BOOK REVIEWS

SIMMS, M. J., CHIDLAW, N., MORTON, N. & PAGE, K. N. 2004. *British Lower Jurassic Stratigraphy*. Geological Conservation Review Series Volume 30. xvi + 458 pp. Peterborough: Joint Nature Conservation Committee; distributed by NHBS Ltd, 2–3 Wills Road, Totnes, Devon TQ9 5XN, UK. Price £55.00 (hard covers). ISBN 1 86107 484 0.
doi:10.1017/S0016756805210774

Following hot on the heels of *British Upper Jurassic Stratigraphy* (no. 21 in the series) and *British Middle Jurassic Stratigraphy* (no. 26 in the series) comes the volume to complete the study of the System and the Period as exemplified by exposures in England, Scotland and Wales. I have to say that I find these volumes extraordinarily useful. Basic stratigraphy is often published in a wide spectrum of regional journals and special symposia: having so much data brought together under one cover is valuable indeed. The information in this and its companion volumes is such as to take you by the hand and lead you to the outcrop with the aid of maps, map references, graphic logs and photographs that, although not stunningly reproduced, are adequate. The reference list is compendious: ten minutes spent searching for significant omissions found none at all and the authors are to be congratulated for producing a work of such significant scholarship.

The book covers seven principal areas: the Wessex Basin of Dorset and Somerset, the Mendips and South Wales, the Severn Basin, the East Midlands shelf, the Cleveland (Yorkshire) Basin, the Moray Firth Basin and the Hebrides Basin. All the 45 outcrops described, ranging from small quarries to coastal cliffs, offer 'features of interest and importance at localities already notified, or being considered for notification as 'Sites of Special Scientific Interest' (SSIs).' Hopefully, therefore, the sections described in this volume will not be lost to the ravages of modern development. In every case there is a detailed account of the biostratigraphy, as presently known of the outcrops in question, and to some extent this volume can be used as an updated version of the *Jurassic Correlation Chart* which is now some 25 years out of date.

I believe that any serious student of the British Jurassic geology will find this an invaluable source book and that it should also find a place in libraries and museums across the country – and beyond.

Hugh Jenkyns

MACLEOD, N. 2003. *PaleoBase. Macrofossils Part 2.0. Ammonoids, Bivalves, Coleoids, Gastropods, and other Mollusca*. vi + 19 pp. + CD-ROM, in boxed set. PC and Mac compatible. Oxford, Malden, Carlton: Blackwell Publishing. Price £29.99 (boxed set). ISBN 0 632 05891 9.
doi:10.1017/S0016756805220770

This is the second of a set of three CD-ROMs providing a gallery of cross-indexed and annotated images (a 'relational database') of representative invertebrate macrofossils from the collections of the Natural History Museum, London. The slim accompanying user's guide, mercifully intelligible enough even for such computer-bozos as me to manage, launches straight into procedures for installation and use, eschewing any prefatory stuff about whom or what it is for. However, the frequent references to Euan Clarkson's (1998) textbook suggest that it might best serve as an illustrative companion to that work, providing virtual practical material. Indeed, additional resources to the latter end for teachers (exercises and PowerPoint images) are advertised as being available on an associated website (www.Paleobase.com), though when I went there just now (Christmas Eve, 2004), these items still related only to the first CD-ROM, so it seems that a little up-dating of that website is needed. In a sense, one might think of it as a personal computer-age successor to John Murray's (1985) *Atlas of Invertebrate Macrofossils*, which will be familiar to an earlier generation of palaeontology students, so I'll draw comparisons with that in passing.

The 318 genera illustrated here can be listed (1) with their author names and dates, and assignment to major taxonomic groups, (2) showing their distributions across 16 generalized palaeogeographical regions (e.g. 'Austral', 'Tethys', 'Rodinia'), or (3) with thumbnails of all the images, and their ages (by period). Double-clicking on any genus opens its 'taxon record panel', where the images, together with further taxonomic and stratigraphical details, plus descriptive text and key references, can be studied. I was surprised to find that slightly fewer genera are covered than in the Mollusca section of Murray (which figures over 340 genera), although we often get two or more views per genus in the CD. While there are a few more gastropods in the CD (83, against Murray's 78, discounting the 5 bellerophonts included by the latter), Murray has the edge for bivalves (82, against 75 in the CD) and even more so for ammonoids (122 against 82 in the CD). But we do get hyoliths in the CD, which didn't make it into Murray, and the photographic illustration of fossil coleoids, especially the soft-bodied ones, are an advance on the line diagrams in Murray. The great strength of the CD, of course, is the quality of its high-resolution digital colour photographs, constrasting with the little black and white cameos in the older work (one of the distinct boons of the IT revolution). Nevertheless, given that only 104 MB of the CD appear to have been used, it strikes me that an opportunity to provide a much more comprehensive virtual display of the Museum's instructive riches has been missed, which is rather a shame.

The 'Compustrat' system used on the CD allows the user to select and display data in many different ways. Thus, particular fossil groups, or taxa from given times or palaeobiogeographical regions can be listed. However, although the user guide promised that I would also be able to compose my own list of individually selected taxa, by clicking on them with the 'Ctrl' button held down, I found that this manoeuvre inclusively highlighted all taxa between any two selected, as a monolithic block. So that is one bug (for my PC, at least) that will need attention in future versions.

A handy feature is that selected text can be edited and downloaded to one's hard-disk (but not the images, as far as I can tell). There is also easy access to useful references and

a glossary for each group. Moreover, a floating menu panel allows different items to be viewed simultaneously.

As one would expect, the scientific content is (mostly) authoritative and accurate, though a few errors have slipped through. For example, the calcitic outer shell layer of the primitive rudist *Diceras* is not 'thick', but in fact shows the primitive condition of being relatively thin (rarely greater than 1 mm) compared with more derived rudists. And the glossary definition of 'aptychus', as a 'pair of plates, possibly functioning as an operculum closing the aperture' looks a trifle dated (cf. Kennedy & Cobban, 1975, p. 13: 'The classic view is that these are opercula, but a series of elegant studies by Lehmann and others suggests that they are wholly or in part ammonite jaws'). Odd editorial glitsches that I came across included a stratigraphical attribution of 'Recent' to 'Labelled Figures' under Rostroconchs (true, I suppose, but curious), and a reference to 'brachiopod labelled images' in a discussion of *Hildoceras* on p. 11 of the user guide.

To return to the question of the CD's purpose, I think its excellent illustrations and the standardized format of the accompanying information should indeed make it an effective virtual supplement to undergraduate palaeo practicals, forming a bridge between textbooks and real specimens. And its flexible search options provide plenty of scope for exploring the general stratigraphical and palaeogeographical contexts of fossil taxa. The relatively modest numbers of genera illustrated, however, will restrict its scope as an aid to classification mostly to rather broad groupings. Someone wanting to sort out what they had collected from the X Formation in Yshire would be better off with the Palaeontological Association's various *Field Guides to Fossils*, or even those perennial warhorses of student field-trips, the Museum's own *British Palaeozoic, Mesozoic* and *Caenozoic Fossils*. In conclusion, although I think that the concept is splendid, and the product will probably prove a useful accessory both for practical classes and associated home study, I am left with a slight feeling of disappointment that the opportunity provided by the technology for significantly greater coverage was not grasped. If this product does catch on as a teaching aid (as the concept deserves to do), then maybe its content could be beefed up progressively in subsequent editions. Indeed, perhaps the website might take on a more active role in this respect, by providing an interface for users to contribute their own exercises and/or images.

Peter Skelton

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REES, P. M. & CLEAL, C. J. 2004. *Lower Jurassic Floras from Hope Bay and Botany Bay, Antarctica*. Special Papers in Palaeontology no. 72. 89 pp. London: The Palaeontological Association. Price £42.00 (paperback). ISBN 0 901702 83 8.
doi:10.1017/S0016756805230777

It is hard to imagine that dense vegetation once grew on Antarctica. These Mesozoic polar forests are currently the focus of intense international research because they may provide an ancient analogue for how the Earth's poles will respond to long-term global warming in the future. Rees & Cleal's book examines one of the most diverse and important of the Antarctic plant fossil assemblages, the Lower Jurassic flora of Hope Bay and Botany Bay. Their technical volume is largely devoted to giving a comprehensive and up to date description of the flora. Judged within this limited frame of reference, Rees & Cleal have certainly produced an excellent monograph. Their systematic description is really meticulous and draws upon several large and previously unstudied plant fossil collections, contributing much to our knowledge of Antarctic biotas. A particularly impressive feature of this publication is its many high-quality, full-page photographic plates (twenty in total), which illustrate the flora in exceptional detail. In fact some of the plates are truly works of art in their own right! The weakest part of the work is the final section, which deals with plant palaeocology. There is a laudable attempt quantitatively to analyse fossil plant assemblages within their sedimentary environment to elucidate community heterogeneity and structure. However, the sedimentary context that Rees & Cleal provide is so sketchy that meaningful patterns are indecipherable. The authors might have been better to leave this part out as it detracts somewhat from an otherwise well-executed fossil plant monograph.

Who will be interested in buying this book? True, its highly technical nature limits its appeal. That said, it will be an essential read for all palaeobotanists and a 'real must' for those working on the Mesozoic evolution of Antarctic ecosystems and climates. The Antarctic Peninsula, from where Rees & Cleal's fossils derive, has recently witnessed an extraordinarily rapid period of climatic warming. Regional mean annual temperature has increased by 2.1 °C over the past fifty years (roughly equivalent to London's climate warming to that of Nice). Given the pace at which atmospheric levels of carbon dioxide continues to rise, perhaps it won't be too long before forests grow once again under Antarctica's midnight sun.

Howard J. Falcon-Lang

RASNITSYN, A. P. & QUICKE, D. L. J. (eds) 2002. *History of Insects*. xii + 517 pp. Dordrecht, Boston, London: Kluwer Academic Publishers. Price Euros 240.00, US $224.00, £149.00 (hard covers). ISBN 0 4020 0026 X.
doi:10.1017/S0016756805240773

'Insects are not dinosaurs' is the slightly self-deprecating comment which opens this massive volume. Small for the most part insects may be, but this wonderful volume goes a substantial way to answering the rest of this opening quotation '. . . and they probably pose us more strange puzzles and unexpected questions'. How very true, and in this epochal book the reviewer is hard-pushed to give even a summary, such is the diversity and range of the material presented. It is also, one must mention, a monument to one of the principal strengths of Soviet, now Russian, palaeontology in that the editors have ably brought together the contributions of no less than 22 palaeo-entomologists based in Moscow.

The heart of the book is a detailed exposition of all the principal insect groups in terms of their chief characters and

fossil representatives, as well as phylogenies with not only character states but detailed stratigraphies. These alone will be a major data source for all those interested in the wider patterns to the history of life. Group by group the major taxonomic divisions of insects roll past the reader's eye, the text well illustrated with fossil specimens, many, many wings with their beautiful venation patterns, and some very striking reconstructions including insects in combat, either with each other or a fish. There is, therefore, much to catch the reader's attention, and a close reading is recommended because embedded in the text are innumerable comments of interest to any evolutionary biologist, be it examples of parallelism, inferred ecology or even the ability to spin that marvel of arthropod bio-engineering, silk.

It is commonly remarked that a stroll in a Carboniferous forest would yield many strange sights, not least the titanic lepidodendron trees, but amongst the more familiar sights would be cockroaches and dragonflies, the one of generally repulsive interest, the other a continuing source of wonder. The Carboniferous is indeed one of the key intervals of insect evolution, most notably with the apparently abrupt appearance of flight. But each geological period has its own highlights and idiosyncrasies of insect diversification and extinction. It is, therefore, fitting that a substantial part of the book deals with the geological history of the insects, and here too there are many insights. Consider, for example, the almost total lack of aquatic insects in the Carboniferous. Or the dung-beetles, those masters of waste disposal and already in the Cretaceous busy carting off dinosaur dung. On the other hand this sense of continuity and uniformity can be extended too far, and again and again it is stressed how radical have been the changes. Much is rightly made of insect–plant interactions, which clearly have been one of the main driving forces in terrestrial ecology. However, there are striking differences between then and now. In the Cretaceous, for example, such detritivores as there were seem to have been opportunistic, and there is little evidence of feeding specialists. Similarly, although it is often supposed particular insect–host relationships are very ancient, very few have been directly inherited to the present day. Even in the case of the living ferns and cycads the associated herbivorous insects appear to be relatively recent colonizations rather than archaic associations. This is consistent with the notion of evolutionary relationships being far more labile and dynamic than is sometimes thought. And this is perhaps the main criticism of this otherwise excellent book, to the effect that the authors shy away from modern palaeobiological theory. Even their justified criticisms of cladistic methodologies are somewhat imprecise and do not tackle the fundamental problems of this approach.

But these are minor quibbles. This is a landmark publication, and not only essential for the library of any (palaeo-) entomologist, but any broadly read palaeontologist. Its large size and range of illustrations (although none in colour) go some way to justify its price, but not far enough. A more sensible price would have served to make this volume much more accessible, and I suspect increased sales.

Simon Conway Morris

PECHARSKY, V. K. & ZAVALIJ, P. Y. 2003. *Fundamentals of Powder Diffraction and Structural Characterization of Minerals*. xxiii + 713 pp. + CD-ROM. Dordrecht, Boston, London: Kluwer Academic Publishers. Price Euros 166, US $163, £104 (hard covers). ISBN 1 4020 7365 8.
doi:10.1017/S001675680525077X

The use of powder x-ray has long been a standard method for mineral identification and characterization. Over the last twenty years or so, the methods of diffraction profile fitting, established by Hugo Rietveld, and others, have extended the use of powder diffraction methods to crystal structure refinement, quantitative phase analysis and even *ab initio* crystal structure determination. While the current volume is primarily aimed at materials sciences, the methods are equally applicable to problems in mineralogy and petrology. The primary aim of the author was to provide a suitable undergraduate and graduate text for those interested in pursuing in-depth knowledge of modern powder diffraction methods. The emphasis in the text is on powder diffraction using conventional x-ray sources rather than synchrotron or neutron sources.

The book, which is divided into seven long chapters, covers the fundamentals of crystallography, diffraction, experimental techniques, data processing and phase analysis, unit cell determination, structure determination and refinement. The volume is accompanied by a CD-ROM, containing colour versions of the figures as well as solutions to the problems set within the text. There is also a section giving web-links for users to download software for powder diffraction studies.

This volume will be of great use for postgraduate students and researchers who want to use modern powder methods for phase analysis and structure refinement.

Allan Pring

KRUMBEIN, W. E., PATERSON, D. M. & ZAVARZIN, G. A. (eds) 2003. *Fossil and Recent Biofilms. A Natural History of Life on Earth*. xxi + 482 pp. Dordrecht, Boston, London: Kluwer Academic Publishers. Price Euros 149.00, US $164.00, £103.00 (hard covers). ISBN 1 402 01597 6.
doi:10.1017/S0016756805260776

Individual organisms can obtain mutual benefit by co-existing in close proximity, and this is true even on vastly differing scales. It is for this reason that biofilms can be viewed as the forests or reefs of the microscopic world. All these organic structures, despite their differences in size, exhibit complex architectures, subtle internal ecological differentiation and collective responses to external factors. But whereas we measure forests and reefs in tens to thousands of metres, biofilms are six orders of magnitude smaller.

Biofilms are to bacteria what permanent nucleated settlements – villages and towns – have been to humans for the past 5000 years: sites where complex mutualism is a way of life. The benefits for bacteria in biofilms range widely from protection and physical stability, to enhanced nutrition and exchange of genetic material. They achieve this by excreting polymeric substances that form an adhesive matrix. This both attaches them to a surface and provides a flexible protective medium for them to live in. In the Preface to this book, Costerton & Stoodley make the case that the biofilm phenotype has been fundamental to bacterial evolution. They contrast it with the planktic lifestyle and suggest that it offers protection from both bacteriophage and predatory amoebae. At intervals, bacteria detach from biofilms, and disperse to

colonize fresh substrates, thus propagating their elaborate way of life.

Bacterial biofilms have thicknesses typically measured in hundreds of microns, so it is not surprising that they were largely overlooked until about thirty years ago. In Chapter 1, Wolfgang Krumbein and his colleagues attribute introduction of the term biofilm to K. C. Marshall in his book *Interfaces in Microbial Ecology* (Harvard University Press, 1976). It is now recognized that biofilms are ubiquitous in Earth-surface environments at the interfaces between solids and aquatic fluids, whether these be within or upon organisms, or on sediments or rocks. Hence the melding of geology and microbiology.

Biofilms can stabilize sediment and promote the preservation of soft-bodied fossils. They are most effective – and certainly most recognizable – if the biofilm itself is impregnated by mineral precipitation. Although biofilms are typically very thin their accretion and lithification at the same site can result in macroscopic structures. And it is in this guise that geologists have been aware of biofilm-related structures for over 100 years, because biofilm's larger siblings are microbial mats, whose lithification results in stromatolites.

The breadth of this book reflects a burgeoning field, and anyone thinking that it is just about biofilm should take note of the subtitle. The coverage is idiosyncratic and eclectic, but above all stimulating. Everything is here: organisms, interrelationships, environments, processes, and products, from the Archaean to the present day, from aquatic to subaerial, and from Earth even to Mars. For the specialist, this approach works, but it does not offer easy solutions. Just as terminological wrangling beset reef studies, so here we find, for example, no clear distinctions between biofilm and microbial mat. On the other hand, by including almost everything one could think of to do with biofilms, the editors succeed in communicating their indefatigable enthusiasm and belief in the wide significance of biofilm studies for geomicrobiology. This is a provocative, stimulating and useful book.

Robert Riding

WENK, H.-R. & BULAKH, A. 2004. *Minerals. Their Constitution and Origin*. xxii + 646 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £95.00, US $130.00 (hard covers), £35.00, US $70.00 (paperback). ISBN 0 521 82238 6; 0 521 52958 1 (pb). doi:10.1017/S0016756805270772

The focus of this new textbook is very much on a modern view of mineral sciences with an emphasis of minerals in the context of mineral forming environments. The book fills the gap in the market between *Introduction to Mineral Sciences* by Andrew Putnis (also published by Cambridge University Press) and the more traditional mineralogy textbooks like Klein's *Mineral Sciences* or Nesse's *Introduction to Mineralogy*. Putnis' *Introduction to Mineral Sciences* is arguably the most innovative and important book written in mineralogy in the last 30 years, but it was not written as an undergraduate textbook for geologists and is difficult to adapt to that purpose.

Wenk & Bulakh have set out to write an undergraduate textbook that covers both the traditional areas of a one-semester course for undergraduates (crystallography, hand specimen identification and mineral optics) and the emerging areas of the physics and chemistry of minerals. Throughout the text emphasis is placed on linking mineral properties to broader geological processes. The traditional mineral groups, native elements, sulphides, halides, etc., are treated in the context of mineralizing environments. The essential details of symmetry, physical and optical properties for the important minerals are summarized in tables within the mineral group chapters. Although the space group symmetry is given for the minerals, the authors decided to omit unit cell parameter information, an omission I find hard to understand. Overall I found this treatment of minerals by formation environment refreshing and useful. By necessity the treatment crosses over into areas more traditionally covered in petrology and geochemistry and thus may help integrate the mineralogy course with other aspects of earth sciences.

The structure of the book is simple and logical. The chapters are grouped in to five sections: Structural Features of Minerals; Physical Investigation of Minerals; Variety of Minerals and Mineral-forming Processes; A Systematic Look at Mineral Groups; Applied Mineralogy. There are also appendices containing determinative tables for hand-specimen identification, determinative tables for optical mineralogy and a glossary.

The authors have divided material into core and optional chapters, to fit in with their view of a one-semester course. I could not fault their treatment of core material; the presentation is clear, concise and logical and illustrated with clean crisp diagrams. I particularly like the chapter on mineral genesis, which contains a very good section on the kinetics of mineral growth and there is even a table giving estimates of mineral growth rates for a variety of species growing under a wide variety of geological environments. As a museum curator I am frequently asked how long it has taken for this or that crystal to grow. The final four chapters of the book (cement minerals; minerals and human health; mineral composition of the solar system; mineral composition of the Earth) are also excellent and I think would make wonderful starting points for student essays. There is a very detailed reference list, which contains full citation for references, even back to the 18th and 19th centuries and a useful glossary of terms.

The authors and publishers are to be congratulated for producing a wonderful and useful book. The volume also contains a selection of beautiful colour photographs of minerals, grouped together in blocks of plates rather than placed within text. In doing this I fear they have lost much of their impact and usefulness and I question their value in this format.

In summary, this is a refreshing new mineral textbook and is a wonderful resource to freshen up an undergraduate course. Every lecturer who teaches mineralogy and every Earth Sciences library should get a copy. Whether it should be used as a course textbook is more a matter of personal taste. Very highly recommended.

Allan Pring

MASSA, W. 2004. *Crystal Structure Determination*, 2nd ed. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 44.95 (+VAT at local rate), SFr 82.00, £34.50, US $49.95 (hard covers). ISBN 3 540 20644 2. doi:10.1017/S0016756805280779

Crystallography textbooks tend to have long shelf lives, so the announcement of a 'second completely updated

edition' of Werner Massa's book, within a few years of the first, was a slight surprise. However, the rapid advance in crystallographic techniques in recent years – in large part fuelled by the development of solid-state detector systems – has catapulted this allegedly 'dusty' subject into the forefront of high-tech science. It is to Professor Massa's credit that he has sought to keep up with many of these advances, devoting much of his book to current techniques. Whether or not this counts as a completely updated edition is another matter; much of the book is identical to the previous edition, although the updated sections on experimental methods and a revised structure solution tutorial are very welcome.

This book, as its title suggests, is concerned primarily with the aspects of crystallography relating to solving crystal structures. It is not intended as, and does not provide, a full and comprehensive tract on the subject as a whole. Important subject areas such as powder diffraction are barely mentioned. This is a firmly focused approach, serving to guide the advanced student or researcher, single crystal in hand, safely through the realms of 'black box' laboratory techniques, and onto that elusive crystal structure refinement.

The first half of this book provides an essential exposition to the subsequent description of experimental techniques. We begin with a traditional review of crystallographic concepts, starting with unit cells and lattices, and proceeding rapidly to x-ray diffraction and its mathematical description, via the Laue and Bragg equations. A full three-dimensional treatment inevitably leads into a discussion of the Reciprocal Lattice and Ewald Sphere construction. Having considered diffraction from point scatterers in an idealized lattice, we next focus on real atoms in the unit cells. This introduces concepts of atomic scattering factors, atomic displacement factors and structure factors.

Professor Massa includes a good overall summary of point and spacegroup symmetry – essential background for macroscopic symmetry and understanding systematically-absent reflections in diffraction patterns. A discussion of group/sub-group relationships is also included, which is useful when considering phase transitions.

An extended chapter on experimental methods covers single-crystal techniques that one might encounter in a modern x-ray lab, including helpful tips on choosing and mounting a suitable crystal. In this second edition, the treatment of film methods has been dramatically curtailed, to make room for an expanded section on area detectors – CCD and image plate systems – which are fast replacing traditional film and diffractometer techniques.

Having established how to collect diffraction data from a single crystal, the author now turns his attention to how such data should be processed in order to 'solve' the crystal structure. Patterson synthesis, so-called 'direct methods' and general strategies are discussed, before embarking on a detailed description of least-squares methods. Whilst such methods are described in many other crystallography textbooks, the present text is distinguished by its attention to the *practicalities* of working with real crystals. The effects of anomalous dispersion, chiral and polar space groups, extinction, thermal diffuse scattering, etc., are all well described and there is an entire chapter devoted to 'errors and pitfalls'. This culminates in a final, worked example of a structure determination (which now describes area-collector diffraction methods).

A revised section on computer graphics programs remains curiously idiosyncratic, neglecting some of the more important (and useful) programs. The following section, on computer databases, contains little new material, although there are now several pages devoted to screen shots of database programs. Why authors and publishers persist in doing this eludes me: this hardbound textbook will probably be around for much longer than any of these programs, and certainly their current interfaces. Maybe the transient nature of crystallographic computing will be addressed in a third edition?

Reservations aside, this is a high-quality, handy-sized reference book which will be invaluable to anyone who has an interest in crystal structure refinement.

David C. Palmer

YOUNG, G. C. (ed.) 2004. *Lower Vertebrates from the Palaeozoic. First International Palaeontological Congress, Sydney, Australia, July 2002. Proceedings of Symposium 6 [Palaeozoic Vertebrates]*. iv + 123 pp. Fossils & Strata no. 50. Oslo: Taylor & Francis. Price US $40.00 (paperback). ISSN 0300-9491. doi:10.1017/S0016756805290775

Studies in lower vertebrate evolution have of late been receiving increasing attention in the high profile scientific journals such as *Nature* and *Science* due to new discoveries that have elucidated some of the fundamental stages in the evolution of fishes through to tetrapods. Australia has been one of the places, along with China and North America, where recent discoveries have greatly contributed to the debate on the early radiations of osteichthyan fishes. It was no surprise then that as the call for papers for a specialist symposium on Palaeozoic vertebrates went out as part of the first International Palaeontological Congress in Sydney (for July 2002), a number of international researchers responded to the call and eventually contributed to a successful meeting. The result is this volume of eight papers, edited by Gavin Young, which covers all the major groups of early fishes from heterostracan agnathans, placoderms, sharks, acanthodians, sarcopterygians and tetrapods.

Vincent Pernegre's paper on pteraspidiform biostratigraphy from the Lower Devonian Wood Bay Group of Spitsbergen indentifies two new species of *Doryaspis* and *Gigantaspis*, which enable a more precise correlation to the Severnaya Zemlya sequence. Carole Burrow's paper on acanthodian jaw bones introduces *Acanthodopsis russelli* from Australia and confirms an earlier idea that *Acanthodopsis* is really a toothed acanthodiform fish, not an ischnacanthid. Gavin Young and Carole Burrow describe acanthodian remains from the Aztec Siltstone of Antarctica, including a new genus of diplacanthid, *Milesacanthus antarctica*, known from relatively complete remains. Vincent Dupres provides a phylogenetic analyis of basal arthrodiran placoderms, placing phyllolepids within higher 'actinolepidoids' (a paraphyletic group).

Alex Ritchie presents a new genus of primitive groenlandaspidid arthrodire, *Mulgaspis*, known from two new species (*M. evansorum, M. altus*) from the Eifelian Mulga Downs Group of New South Wales. Alexander Ivanvov and Olga Rodina from Russia describe a new basal Late Devonian phoebodontid shark, *Siberiodu mirabilis*, from western Siberia. The new genus, known from teeth, ranges from the *crepida–expansa* zones of the Famennian and will be useful for biostratigraphers. Gael Clement and Philippe Janvier describe a new species of the enigmatic sarcopterygian *Powichthys*, *P. spitsbergensis*, providing much new anatomical data from 3D mechanically prepared skulls.

Their work shows that *Powichthys* is not a porolepiform, but has a mixed suite of basal and advanced sarcopterygian features. The final paper in the volume by Stuart Sumida, David Berman, David Ebert and Amy Henrici gives a review of the palaeoecology of the well-known Lower Permian German vertebrate site at Bromacher, highlighting the strictly 'terrestrial' aspects of the site.

The volume has high quality black-and-white plates with clear line diagrams and stratigraphic charts. It has something that will appeal to all those interested in lower vertebrate palaeontology, Palaeozoic biostratigraphy and biogeography.

John Long

HARRIES, P. J. (ed.) 2003. *High-Resolution Approaches in Stratigraphic Paleontology*. Topics in Geobiology Series Volume 21. xv + 474 pp. + CD-ROM. Dordrecht, Boston, London: Kluwer. Price Euros 159.00, US $175.00, £110.00 (hard covers). ISBN 1 4020 1443 0. doi:10.1017/S001675680530077X

High-Resolution Approaches in Stratigraphic Paleontology is a collection of essays on aspects of biostratigraphy including elements of litho-, sequence and event stratigraphy. With one New Zealand exception, all the authors are based in the USA. Of the thirteen chapters presented, seven are based largely on studies of the Cretaceous faunas of the Western Interior Seaway, reflecting the major contribution that this region has made to stratigraphic studies. There are single contributions from the Cambrian, Ordovician and Devonian of the USA. It is difficult to review the book as a whole, because of the very varied composition of the contributions, but the following comments relate to the individually authored chapters.

Kowalewski & Bambach introduce 'The Limits of Paleontological Resolution' with a very thorough and detailed review of the developments and precision in the various techniques of biostratigraphic dating. They examine three primary viewpoints: depositional resolution of palaeontological records, diastems and stratigraphic resolution, and palaeontological resolution. If you have time for nothing else, read this chapter.

Sadler & Cooper examined 'Best-Fit Intervals and Consensus Sequences: Comparison of Resolving Power of Traditional Biostratigraphy and Computer-Assisted Correlation'. This is an important set of case studies using Cambrian trilobites from the Riley Formation of Texas, integration of graptolites, conodonts and bentonites from the Ordovician of the Mowhawk Valley, New York, world-wide Cambrian to Devonian graptolite with bentonite time control, and integrated seismic cross sections with microfossils from wells in the Taranaki Basin of New Zealand. Correlations were achieved with various computer programs including CONOP9 (CD enclosed with book). Solution times ranged from 30 seconds to 17 days! Webster, Sadler, Kooser & Fowler again used the CONOP9 programme in 'Combining Stratigraphic Sections and Museum Collections to Increase Biostratigraphic Resolution: Application to Lower Cambrian Trilobites from Southern California'. Their approach allows integration of museum material which contains vital data on taxa associations. Savrda's 'Zoophycos, Systematic Stratigraphic Leaking, and Lamella Stratigraphy – Do Some Spreiten Contain a Unique Record of High-Frequency Depositional Dynamics?' examined bioturbation and its potential to reduce stratigraphic resolution.

Landman, Klofak & Sarg's 'Variation in Adult Size of Scaphitid Ammonites from the Upper Cretaceous Pierre Shale and Fox Hills Formation' confirmed sexual dimorphism. They found that the adult size of macroconchs sometimes showed variation across the Western Interior, but at other times did not, so reflecting some sort of palaeoenvironmental control. The fluctuation in shell size, lacking unidirectional change with time, reflected evolutionary stasis.

Yacobucci studied 'Controls on Shell Shape in Acanthoceratid Ammonites from the Cenomanian–Turonian Western Interior Seaway'. Although she concluded that ammonoid morphology reflected the complex interaction of environmental, developmental, and genetic factors, major environmental events did not affect greatly the shell shape, thus reinforcing the value of ammonoids in biostratigraphy.

Harries' 'A Reappraisal of the Relationship between Sea Level and Species Richness' used the Albian to Maastrichtian inoceramid succession of the Western Interior Seaway to conclude that sea level change played a small role in the regulation of inoceramid diversity. He compared his observed cyclothems to the Hancock sea-level curve. In the appendix for each biozone is given the timing including duration, inoceramid species richness, evolutionary rate, and relative sea level. The duration of the biozones ranged from 0.00 (!) and 0.1 to 1.3 Ma.

Eaton & Kirkland looked at 'Diversity Patterns on Nonmarine Cretaceous Vertebrates of the Western Interior Basin'. Aquatic and terrestrial genera were distinguished. Both groups showed an increase in diversity at order, family and genus levels in the Barremian–Albian, a levelling off or very gentle decline until about the Santonian, followed by rise into the Maastrichtian. The Cenomanian–Turonian extinction event affects aquatic orders, possibly related to elimination of flood-plain-dwelling orders. End-Campanian generic reduction appears to correlate with transgression, and diversity falls with the sea level in the Maastrichtian. Changing palaeotemperature and angiosperm development impacts upon the faunas. However, the authors believe that the data must be made more robust before more detailed conclusions can be made. A useful appendix lists all orders, families and genera of nonmarine vertebrates recorded from the Barremian to the Maastrichtian of the Western Interior Basin.

Brett, Algo & McLaughlin studied the 'Use of Event Beds and Sedimentary Cycles in High-Resolution Stratigraphic Correlation of Lithologically Repetitive Successions – the Upper Ordovician Kope Formation of Northern Kentucky and Southern Ohio'. This resulted in the recognition of eight decameter-scale cycles and 40 one-metre-scale cycles across Kentucky. Correlation was improved by the use of event horizons featuring faunal epiboles, trace fossils, taphonomic features, and sedimentary structures. Allocyclic forcing was probably controlled by glacio-eustasy.

Morrow & Sandberg examined the 'Late Devonian Sequence and Event Stratigraphy across the Frasnian–Famennian (F–F) Boundary, Utah and Nevada'. This time interval contains the Late Frasnian mass extinction event. Ranging from inner shelf, outer shelf, slope to basinal settings, nine sections were analysed in very great detail with conodont biostratigraphic control. Event resolution was claimed to the level of 210 and even 100 ka.

Carpenter analysed 'Vertebrate Biostratigrphy of the Smoky Hill Chalk (Niobrara Formation) and the Sharon Springs Member (Pierre Shale)', within seven molluscan and vertebrate biozones of Coniacian to Campanian age. Although providing an important summary of the vertebrate

distribution, biostratigraphic resolution was not appreciably refined. The relationship between sea level change and vertebrate diversity did not appear to follow regular patterns and further research is needed on understanding the faunal turnover.

Kauffman studied 'Limestone Concretions as Near-Isochronous Surfaces: a Cretaceous Example from the Western Interior of North America', demonstrating that beds of concretions were 'synchronous' within biozones which averaged from 0.2 to 0.8 Ma duration. Their origin is biological and they nucleated on widespread molluscan event horizons.

Although the volume is generally well written and clearly illustrated, unfortunately it is marred by a number of minor errors such as the mis-spelling 'paleotnologic' in the preface, and there are at least two complete full line errors in the Contents. There is even an error in one of the chapter titles. These suggest a rather sloppy final checking process. Although individual chapters do not have abstracts or key-wording, each has a contents list and there is a valuable index. The composition of the book is no doubt influenced by Harries' own deep involvement in the Cretaceous of the Western Interior Seaway. The addition of the Palaeozoic chapters broadens the stratigraphic coverage. This is a stimulating collection of papers, which should appeal not just to those involved in biostratigraphy, but also those specifically interested in the Cretaceous Period. However, the price at over £100 for the British market is high, meaning that this volume is probably only for libraries, but the cost does include the important CD CONOP9, the use of which is ably demonstrated in several chapters, and shows great potential.

Simon R. A. Kelly

HERZFELD, U. C. 2004. *Atlas of Antarctica. Topographic Maps from Geostatistical Analysis of Satellite Radar Altimeter Data*. xvi + 364 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 149.95 (+ VAT at local rate), SFr 254.00, £115.50, US $159.00 (hard covers). ISBN 3 540 43457 7.
doi:10.1017/S0016756805310776

Think for a while about the vast area of Antarctica that is covered by gently sloping ice. Much of that area, especially in the interior of the continent, has neither been visited on the ground, nor covered in detail by air-borne surveys. How are topographic contours to be drawn on maps of such areas? The answer is either by joining up the few available dots and tracks aided by guesswork, or by using satellite radar altimetry. Herzfeld's book presents a new series of maps of Antarctica derived from satellite radar altimeter data showing topography of the ice/snow surface. This is therefore a valuable contribution to Antarctic studies.

Despite the main title, this book is certainly not a general atlas of Antarctica; it contains no systematically presented information on geology, biology, climatology or human activities, and the maps are based on the radar altimeter data alone. The emphasis is strictly on glaciological features. The series of maps shows Antarctica and its ice shelves between 63° and 81.5° S. The coverage is complete and overlapping. The data used are from the GEOSAT satellite (1985–1986 data used), covering latitudes 63° to 72.1° S and the ERS-1 satellite (1995 data) covering latitudes 63° to 81.5° S. The absence of data south of 81.5° means that there is a hole in coverage around the South Pole, but most of Antarctica, and nearly all its coastline, is adequately covered. Dual maps are presented of the areas covered by both data sets. Although some cartographers might quibble about the use of the UTM projection for the maps, the result is an excellent coverage of most of the continent.

The book explains various satellite data sets available for Antarctica, particularly the radar altimeter data. It explains in detail the geostatistical treatment used, and the map production. Most of the book is devoted to presentation of the maps at 1:5 000 000 scale, with descriptions of their glaciological features, and some brief notes on the history of exploration and the origin of some of the names of each region. The radar altimeter data produce good representation of the topography of relatively flat, ice-covered areas – i.e. most of the continent. Major ice streams and ice shelves appear to be accurately depicted. On the other hand, the method is much less successful in areas of steep terrain. The maps of mountainous regions of Antarctica, notably the Antarctic Peninsula and the Ellsworth Mountains, are therefore very poor and of limited value. Cliffs forming the ice fronts of ice shelves and coastlines are also relatively poorly depicted; the reasons for these weaknesses in the data are clearly explained in the book. The last part of the book is an account of how radar altimeter data can be used to map critical features of glaciers such as grounding lines, and to track scientifically important changes in glaciers and ice shelves over time. The case is made that radar altimeter data can be used to monitor changes in glacier topography related to climate change and surge events. This book is an important contribution and groups working in glaciology and remote sensing of polar regions should not allow the rather poor editing of the book, and the slightly eclectic referencing, to deter them from buying a copy.

Philip T. Leat

WILSON, M., NEUMANN, E.-R., DAVIES, G. R., TIMMERMAN, M. J., HEEREMANS, M. & LARSEN, B. T. (eds) 2004. *Permo-Carboniferous Magmatism and Rifting in Europe*. Geological Society Special Publication no. 223. viii + 498 pp. London, Bath: Geological Society of London. Price £95.00, US $159.00; GSL members' price £47.50, US $79.00; AAPG/SEPM/GSA/RAS/EFG/PESGB members' price £57.00, US $95.00 (hard covers). ISBN 1 86239 152 1.
doi:10.1017/S0016756805320772

This volume, another in the excellent Special Publication series produced by the Geological Society of London, presents the results of an international research project on Permo-Carboniferous rifting (PCR) in Europe. The project was funded by the European Commission, together with logistic support from other organizations and petroleum companies. The breadth of material is impressive and the overall production is excellent. As with all Special Publications, the various contributions have been peer-reviewed and are of a high standard, ensuring wide circulation. Having been involved with the editing of one of these Geological Society volumes, and the difficulties in dealing with tardy contributors, I congratulate the editors on bringing together twenty papers to produce a coherent and comprehensive account of Permo-Carboniferous igneous rocks from throughout

Europe. The quality of the figures is somewhat variable and no specific house style is adhered to; however, reproduction is excellent.

The volume gets underway with a useful introduction by the editors and an explanation of the main objectives of the PCR project. A chronology of events is presented for both the foreland and the Variscan Orogenic Belt, using data from the various contributions. The editors then present a 'map' of the volume, guiding the reader to the key aspects of each contribution.

In the following nineteen contributions, the various papers describe aspects of the magmatism, associated tectonism, geochemistry and geochronology on a variety of scales, ranging from broad overviews to more specific studies. The role of a mantle plume (or plumes) is discussed in a number of the contributions and arguments are put for and against its involvement. Briefly, papers by Neumann *et al*. and Timmerman present reviews on the interplay of rifting and magmatism in northern Europe and the geodynamic setting and character of PCR magmatism, respectively. Heeremans *et al*. provide a commentary to a useful new map that depicts late Carboniferous and Permian sedimentary basins and igneous rocks. Subsequent papers deal with more area-specific studies.

For those not familiar with this wide-ranging province, this volume offers a very useful route into current thinking, each paper being supported by an extensive reference list. At a more general level, the volume covers just about every conceivable aspect of magmatism, from melt generation, through crustal ascent and differentation, to final emplacement or eruption. The roles played by regional and local stress fields are investigated and explanations offered as to how magmatism and tectonism are linked. All things considered, there is something for everyone in this volume!

I very much like the Special Publication format, bringing together papers that deal with one (either broad or more focused) theme. This allows for a degree of integration and archives our knowledge and opinions at a specific point in time. We should be grateful that the Geological Society of London has produced such a wide-ranging series of monographs – long may this continue.

Brian Bell

GROCOTT, J., MCCAFFREY, K. J. W., TAYLOR, G. & TIKOFF, B. (eds) 2004. *Vertical Coupling and Decoupling in the Lithosphere*. Geological Society Special Publication no. 227. vii + 344 pp. London, Bath: Geological Society of London. Price £80.00, US $134.00; GSL members' price £40.00, US $67.00; AAPG/SEPM/GSA/RAS/EFG/PESGB members' price £48.00, US $80.00 (hard covers). ISBN 1 86239 159 9.
doi:10.1017/S0016756805330779

Introducing the concept of 'rheologically layered lithosphere' in tectonic studies was the source of severe headaches for geoscientists eager to better understand how the lithosphere deforms. Could you imagine the mechanical behaviour of a multilayer involving a ductile lower/middle lithospheric mantle, a rigid (or is it softened by water?) uppermost lithospheric mantle, a rigid (or is it extremely soft?) lower crust, a low-strength, ductile middle crust and a brittle upper crust? This rheological layering raises a series of fundamental questions on the mechanics of the lithosphere. How is the necessary mechanical/kinematic compatibility between these layers maintained? Are these layers mechanically decoupled or coupled? Does the lithospheric mantle play a major or a subsidiary role in orogenic processes? And many others . . .

When the first lithospheric rheological profiles suggesting alternating strong and soft layers were published, many of us believed that strength contrasts between the different layers should result in the development of one or several decoupling horizons within the lithosphere. This belief had a major advantage: it was possible to deal separately with the deformation of the lithospheric mantle, of the lower crust and of the upper and middle crust.

It became rapidly obvious that these rheological models were far too simplistic. A certain degree of coherence should exist within the crust and between the crust and lithospheric mantle. The concept of attachment was thus introduced to express the incomplete coupling of layers of contrasted strength. One major consequence of the attachment, or 'clutch tectonics' concept, is that displacements are transferred from one lithospheric layer to the other. It is therefore necessary to consider deformation processes at the lithospheric scale. This is, I think, the main characteristic shared by the papers published in '*Vertical Coupling and Decoupling in the Lithosphere*' edited by J. Grocott, K. J. W. McCaffrey, G. Taylor, and B. Tikoff. The authors have accepted the complexity of this approach, and, as a result, many interesting questions have been tackled.

It would be fastidious to make an exhaustive list of important issues I found in this book – better to read it. I will however highlight a few points that, perhaps due to my own interests, seemed to me of major importance. Several contributions converge to suggest that the degree of complexity is even larger than initially thought. On the one hand, lateral crustal or lithospheric heterogeneities are thought to control the lateral and vertical strain propagation, and thus the degree and modalities of vertical coupling. On the other hand, lateral variations in the style and magnitude of deformation/exhumation might reflect variations in the degree of vertical coupling. This suggests that the deformation of the lithosphere is strongly controlled by interfering vertical and lateral heterogeneities. High- and low-angle shear zones play the role of attachment zones between contiguous blocks that may accommodate deformation in a different way.

A basic, still unresolved question is how deformation is driven: is it from below (the mantle entrains the crust through an attachment system); from above (the upper crust drives the whole lithosphere); or laterally (structurally different domains of an orogen are clutched together by transcurrent shear zones)? The importance of this issue is not only academic; better understanding of strain transmission across the lithosphere would help to better understand the cycle of energy accumulation and release in seismic domains. A participation of the mantle in the deformation of orogenic areas is supported by the results published in this book. Indeed, the suggestion is made that deformation of continents is driven from below, and transmitted to upper levels and laterally by attachment zones. This model is applied, for instance, to explain vertical-axis rotation of 'rigid' blocks. The blocks, bounded laterally by discrete faults, rotate due to mantle flow in a broad transcurrent domain. A flat-lying shear zone attaches both parts of the system.

Vertical Coupling and Decoupling in the Lithosphere provides a lot of new and interesting ideas and examples coming from various domains of Earth Sciences (structural geology, seismic anisotropy analysis, numerical or analogue

modelling) and from different regions of the world (southern Mexico, western North America, New Zealand, Betic Cordillera, south Greenland). The reader may start his own thinking on the deformation of a more realistic and therefore rheologically and mechanically complex lithosphere. This is a domain of Earth Sciences where progress is needed and is attainable in the next few years.

Alain Vauchez

HAMBREY, M. & ALEAN, J. 2004. *Glaciers*, 2nd ed. xviii + 376 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £35.00, US $60.00 (hard covers). ISBN 0 521 82808 2.
doi:10.1017/S0016756805340775

Over the 12 years since it was first published *Glaciers* has presumably been successful enough for Cambridge University Press to encourage the authors to produce an expanded second edition of this semi-popular and beautifully illustrated science book. An extra 170 pages and a lot more photos have been added for this new edition. Extra chapters cover various aspects of the impact of glaciers on humans and include discussions of both the benefits and hazards associated with glaciers and their future prospects under global warming.

From the geological point of view, the overall emphasis is on modern glaciers although there is a brief discussion of the Earth's past glacial record stretching back to the Precambrian and the 'snowball earth' hypothesis. The level of the text is pitched at the informed general reader and first-year undergraduates, especially geographers. There are hardly any numbers, equations or other technical data but a brief bibliography does however direct readers towards the appropriate textbooks.

As an introduction to an important and interesting subject which has had a huge influence on the development of earth science since the early decades of the 19th century, *Glaciers* provides an excellent readable and authoritative account. My only quibble is that in production something strange has happened to the colour values on a number of the photos so that the snow and ice appear distinctly pink, but perhaps they are just taken from old colour transparencies which have begun to deteriorate.

Douglas Palmer

ELLISON, R. A. 2004. *Geology of London. Special Memoir for 1:50 000 Geological sheets 256 (North London), 257 (Romford), 270 (South London) and 271 (Dartford) (England and Wales)*. x + 114 pp. Keyworth: British Geological Survey. Price £24.00 (paperback). ISBN 0 85272 478 0.
doi:10.1017/S0016756805350771

The geology of the London area has been of interest and concern to its occupants ever since the Romans found that the readily available building materials – wood, reed and mud – were not good enough to defend them against disaffected pyromaniacal locals. Defensive strategies and changing technological demands have continued to drive the geological investigation of the city and its 'urbs' ever since. The most recent extension to the Jubilee Line underground and the Channel Tunnel Rail Link have required the driving of new investigative boreholes from which a great deal of new information about the subsurface geology has been recovered.

These days the geologically related problems of London are more to do with water, both too much and too little. The problems of increasing water extraction from the region have been well known since the 1980s. As described and graphically illustrated in the section on water resources, extraction rates have steadily climbed since the 1830s, doubling every 20 years or so until the 1970s when extraction rates first rose above the natural recharge rate.

In central London the 'original natural groundwater level was 7.5 m above OD' and 'was lowered to around 88 m below OD by the mid 1960s', due to pumping from the innumerable boreholes, with the top of the Chalk being 'dewatered over several square kilometres'. Subsequent reduction in pumping has led to rising levels of groundwater – up to 3 m a year in places but apparently in central London this has now fallen to around 0.5 m/year thanks to 'a combination of natural causes and a strategy to manage water levels'. Probably just in time too for the foundations of many high-rise structures, not to mention the deeper tunnels of the Underground. I do not know how deep the Underground goes but travellers may yet have to wear wellington boots. According to Figure 51, water level seems to have stabilized at around 35 m below OD under Trafalgar Square.

The present *Geology of London* also supplies a variety of information about the different maps that cover the geophysics, geochemistry, hydrogeology, plus reports on the palaeontology, mineralogy, etc., and an excellent bibliography and index. The description of the capital's geology has indeed changed over the last 90 years. The helpful hints that my copy of G. M. Davies' *Geological Excursions in the London Basin* (1914) contains are largely restricted to the problems of travel and refreshment. Then, the cost of the bus fare from East Croydon to Selsdon Road Station was one and a half pence, and tea could be obtained in George Street on the way to East Croydon Station; no doubt it still can be.

Douglas Palmer

LOPES, R. M. C. & GREGG, T. K. P. 2004. *Volcanic Worlds. Exploring the Solar System's Volcanoes*. xxiv + 256 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 54.95 (+ VAT at local rate), SFr 97.50, £42.50, US $59.95 (hard covers). ISBN 3 540 00431 9.
doi:10.1017/S0016756805360778

It is always satisfying to report on a book that is not only up to date and technically informative but also a pleasure to read. This certainly true of *Volcanic Worlds*. After a brief introduction by the editors, Rosaly Lopes and Tracy Gregg, ten chapters follow, each written by a different author (in one case jointly by two authors). All of the contributors are currently very active researchers in planetary volcanology, and taken together these essays give an excellent survey of volcanism, both on the Earth and wherever it is found to occur on other planets and satellites. The standard of production, including the excellent monochrome and colour images, is excellent. This must surely constitute the best popular introduction to planetary volcanism currently available.

This does not claim to be a textbook; no mathematical treatments are used and little time is spent on the geophysics

underlying volcanology. However, the first chapter, by Katharine Cashman, gives detailed descriptions of all of the major volcanic processes found on Earth, and the tectonic settings in which they occur are clearly explained. The Earth's ocean floor is treated next by Tracy Gregg, on the grounds that activity under deep water is sufficiently different from that on land to warrant the introduction of a new viewpoint. The basic ideas gleaned from studying the Earth are then used as the context for examining the types of volcanic features and processes found on each of the other bodies of our Solar System that have undergone or are undergoing silicate volcanism: Venus (treated by Ellan Stofan), the Moon (discussed by Lisa Gaddis), Mars (covered in two chapters, by Susan Sakimoto and Joy Crisp) and Io (described by Rosaly Lopes). There follows a survey by Louise Prockter of the various ice-rich bodies of the outer Solar System that appear to have experienced cryo-volcanism: the eruption of liquid water, commonly contaminated with other volatile compounds. The penultimate chapter, by Mary Chapman & Gudrun Larsen, describes how studies of the deposits from large-scale explosive eruptions on Earth may help us to understand the origin of the widespread sequences of layered rocks which spacecraft images have revealed on Mars. The book closes with a particularly interesting review by Susan Kieffer of how her attention has shifted back and forth over the years between the Earth and several other planetary bodies. This is a an excellent illustration of how the ongoing feedback between studies of volcanoes on Earth and the other planets have stimulated developments in our understanding of the basic processes involved.

I have mentioned all of the contributors to this book by name to underline the fact that all of them are women. In her foreword to the book, ex-astronaut Sally Ride comments not only on the advances over the last couple of decades in volcanology as a subject but also on the fact that there has been a significant increase in the proportion of female scientists working in this field. At a time when women are generally still under-represented amongst the upper echelons of academia I find it very encouraging to be reminded that, at least in planetary volcanology, the glass ceiling is showing strong signs of impending collapse.

Lionel Wilson

GILI, E., NEGRA, M. E. H. & SKELTON, P. W. (eds) 2003. *North African Cretaceous Carbonate Platform Systems*. NATO Science Series IV. Earth and Environmental Sciences Vol. 28. x + 252 pp. Dordrecht, Boston, London: Kluwer Academic Publishers. Price Euros 105.00, US $116.00, £72.00 (hard covers). ISBN 1 402 01606 9.
doi:10.1017/S0016756805370774

This publication arises from a NATO Advanced Workshop held in Tunisia in May 2002. This reviewer opened the book with some anticipation, having worked intermittently for seven years on some problematic Cretaceous reservoirs of a major Tunisian offshore oilfield. The majority of the papers are short. Following a review by Bob Scott on high resolution Cretaceous stratigraphy in North Africa, the next nine chapters are case studies on North African Cretaceous carbonates (one on Morocco, two on Algeria, five on Tunisia, one on the Egypt–Jordan area).

Joseph Canerot *et al*. document the development of carbonate platforms in Morocco through the Jurassic and Cretaceous in the High and Middle Atlas systems, identifying broad tectonic patterns during rifting. Hassen Abdallah discusses the Lower Turonian successions of the Gattar platform in Tunisia, including their diagenesis. Jamel Tour and M. Sussi document the development of two Turonian platforms in central Tunisia, assessing eustatic and tectonic controls, including the Gattar platform. Dalila Zaghbib-Turki provides a compilation of rudist-coral-bearing formations in Tunisia, a theme further developed by Mohamed Zagrarni and colleagues in the next paper. The final Tunisian paper is that of Hedi Negra on the Upper Cretaceous conglomerates of central Tunisia, produced by synsedimentary fracturing and slope processes.

Missoum Herkat documents Cenomanian and Turonian platforms of the eastern Atlasic Domain of the Aures Basin and Zibans High zone of Algeria. Fettouma Chikhi-Aouimeur provides the second Algerian study, on rudists. The final paper on the specific North African theme is that by Jochen Kuss and co-workers on the sequence stratigraphy of the Lavant Platform, through Egypt, Sinai to Jordan. The regional section ends with a paper on the southern Apennines of Italy by Gabriele Carannante *et al.*, on the Senonian rudist-dominated successions.

The second set of papers is more general in content and commences with an integrated study of Lower Aptian carbonates by Jean-Pierre Masse emphasizing stratigraphic tools. This is followed by three rudist papers, and considering the well-known interests of the editors, such a bias towards this important carbonate-producing group is hardly unexpected. Peter Skelton provides a review of the global aspects of rudist evolution and extinction, with a North African perspective. Thomas Steuber discusses the use of Sr isotope chemostratigraphy of rudists, and the final paper is by Eulalia on the use of hippuritids for palaeoenvironmental interpretation. The book also includes an index.

The book serves its purpose in bringing together an accessible collection of papers on North African Cretaceous successions, complemented by short general reviews on Cretaceous themes. The quality of the black-and-white photographs is disappointing in places, and some of the diagrams are not as clearly printed as one might reasonably expect in a book costing £92. However, I am pleased to have a copy but am little the wiser about my problematic offshore successions; that is not the fault of this book but of some weird combination of environmental factors in the Coniacian.

Who should buy a copy? Certainly it should be available in major university libraries where there is a research interest in circum-Mediterranean geology, and likewise the libraries of oil companies (if they still maintain them).

Paul Wright

MICHEL, J.-P., CARPENTER, M. S. N. & FAIRBRIDGE, R. W. 2004. *Dictionnaire des Sciences de la Terre. Anglais/Français, Français/Anglais*, 4th ed. xvi + 496 pp. Paris: Dunod. Price Euros 55.00 (hard covers). ISBN 2 10 008290 6.
doi:10.1017/S0016756805380770

The fourth edition of this Anglais–Français/French–English dictionary is an excellent compact book. It provides a very good reference source and guide for English- and French-speaking geoscientists. The dictionary starts with a fine short account on the methods used to write it. In the first pages, the authors draw the reader's attention to a list of key

references on various conventions, units, symbols, locality names, stratigraphic terms, tectonic terms and nomenclatures used in the dictionary. A good account on translation pitfalls such as the *'faux amis'* is also provided. The stratigraphic time scale used (Odin *et al*. 1990) is somewhat dated, but as this scale is a classic and as recent scales differ only slightly from it, this should be a concern only for specialist stratigraphers as it does not affect the overall quality of the dictionary.

Overall, English (British) and American orthographic and grammatical variations are well accounted for. The length of translations varies enormously in length and depth according to the 'nuances' of meaning one expects for given entries. A useful lexicon of English abbreviations and a simple unit converter list can be found at the end of the dictionary.

As the authors humbly recognise, there is 'no such thing as a one stop dictionary', but I would add that if you need to work on English–French translations their dictionary is definitely worth having close to hand.

Eric J.-P. Blanc

FITTON, J. G., MAHONEY, J. J., WALLACE, P. J. & SAUNDERS, A. D. (eds) 2004. *Origin and Evolution of the Ontong Java Plateau*. Geological Society Special Publication no. 229. vi + 374 pp. London, Bath: Geological Society of London. Price £80.00, US $134.00; GSL members' price £40.00, US $67.00; AAPG/SEPM/GSA/RAS/EFG/PESGB members' price £48.00, US $80.00 (hard covers). ISBN 1 86239 157 2. doi:10.1017/S0016756805390777

This is a fascinating volume and well worth reading by anyone interested in the problems of large igneous provinces (LIPs), mantle plumes, and scientific controversies. The editors' introduction identifies the Ontong Java plateau in the SW Pacific as the most voluminous of the Earth's LIPs with an area similar to that of western Europe representing the products of the largest known magmatic event on the planet. LIPs require some special explanation as they cannot be accounted for by normal plate tectonic processes, and this volume discusses possible causes and some of the problems these face. For the disinterested reader the fascination lies in the fact that all the explanations proposed to account for the Ontong Java plateau have major problems, and it seems that we are still very far from understanding how these major features of the planet are produced.

This is one of two important volumes of papers recently published on the Ontong Java plateau; the other is that edited by Mann & Taira (2004). The two volumes complement one another. Mann & Taira's volume focuses primarily on the structure and collision history of the plateau based on marine geophysical and onland geological observations in the Solomon Islands and surrounding regions. The Fitton *et al*. volume is concerned mainly with the origin of the plateau based on studies of rocks recovered from deep ocean drilling; these are covered in book sections on palaeomagnetic, biostratigraphic, petrological and geochemical studies, and a final section devoted to unusual volcaniclastic rocks found at a single ODP site. There is one paper, by Petterson, which gives an account of what the plateau actually looks like, based on geological mapping on the island of Malaita in the Solomons.

The two principal explanations for the origin of the Ontong Java plateau are magmatism resulting from a rising mantle plume or following an asteroid impact. Both can account for some of the features of the plateau rocks, such as the abundance of chemically very uniform Mg-rich basalts, the evidence of high degrees of mantle melting (about 30%) without indications of hydrous melting, and the apparent short period of magmatism. However, the plume model requires a trail back to the site of the original new hotspot, and although there are several important hot spot tracks in the SW Pacific none seems to be in the right place. The papers on geological evolution and palaeomagnetism further complicate the location of the missing track since there is a continuing debate about whether hotspots are fixed or not. Kroenke *et al*. use a fixed hotspot frame to calculate that the Louisville hot spot was far (about 9°) from the site of formation of the Ontong Java plateau, whereas Antretter *et al*. conclude in the following paper that the Louisville hot spot could still be a candidate, despite a 26° difference between its present latitude and Ontong Java palaeolatitudes, by taking into account polar wander, moving hot spots and non-dipole effects.

The biostratigraphic papers (Sikora & Bergen, and Bergen) keep the debate bubbling. Both plume and impact theories have been proposed to account for a very short-lived magmatic event at about 120 Ma with extremely high eruption rates. The biostratigraphic studies suggests that magmatism may have continued for longer than suggested by isotopic dating, perhaps over a period of about 10 Ma, with the possibility of another magmatic episode in the Eocene.

The geochemical papers provide the evidence for what was melting, under what conditions and how melts evolved. Here again there are controversy and problems. Tejada *et al*. show that some of the isotopic characteristics of Ontong Java basalts are consistent with melting of a lower mantle which had been unmelted since about 3 Ga, supporting a plume model, but they point out some of the problems of the plume hypothesis and discuss alternatives such as an impact origin. Fitton & Godard also favour a plume origin but highlight one of the major problems: the apparent absence of uplift expected above a huge rising plume head, and the deep marine origin of the basalts, as also indicated by studies of volatiles (Roberge *et al*.), biostratigraphy and land observations in the Solomons. Chazey & Neal report evidence that even outer core material may have contributed to melts. There seems to be agreement that large amounts of melting required high mantle temperatures with little evidence for significant H_2O; beyond that it is not clear if the melts originated in the lower or upper mantle, and how a plume model can be adapted to account for features such as evidence for deep marine extrusion, lack of an obvious hot spot and lack of a hotspot trail. None the less, it seems that impact theories face similar, although different, major obstacles (Tejada *et al*.)

The final section in the book deals with unusual pyroclastic rocks found at ODP Site 1184. These were unexpected, suggesting previously unrecorded phreatomagmatic activity which could be subaerial, and their age appears to record a much later episode of magmatism in the Eocene. Thordarson concludes that these rocks are probably Cretaceous subaerial eruptive products, which may indicate that there was some initial elevation of the region as would be expected above a rising plume head. This explanation requires the Eocene nannofossils to have been incorporated in the sequence later, but it is supported by some imprecise $^{40}Ar/^{39}Ar$ ages (Chambers *et al*.) from basaltic clasts in the volcaniclastic sequence.

This review has not identified all the 19 papers in this volume but each makes a valuable contribution to our

knowledge. What would we think of our understanding of continental geology if we had so little information on an area the size of Western Europe? It is fascinating to discover that despite the high quality work reported in this volume, and that in Mann & Taira's (2004) volume, there are still major problems in accounting for the huge volumes of magmatic rocks. The preferred hypothesis is the least worst and accounts for more of the observations than rival hypotheses, as acknowledged by the editors in their introduction, but still leaves important features unexplained or important predictions unfulfilled. One also wonders what is deeper. The introduction and some papers recognise that only the surface of the 30–35 km crust has been scratched, and there is a suggestion by Roberge *et al*. of substantial volumes of cumulates, but there is no significant discussion in any of the papers of what is below the one kilometre or so that has so far been penetrated into the top of the crust of the Ontong Java monster in the SW Pacific. As the ocean drilling programme winds down, and the enthusiasm for science declines, a pessimist might conclude that we will never discover what lies beneath.

Robert Hall

Reference

MANN, P. & TAIRA, A. (eds) 2004. Tectonics, Seismicity and Crustal Structure of the Ontong Java Plateau: Solomon Island Arc Convergent Zone, Southwest Pacific Ocean. *Tectonophysics* **389** (3–4), 125–309.

GROVE, J. M. 2004. *Little Ice Ages. Ancient and Modern. Volumes 1 and 2*, 2nd ed. London, New York: Routledge. xxvi + 402 pp; xiii + pp. 406–718. Price £325.00 (2-volume set); hard covers. ISBN 0 415 33422 5 (Vol. 1); 0 415 33423 3 (Vol. 2); 0 415 09948 X (2-volume set). doi:10.1017/S0016756805400771

This pair of volumes represents a major update and expansion of Jean Grove's *The Little Ice Age* of 1988, and represents a life-time's research by one of the leading exponents of this fascinating period of Earth History. Sadly, Dr Grove died before seeing the fruits of her labours, and final stages of the book were revised and seen through to publication by her husband, Dr Dick Grove.

A large volume of research has been undertaken since the first volume was published, and the concept of the Little Ice Age itself as a Middle Ages to early twentieth century phenomenon has expanded to embrace other cold phases of the Holocene Epoch, hence the revised title. The book consists of three Parts: (1) 'The Little Ice Age of the Second Millennium' (Vol.1); (2) 'The Holocene' covering the glacial history of the whole Holocene Epoch (Vol. 2); and (3) 'Context, Causes and Consequences', which explores broader Quaternary issues.

In more detail, Part 1 covers introductory concepts such as dating. Then regional descriptions are provided of almost every part of the world where glaciers have existed – from the poles to the tropics. Fascinating historical data from the Little Ice Age are combined with the results from the physical record. The impact of the cold period and glacier expansions on human populations, such as failed harvests and floods, are considered. Many useful maps, graphs and tables provide a clear illustration of glacier and climatic fluctuations throughout this period. These are supplemented by black-and-white reproductions of paintings and sketches of Little Ice Age glaciers, and compared with twentieth century photographs. Global perspectives on climate are provided in summing up this part of the book.

Part 2 covers the glacial history of the whole Holocene Epoch and dips into Pleistocene events as well. Background material includes a review of chronologies, constrained especially by radiocarbon dating and palynological records. Once again, a regional approach is taken in dealing with climatic events.

Part 3 places the Little Ice Age in a temporal context. Ice-core and deep-sea sedimentary records are reviewed from the polar regions to the tropics. The focus is on the whole Quaternary Period, but especially the last glacial cycle. The causes of the Little Ice Age are evaluated, with brief summaries of climatic, terrestrial and planetary processes. The consequences of climatic fluctuations that are included in the discussion are sea-level changes, erosion, mass movements, inland sea evolution, floods, and the impacts on the biological and human records.

The book concludes with some 60 pages of references, testifying to the scholarly nature of the work. The two volumes are bound in stylish hardback black covers. Figures are generally well produced, but the reproduction of black-and-white photographs is disappointing. The list price is an almost unbelievable £325, but a check on the 'Amazon' website indicated a price of 'only' £100. Even the reduced price places it out of reach of many libraries and academics. Yet the book is essential reading for all Quaternary researchers. It ought to be listed as a mandatory textbook for senior undergraduates and Masters students, but this is only feasible if the publisher produces a reasonably priced paperback version. I would urge them to do so.

In conclusion, this book is a mine of useful information and fascinating facts. Anyone preparing to work on the Holocene history of any glaciated area in the world would do no better than to read the relevant parts of this book. It provides a lead-in to much of the important literature, and hence is a particularly effective research tool.

Michael J. Hambrey

SELLEY, R. C., COCKS. L. R. M. & PLIMER, I. R. (eds) 2004. *Encyclopedia of Geology* (5 volumes), *Volume 1*: xxxvii + 594 pp; *Volume 2*: xxxvii + 545 pp.; *Volume 3*: xxxvii + 659 pp.; *Volume 4*: xxxvii + 692 pp.; *Volume 5*: xxxvii + 807 pp. Amsterdam: Elsevier. Price (set) £775.00, US $1200.00 (hard covers). ISBN (set) 0 12 636380 3. doi:10.1017/S0016756805410778

Not since the institution of encyclopedias such as the late 19th century British editions of the *Encyclopedia Britannica* have so many experts (some 320) collaborated to produce such an extensive and authoritative collection of essays (some 340) on every aspect of geology from Africa to weathering.

One might question why anyone would want to try and produce such a lavish set of books in this day and age when so much information is available to most students of geology on the internet? Even Dan McKenzie confesses in his foreword that he has 'become addicted to using the Internet as my general encyclopedia' but quickly adds that he will also 'be delighted to be able to access something concerned with my own field that is as organised and scholarly as these volumes'.

A glance at the price of these monumental volumes shows that the publishers cannot be expecting too many individual subscribers but rather are aiming at earth science institutions and their libraries. Even here the cost could burn up a fair bit of annual expenditure in one go.

However, the publishers also say that the encyclopedia will be available online via ScienceDirect as of 2005. From this readers should be able to browse the whole work 'using extensive internal cross-referencing and dynamic linking from bibliographic references to primary-source material' according to the publisher's blurb. Furthermore, all articles will be 'available as full text HTML files, and as PDF files that can be viewed, downloaded or printed in their original print format'. Thus the electronic ScienceDirect version of the *Encyclopedia of Geology* can be purchased according to various contractual arrangements which may be much more suitable for many libraries. I have not been able to 'test run' the online version so I cannot comment on this very important aspect of the publication which will probably the one that most students will see. The real tests of the viability of what is, on paper at least, such a potentially useful project will depend on the cost of online access and the quality and contemporaneity of the information. Will it be upgraded from time to time?

As one would expect from the named editors, the overall production is very well structured and presented and the listed editorial board plus authorship of the articles gives one considerable confidence in the quality of the content. The 37 pages of introductory matter includes a clear guide to usage and list of contents and all this is repeated at the beginning of each of the five volumes. The overall structure is organized around general themes. For instance Volume One (A to E) covers some 40 themes ranging from Africa to Engineering Geology, but a number of the listed themes are cross-referred to other sections; for example, the Alps is dealt with in the article on Europe. One of the interesting foci of this encyclopedia is on good detailed outlines of the geology of whole regions which may be of continental size such as Africa. I think this will be of particular use to students who otherwise would have to hunt around all over the place to find up-to-date discussions (including maps, stratigraphical and structural information) that have an overall global coverage. Volume Five ends with a comprehensive index which is over 200 pages long and provides the core search tool: for instance, according to the index the topic 'palaeontology' has subheadings running from biozones (Vol. 1:294–305), Steno (2:226), and otherwise is scattered throughout all five volumes. However, the well-developed main taxonomic section has 271 pages (2:274–545), running from fossil invertebrates through plants to vertebrates (including hominids) but microfossils are hived off into another 57 pages in Volume 4 (418–475). I find it slightly curious that the geology of beer and whisky should command more pages than the palaeontology of the hominids (7 and 5 pages respectively) but then graptolites get 10 pages. At least *Sahelanthropus* is mentioned but this emphasis is a rather traditional geological perspective in which our own immediate fossil ancestry is downplayed and probably reflects old-fashioned demarcation lines between palaeontology and palaeoanthropology. Nevertheless it is clear that major themes such as palaeontology, plate tectonics, etc., each have coverage that amounts to a substantial book length. I cannot find any topic that would be significant for a first- or second-year undergraduate that is not covered at some length and has reference to a more detailed work.

There is some sort of illustration, ranging from full colour photos and maps to black-and-white graphs and diagrams. Authors have evidently been encouraged to make use of full colour and many have usefuly done so. It makes a huge difference to such a reference work when complex geological maps can be seen in full colour. Modern printing makes a very wide colour palette available. I have not tried to count the maximum number of colours used on any one map but it is probably in excess of a dozen. Sometimes indeed the keys are too small to differentiate clearly between all the different colours. Gone are the days of those gruesome black-and-white maps where some poor author or draftsperson has struggled, often ineptly, to devise some scheme which includes more than half a dozen ornaments. The reproduction standard for colour photos is also invariably good or excellent with little of the pixellation which bedevils so many modern publications.

My sampling of the 'further reading' which ends each article shows a good sprinkling of 2004 references, which suggests that somehow or other the editors have managed to keep the whole enterprise well up to date, which is some achievement considering the number of authors – maybe they sacked the slow-coaches or were very careful in their selection of authors who have contributed to the work.

Only time will provide the final test of durability and relevence. I hope some 'mechanism' is in place which will allow upgrades in the not too distant future, in the way of the *Encyclopedia Britannica*, when so many experts were willing to contribute authoratitive and up-to-date articles for successive editions. Nowadays this should be relatively easy to do for online access but not for such expensive paper editions.

The encyclopedia is part of a series published by Elsevier inaugurated in 1998 with an *Encyclopedia of Geology* and further volumes since then covering *Ocean and Atmospheric Sciences* and *Soils in the Environment*.

Douglas Palmer

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