGS) Subcommission on the Systematics of Igneous Rocks. It is the second edition of a volume first published in 1989. Copies of the first edition have been unobtainable for about five years and so I, and am sure many others, will be delighted that this book has been revised and republished. For those who have not yet discovered *Igneous Rocks: A Classification and Glossary of Terms*, it is an invaluable resource to specialist and non-specialist alike, seeking to understand the meaning of some seemingly incomprehensible igneous rock name. Importantly, it presents a standardized way of naming igneous rocks, one that has been widely accepted by the geological community.

In many respects this second edition is very similar to its predecessor. It has, however, increased in length by ~20% and all the tables and figures have been redrafted. The book contains updated versions of the QAPF and TAS systems. The most significant changes relate to classification schemes for high-Mg rocks, and alkaline and related rocks.

The book consists of four chapters. It begins with a five-page tribute to Albert Streckeisen (1901–1998) who instigated the creation of the IUGS Subcommission on the Systematics of Igneous Rocks (formerly the Commission on the Systematics of Magmatic Rocks). This is followed by two-page prefaces by both the IUGS Subcommission chairman (M. Le Bas) and the editor (R. W. Le Maitre)

The Introduction outlines the main changes between the first and second editions. Chapter 2 examines the principles of igneous rock classification, nomenclature and their usage. It includes 21 pages on the classification of common plutonic and volcanic rocks. This section contains numerous diagrams on which the co-ordinates of field boundaries are clearly illustrated such that, armed with either the modal mineralogy of a coarse-grained igneous rock or the major element chemistry of a fine-grained igneous rock, the researcher is readily able to find the appropriate nomenclature. This section also contains up-to-date geochemical criteria for the classification of high-Mg volcanic rocks (e.g. komatiites and picrites). The classification for pyroclastic rocks and tephra is a purely descriptive scheme and the book provides tables, etc., on how best to do this. The first edition of the work contained a section on 'Lamprophyric rocks'. Due to a recent change in scientific opinion on how best to classify these exotic rocks, this section has been replaced by individual ones on 'Kimberlites' 'Lamproites' and 'Lamprophyres'. There is, however, currently no clear consensus on the best way to classify kimberlites and so the subcommission has adopted the petrological scheme that has been used to differentiate so-called Group I and Group II South African kimberlites. In the case of lamproites, the subcommission discards the historical nomenclature in favour of more self-explanatory petrographic terms, e.g. the rock name mamilite has been replaced by leucite-richterite lamproite. Lamprophyres, leucite- and kalsilite-bearing rocks, and charnockites each occupy an individual page of Chapter 2.

The Glossary contains a total of 1637 rock names (51 have been added since the first edition). Of these, only 316 rock names are recommended by the IUGS Subcommission, with most of the remainder obsolete or local terms. It may be of some comfort to igneous petrology students that only 179 of the recommended terms are 'root' names. A petrological description of each rock name, together with the source reference and alternative spellings, are provided in the Glossary. Where possible, the origin of the rock name is also given. The Glossary also includes several pages on the historical perspective of igneous petrology. Thankfully, perhaps as a result of the work of the IUGS Subcommission, significantly fewer new rock names have appeared in the literature in the last decade.

The Bibliography contains 809 source references of the rock names presented in the Glossary. The majority of these are in obscure publications but all are housed in archives at the Natural History Museum, London and at the Geologisk Central Institut, Copenhagen. Appendix A provides a list of the 456 international contributors that have been involved with the classification schemes. The recommended IUGS names are presented in Appendix B. Details of a collection of C++ routines for implementing the TAS classification for volcanic rocks are given in Appendix C. These use analyses of major elements to calculate CIPW NORMs and rock names. The source code for this can be downloaded from the Cambridge University Press website.

In summary, this is an excellent reference book. It is a must for all Earth Science libraries and those involved in the study of igneous rocks.

Sally Gibson

MIENERT, J. & WEAVER, P. (eds) 2003. *European Margin Sediment Dynamics. Side-Scan Sonar and Seismic Images*. xii + 309 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 99.95 (+ VAT at local rate), SFr 166.00, £70.00, US $109.00 (hard covers). ISBN 3 540 42393 1.
DOI: 10.1017/S0016756803398024

Continental margins are the focus of intense attention by academics and industry for a number of reasons; they are a key region for the exploitation of marine resources, notably hydrocarbons, and can be a source of hazards such as slides and slumps and can also provide unparalleled records of climatic and tectonic change. Margins represent the transition between the oceanic and the coastal, both in terms of hydrography and geologically. Shorelines are among the most highly populated zones of the world and yet perversely the most vulnerable to environmental change. It is surprising, given all this, that the processes operating on continental margins remain poorly understood.

This timely volume presents a unique collection of short 'themed' contributions illustrating the morphology and the outlining processes that have shaped the European margin (Iberian–Norwegian). In this respect the book can be viewed as a 'state of the art' snapshot of our current understanding of not only European margins but of the system as a whole. The bulk of the work collected in the book represents a summary of the ENAM (European North Atlantic Margins) and STEAM (Sediment Transport on the European Atlantic Margin) European Commission

supported programmes which ran from 1993 to 1999 and 1993 to 1996 respectively. The volume is clearly and logically divided up into geographical areas: Norwegian Margin, Faeroe–Shetland Margin, Rockall and Porcupine Margins, Celtic and Amorican Margins and finally Iberian and Canaries Margin. Within each geographical region summary papers are presented, grouped together by process, e.g. the Faeroe–Shetland Margin chapter contains works on Slides, Channels and Drifts. The book is introduced by its editors, Jürgen Mienert and Phil Weaver, with an entertaining and lively paper summarizing the geological setting, historical background and highlighting its main aims of drawing together seafloor images and their interpretation in studying sediment dynamics. This is followed by a very informative summary of geophysical techniques by Doug Masson, outlining the methods used and, importantly, their resolution and limitations. Each subsequent geographical chapter has a summary paper introducing the work that follows.

Where the book really comes into a field of its own is in bringing together a fascinating and sometimes breathtaking collection of acoustic seabed images from a number of different sources. The authors provide spectacular images from GLORIA, TOBI and OREtech side-scan sonar packages and high-resolution seismic systems such as Topas, Deep-Tow Boomer, Sparker and multibeam bathymetry systems, as well as the occasional good-old fashioned picture of a core! Highlights are numerous, although worth mentioning are the superb contributions on the Storegga Slide by Haflidason; the glacigenic debris flows on the Bear Island Trough by Taylor; the exciting new discoveries of the deep-water coral *Lophelia pertusa* in the Rockall Trough as described by Akhmetzhanov; and I defy readers on the allegedly tsunami-prone UK south coast not to be checking their lifejackets after seeing the stunning images of the EI Hierro landslide as presented by Masson!

One minor criticism is in the quality of some of the line illustrations; the map introducing the chapter on the Celtic and Amorican Margins on page 224 is, frankly, illegible. It is a shame that for a relatively expensive volume, that is selling itself on wonderful images of the seafloor, it still suffers from the occasional poor map. This aside, I thoroughly recommend this text to students and researchers of the seafloor as both a fascinating overview of the subject and as a fine starting point to begin a deeper delve into the processes that have shaped the European margin. One last point: for once the book is of a decent size that will not warp your bookshelves!

J. A. Howe

TAUXE, L. 2002. *Paleomagnetic Principles and Practice*. Modern Approaches in Geophysics Series Volume 18. First paperback version; first published in 1998. xi + 299 pp. + CD-ROM. Dordrecht, Boston, London: Kluwer Academic Publishers. Price Euros 47.00, US $47.00, £31.00 (paperback). ISBN 0 4020 0850 3.
DOI: 10.1017/S0016756803408029

The intended audience for this book encompasses both professional users and students of the palaeomagnetic technique. In comparison to many previous books on palaeomagnetism this book has a particular emphasis on the numerical and statistical analysis of the data. Given the clarity of the writing, the freely available software that accompanies the book and the accompanying sample data to explore the analytical techniques, Lisa Tauxe does an excellent job in shedding light on what are potentially difficult aspects of the subject area.

The book opens with three chapters on what might be termed the generic introductory subject areas for all palaeomagnetic books – these are geomagnetism, rock magnetism and the basic procedures for palaeomagnetic field and laboratory work. The depth of description of detail in any book is always a subjective matter and for me the first two chapters on geomagnetism and rock magnetism were well balanced while the third on basic palaeomagnetic techniques fell a little short. Certainly for most students I would expect that they would need to delve into other basic texts to find out more on laboratory and field practices.

The real beauty of this book shines out in chapters four and five on the analysis of vectors and tensors. This could have been exceptionally dry but it is clear from the text that this is written by an expert in the field who is well able to deliver these difficult topics in a clear and concise manner. The use of sufficient, simple, line drawings with good supporting figure captions really adds greatly to the clarity of the text here in particular but also throughout the book as a whole. It is in support of these chapters that the software provided is at its best. The software is relatively simple to use for those familiar with command line entry of program parameters, and the software is integrated into the text with clear instructions on inputs and example datasets. (I suspect however that some students will find this a rather dated-looking form of computing if not used to the Unix environment.) The final chapter on applications is again, for me at least, rather short but quite adequate given the range of other books and journals available.

No active professional palaeomagnetist should be without a copy of this book on their shelf both for reference and as a teaching aid on the difficult areas of vector and tensor analysis. Despite the publication of this new, paperback, version I remain to be convinced however that students on an introductory course would be willing to read the most valuable analytical chapters. Overall the book does what it says in the final summary – it introduces the nuts and bolts of palaeomagnetism and, in my opinion, gives a very clear and thorough airing of the analytical tools of the trade allowing the readers to go forward and explore palaeomagnetic data for themselves.

Graeme K. Taylor

STRUNZ, H. & NICKEL, E. H. 2002. *Strunz Mineralogical Tables. Chemical Structural Mineral Classification System*, 9th ed. ix + 870 pp. Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung. Price Euros 148.00 (hard covers). ISBN 3 510 65188 X.
DOI: 10.1017/S0016756803418025

The need to understand the relationships between parts of the natural world led Linnaeus to devise classification schemes for plants and animals in the second half of the 18th Century. He later expanded his system to cover the mineral kingdom. J. J. Berzelius developed the first chemical classification of minerals in 1824 and Gustav Rose later extended this to incorporate aspects of crystal structure in 1852. Chemical classification was adopted by James Dana in the fourth edition of his *System of Mineralogy*, published in 1854, and subsequently by most other authors in the second half

of the 19th Century. These crystal chemical classification principles were further developed in the light of the results of crystal structure analysis during the 20th Century. These developments were crystallized in the first edition of Strunz's *Mineralogische Tabellen* in 1941 and the recently completed eighth edition of *Dana's Mineralogy* of 1997 (see review in *Geological Magazine* **135**, p. 723, 1998).

The current volume is the ninth edition of *Strunz Mineralogical Tables*, revised in collaboration with Ernest Nickel, and is in English. The work is considerably enlarged; the eighth edition published in 1982 covered less than 3000 mineral species, while the current edition gives data on some 4000 mineral species. Strunz's classification arranges the minerals in ten major chemical subdivisions: Elements, Sulphides and sulphosalts, Halides, Oxides, Carbonates, Borates, Sulphates, Phosphates, arsenates and vanadates, Silicates and finally Organic compounds. Within each chemical group the minerals are further subdivided into structural families and finally isostructural groups. For each isostructural group, a brief description of the structure is given and then minerals are listed with the chemical formula, crystal system, space group and cell parameters. References for the structures are given in footnotes. Polyhedral structural diagrams illustrate many of the major structure types, and some of the more unusual structures. These diagrams are clear and add greatly to the text.

The volume is a tabulated classification of minerals and not a descriptive mineralogy, so physical properties, occurrence and locality data are not included. The book does, however, contain a comprehensive index and gives the modern names for many obsolete minerals. Overall the classification scheme, which is based on grouping by anion type, is logical and well organized. However there are some minor problems with anion solid solutions, the Achilles heel of all anion-based classification schemes. For example the mineral pyroaurite $Mg_6Fe_2(OH)_{16}(CO_3)\cdot 4H_2O$ and most of the rest of the hydrotalcite group are classified as a carbonates, while the isostructural iowaite $Mg_6Fe_2(OH)_{16}(Cl)\cdot 4H_2O$ is classified as a hydroxide. Since the carbonate and chloride ions in these minerals can be readily exchanged, it would seem more sensible to me to classify them all as hydroxides, especially as their structures are based on brucite-like layers. However classification schemes are merely tools and not a straight-jacket; for minerals there is no right or wrong answer.

The format of the volume is clear, well set out, the typeface is easy to read and a high quality stock has been used. As far as this reviewer can tell the text is free from errors. Mineralogists will find this book indispensable in quickly establishing the relationships between minerals. *Strunz Mineralogical Tables* is a major mineralogical reference work and should be in all Earth Science libraries and on the bookshelves of all serious mineralogists.

Allan Pring

CATTERMOLE, P. 2001. *Auvergne*. Classic Geology in Europe Series Volume 2. viii + 168 pp. Harpenden: Terra Publishing. Price £12.95 (paperback). ISBN 1 903544 05 X.
DOI: 10.1017/S0016756803428021

The Auvergne is one of the most diverse geological areas of France and has been the subject of geological guides since Scrope (1836). This book follows in this long tradition. It is the only modern English text on the area, and thus serves as an important reference for either individuals or groups. The text is very comprehensive in terms of itineraries, and those areas I personally knew before reading are clearly described. I followed the well trodden Châine de Puys and Puy de Sancy itineraries without problem. I have found the book useful for discovery of new outcrops, for improving my general geological knowledge of the area and also of the history, fauna and flora.

However, I have several criticisms about the book, which might well be ironed out in future editions. Firstly, and obviously, it is out of date as it works in francs. However, this is not serious, as many Auvergne inhabitants have not even converted to the new franc (introduced in the 1950s!). Secondly, the text is low on location maps and also on grid references, which makes it hard accurately to find places described and to have a spatial awareness (all important to a geologist). Now that GPS is easy to use, grid references are a must. Thirdly, and finally, there is no discussion of the major volcano-tectonic features and the debris avalanche deposits of the major volcanoes. These have only been identified in the last 20 years, but represent, in the Cantal, Sancy and Monts Dore, one of the most important geological features and almost 30% of the outcrop area. The most recent reference in the bibliography is 1977; a lot has been published since then and there are excellent introductions to the evolution of the large volcanoes, dating, debris avalanches, pyroclastic rocks and magma evolution, that are not included here. These are things that most geological visitors would want to know.

Apart from these caveats, the most important test for a guide such as this is, is it useful? It is. As a general introduction, to someone with a critical eye and a bit of experience, looking for good geology, it works well.

Benjamin van Wyk de Vries

PIRAJNO, F. 2001. *Ore Deposits and Mantle Plumes*. xx + 556 pp. Dordrecht, Boston, London: Kluwer Academic Publishers. Price Euros 134.00, US $145.00, £90.00 (hard covers). ISBN 0 412 81140 5.
DOI: 10.1017/S0016756803438028

This hardbound book in 556 pages covers a range of topics discussing the physics and chemistry of mantle plumes and their relationship to ore-forming processes. Part 1 consists of five chapters devoted to the internal structure of the Earth, the controls of plume formation and the geological features at the Earth's surface, such as large igneous provinces and intracontinental rifts, that are considered to be the result of plume activity. Part 2 comprises ten chapters that describe in detail the ore deposits, including orthomagmatic deposits and a range of hydrothermal ores, that are considered to have direct or indirect links with mantle plumes.

The book is generally well laid out with clear figures, but suffers from an annoying frequency (most pages) of minor grammatical and typographical errors that could easily have been picked up with more careful editing. There is also a little bit of overlap in places where similar material is reiterated.

As a whole I found the book interesting and thought provoking but always slightly unsatisfactory in its assumption of an underlying role for mantle plumes in many geological phenomena. This stems from the inevitable uncertainty and controversy that surrounds the mantle plume paradigm. Consequently, the reader is asked to accept the links between plumes and a range of geological processes that, in turn, are

fundamental in the genesis of certain types of ore deposits, yet such links are often equivocal. Although many people might accept that plumes play a role in generating large igneous complexes and their attendant magmatic deposits of Cr, Ni and PGE, the suggestion that plumes play a role in generating sediment-hosted base metal deposits, lode gold deposits or even Banded Iron Formations could be regarded as rather tenuous. Whilst in some cases such links may exist, they are yet to be proven or are very indirect, and it seems likely that such deposits could also form in the absence of plume activity. Despite, this, the detailed summaries of mantle processes and plume generation are useful for those unfamiliar with this literature. The descriptions of the geological settings and genesis of the very wide spectrum of mineral deposits linked to plumes are also well informed. It is the combination of the two that doesn't quite seem to work.

In conclusion, the book will be of interest of explorationists, economic and academic geologists interested in learning more about the possible connection between plumes and ore deposits and the wider geological processes that accompany plume activity. It also provides both a useful introduction to mantle processes and acts as an Economic Geology textbook. How many library shelves the book ends up on I expect will depend to some extent on how competitively priced it is.

J. J. Wilkinson

CARRACEDO, J. C. & DAY, S. 2002. *Canary Islands*. Classic Geology in Europe Series Volume 4. viii + 294 pp. Harpenden: Terra Publishing. Price £14.95 (paperback). ISBN 1 903544 07 6.
DOI: 10.1017/S0016756803448024

The Canary Islands in the Northeast Atlantic are a wonderful place to study volcanic, structural and sedimentological aspects of ocean island volcanoes. Their geology is varied and superbly exposed, with over fourteen million years of submarine and subaerial, effusive and explosive volcanic activity, intrusion, caldera collapse, landslides, and erosion recorded. Visitors should not be put off by the recent oversensationalist TV documentaries predicting future landslides and the inundation of Florida and New York by tsunami! The presence of voluminous felsic explosive products, sediments and uplifted submarine successions, make the Canaries more varied than the Hawaiian islands with which they are often compared. With low-cost flights, accommodation and car-hire, they have become particularly accessible to northern Europeans.

To my knowledge *Canary Islands* is the only field guidebook that attempts to cover the geology of all seven main islands in the Canary archipelago. This is an ambitious remit, and the authors have many years of research expertise in the islands. The result is an attractively produced and well-illustrated book, with diagrams and many superb black-and-white photos. The text is well-written and up-to-date, with a glossary and index. An introductory review of the geology, environment, flora and fauna of the archipelago is followed by a section on logistics. Ensuing chapters describe the seven islands, each with a summary of the geology followed by a list of field localities to visit.

For me, the book's strength is the facinating and informed geological summaries provided. There are insufficient localities (from just 19 to 36) on each island for a typical seven- to ten-day tour, which is unfortunate given that most visitors stay on one island rather than hop from one island to another, as, for example, is common practice in the volcanic Aeolian Isles or Cyclades. The localities are widely spaced and require a lot of driving, which is a pity because the itineraries pass numerous classic geological sites without a mention. Therefore I would recommend that any geologist planning to visit Tenerife also acquire a copy of the field guide by Martì & Mitjavila (1995) and anyone visiting Gran Canaria purchase a copy of Schmincke's excellent guidebook (see below). These are relatively hard to get hold of, but contain a wealth of fascinating itineraries to keep the keenest geologist busy. Its a pity they weren't cited. There is also a brief, now dated, guide by Gill *et al.* (1994). I am not aware of similar guides to the other islands.

Some of the itineraries could have been more clearly set out, with a better map, showing all the field locations and place-names mentioned in the text. I hope this can be amended in future editions. The reader might best clarify the route prior to departing, using a good topographic map (topographic maps, produced by the Spanish military, are hard to purchase in many Canarian shops, and short-term visitors might lose a day in the field trying to acquire them).

Canary Islands was written 'with the beginner very much in mind' but is intended to be 'essential reading for the student, amateur and professional Earth scientist'. It is always difficult to reconcile these disparate requirements. The language is somewhat heavy for the beginner, whilst the serious geologist will be irritated by the absence of citations which makes it difficult to find the source of many of the interesting interpretations presented. The photos are beautiful although could have been more informatively annotated. Treatment of the volcanic geomorphology is excellent – far better than the treatment of the products of explosive eruptions. I was amazed at the paucity of localities of pyroclastic rocks in the southern deserts of Tenerife and Gran Canaria. Not only are these locations closest to where most visitors stay, but the Miocene (Mogán and Fataga) and Pliocene (Bandes del Sur) successions are particularly spectacular, superbly exposed and of international importance, yet key exposures are omitted and most units are not even named. The same emphasis applies to the glossary. Although generally helpful, some definitions are left wanting: 'ignimbrite' (a pumice-rich deposit of a pyroclastic flow) is defined without reference either to pumice or pyroclastic flow, and the definitions of 'Plinian' and 'Plinian airfall' omit to mention pumice or dispersal.

The authors are to be congratulated at having brought together a very readable account of Canarian geology. Their enthusiasms come through, and I learnt a great deal from reading the guide. It is a convenient size to take along and should prove very popular with the more curious package-tourist.

Michael Branney

References

GILL, R., THIRLWALL, M., MARRINER, G., MILLWARD, D., NORRY, M., SAUNDERS, A. & MARTÌ, J. 1994. *Tenerife, Canary Islands.* Geologists' Association Guide no. 49. London: The Geologists' Association, 38 pp.

MARTÌ, J. & MITJAVILA, J. (eds) 1995. *A Field Guide to the Central Volcanic Complex of Tenerife (Canary Islands).* IAVCEI Commission on Explosive Volcanism, Serie Casa De Los Volcanes no. 4. Cabildo Insular de Lanzarote, 156 pp.

SCHMINCKE, H.-U., with contributions by FREUNDT, A., FERRIZ, H., KOBBERGER, G. & LEAT, P. 1993. *Geological Field Guide to Gran Canaria*, 6th ed. Kiel: Pluto Press. FRG. 227 pp.