BOOK REVIEWS

PETERS, K. E., WALTERS, C. C. & MOLDOWAN, J. M. 2005. *The Biomarker Guide. Volume 1: Biomarkers and Isotopes in the Environment and Human History. Volume 2: Biomarkers and Isotopes in Petroleum Exploration and Earth History*. Second Edition. (First edition published 1993 by Chevron Texaco.) 1132 pp. total. Cambridge, New York, Melborne: Cambridge University Press. Price £150.00, US $250.00 (hard covers). ISBN 0 521 83763 4.
doi:10.1017/S0016756806212056

If you are an organic geochemist, or a geologist who has ever made significant use of molecular organic geochemistry data, it is highly probable that you would be familiar already with the first edition of *The Biomarker Guide* (1993). *The Biomarker Guide* was the first, and remains really the only, text to synthesize comprehensively our knowledge of molecular fossils (biomarkers) in petroleum and ancient sediments. Since 1993 the field of organic geochemistry has flourished, and the application of molecular biomarker compounds has both matured and diversified, so an updated edition of *The Biomarker Guide* is therefore timely. The new edition is much longer (just over three times the pages of the first edition and in a larger format), and the scope has also been broadened somewhat, to including the application of biomarkers to pollution and archaeological studies; however, the focus remains primarily petroleum-related.

The first volume (471 pp.) is subtitled 'Biomarkers and Isotopes in the Environment and Human History'. Despite this, of the eleven chapters, there is just one on stable isotopes, one on environment (actually dealing predominantly with oil spills), and one on archaeology (applied mainly to the investigation of man's past use of petroleum products, gums, resins, and beeswax). Together these three chapters total less than 30 % of the main text. Much of the remainder is an update of the first half of the 1993 edition. There is a rather brief introduction to the origin and preservation of organic matter (which 'operates under the working assumption that anoxia is important'), an introduction to basic organic geochemistry, and a chapter on the biochemistry of biomarker compounds (their biosynthesis and role in the living organism). These are followed by a useful review of non-molecular bulk geochemical 'screening' techniques for assessing source rock potential and level of organic maturation (including total organic carbon, Rock-Eval pyrolysis and kerogen microscopy). Something that caught my eye was the very clear and succinct four-page explanation of mass-balance modelling for the reconstruction of initial TOC and hydrogen indices (contributed partly by G. E. Claypool). There are also chapters on refinery oil assays, reviews of the organic geochemical methods for studying biomarkers (including HPLC, GCMS and GCMS/MS) and light (C_7) hydrocarbons, and a final chapter discussing the origins of petroleum (which of course favours an overwhelmingly organic origin).

The second and larger volume (680 pp.) is subtitled 'Biomarkers and Isotopes in Petroleum Exploration and Earth History' and has two approximately equal parts. The first four chapters are the updated equivalent of the second half of the first edition, and focus on the interpretation of biomarker or other compounds applied to oil–oil and oil–source rock correlation (including age diagnostic markers), organic maturation, and assessment of the extent of oil biodegradation. The second half of Volume Two comprises a couple of chapters whose stratigraphic focus and organization represent a significant new departure and explain the inclusion of 'Earth History' in the subtitle. Chapter 17, entitled 'Tectonic and biotic history of the Earth', provides a general review of the evolution of the biosphere, placing this in the context of palaeogeographic changes, palaeoclimatic evolution, extinction events and episodes of source rock deposition. Chapter 18, entitled 'Petroleum systems through time' is essentially a 213-page catalogue of the key major source rocks of the world, arranged mainly stratigraphically (but with some regional detours). For each source rock there are a few paragraphs of text reviewing the key published information on the facies and organic geochemistry, supported variously by 144 maps, sections and S2/TOC or van Krevelen plots (many reproduced from the literature or based on literature data). These summaries are certainly not comprehensive, but would serve as a useful introduction to anyone unfamiliar with these deposits. More uniquely, the source rock reviews are accompanied by 53 geochemical summary sheets from Geomark Research Inc.'s Oil Information Library System; these provide information on the bulk properties of each derived oil, along with a GC trace and terpane and sterane biomarker fragmentograms (with some of the key ratios tabulated). As only actual (mature) source rocks are considered, the literature on potential (as yet entirely immature) or non-commercial source rock facies, including those recovered by DSDP and ODP, is under-represented. As in the first edition, the final chapter is a brief review of areas the authors believe to be in need of further research.

Both of the two volumes include an identical 44-page glossary, and each has its own separate reference list and index. Both volumes are also well illustrated (a total of 744 figures and 77 tables), with seldom a double page without at least one table or black-and-white or half-tone figure. The production standards are good, and the binding appears sturdy. I spotted only a handful of typographical errors and a few misleading page headers. I do not entirely agree with the definitions of some non-biomarker terms in the glossary but this is a very minor quibble. The extensive reference lists give good coverage up to 2002 (thus at least a decade's worth of new information compared to the first edition); there are only about 30 citations from 2003, and just five from 2004, but this is not unexpected given the production schedule of major texts.

If you are a professional or postgraduate molecular organic geochemist, or a member of an institution involved in organic geochemical research, I am sure you will need little persuasion either to purchase your own copy of this new edition of *The Biomarker Guide*, or to recommend its purchase to your librarian. It is the most comprehensive, authoritative, and up to date reference work on the subject, and therefore a 'must have' resource for serious organic geochemists. This aside, those used to the more compact first edition may find the size and extended scope of the new edition makes it rather less of a handy reference by comparison. Despite the useful database of oil properties,

some may also feel that the second half of Volume Two is a shift away from the core focus. Given the way the two volumes are organized, if you want the same subject coverage as in the first edition, you will need both.

What about the non-specialist? The new source rock chapter in Volume Two, and the screening chapter in Volume One, should certainly be of interest to all petroleum geologists and anyone working on ancient organic-rich sediments. If the two volumes are to be sold separately, then the subtitle of Volume One may be a little misleading for potential purchasers as the amount of environmental and archaeological content is limited and might not justify actual purchase for those whose interests lie primarily in that direction. The restriction of the 'environmental' content to essentially oil spills is something of a missed opportunity considering the increasing application of biomarkers in oceanographic, palaeoceanographic, and limnological research. Although 'isotopes' appears in the subtitles of both volumes, the isotopic content is also rather limited; only Chapter 6 (20 pages) is devoted to isotopes (with less than five pages on compound specific isotope studies), and the index includes only 15 entries for stable isotopes in each volume (24 and 15 pages respectively).

Richard Tyson

KILLOPS, S. & KILLOPS, V. 2005. *Introduction to Organic Geochemistry*, 2nd ed. ix + 393 pp. Oxford: Blackwell Publishing. Price £29.99 (paperback). ISBN 0 632 06504 4.
doi:10.1017/S0016756806222052

The authors' preface states that their objective was to produce a readily accessible, up to date and integrated introduction to the field of organic geochemistry, at a reasonable price (£29.99). As with the first (1993) edition, this is arguably the only undergraduate to postgraduate (M.Sc.) level textbook on organic geochemistry that is readily affordable for students. This second edition differs from the first in that the focus is much more general than just petroleum geochemistry.

The first of the seven chapters provides a broad overview from the origin of the first organic compounds and the development of photosynthesis in the Precambrian, to the evolution of the key primary producers during the Phanerozoic. The second chapter reviews the basics of organic chemistry and describes the origin and properties of the main classes of organic compounds. The third provides a description of the production, preservation and degradation of organic matter in marine, lacustrine and coal-forming environments (which I found personally a little disappointing), while the next considers humic compounds and kerogen and their long-term fate in the geosphere, including organic maturation and the production of hydrocarbons. Chapter 5 (by far the largest at 79 pages) is concerned primarily with the use of organic geochemistry in identifying the sources of organic matter and the degree of its thermal alteration. The last two chapters reflect a deliberately greater emphasis on the environment in this edition. Chapter 6 deals with the carbon cycle, focusing on bulk stable carbon isotopes rather than organic geochemistry; it progresses from general principles to the Phanerozoic isotopic record and its relationship to palaeoclimate, atmospheric composition, and anoxic and extinction events. The last chapter provides a good introduction to the occurrence and significance of man-made compounds in the environment (including halocarbons, PAHs, hydrocarbons, pesticides, and endocrine disruptors).

The main body of the text (321 pp.) is followed by 35 pages of references (less than 30 items from post-2002) and a 30-page index. The volume is well illustrated with 223 black-and-white figures and 53 tables. In keeping with the target audience there are a few student-friendly features including boxed summaries of associated concepts and principles (64 in all) and a reference list that claims to concentrate on more accessible literature sources. I spotted no typographic errors during my review.

Overall, this book fulfils its stated objectives. It provides the kind of broad introductory overview that will be very useful for any student taking their first general organic geochemistry course; however, as the depth of detail is rather limited in some areas, for more specific courses (e.g. those on petroleum geochemistry) it could only serve as a background reader rather than as a primary course text. Students should certainly be able to afford their own copies, but any institution involved in teaching undergraduate or postgraduate organic, petroleum or general geochemistry should consider purchasing multiple copies for their libraries. It would also serve as a useful and very affordable overview of the subject for any chemist or geologist new to organic geochemistry or working on its peripheries.

Richard Tyson

DASCH, P. (ed.) 2004. *Icy Worlds of the Solar System*. xiv + 202 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £30.00, US $45.00 (hard covers). ISBN 0 521 64048 2.
doi:10.1017/S0016756806232059

The arrival of the Cassini–Huygens mission to remote Titan was another eye-opener. What would the lander see? Ethane oceans, and maybe, just maybe, an analogue of a whale disporting itself and bellowing into the methane rain? The reality was, in the end, more familiar, a very cold world but active and not entirely unlike the Earth. It was a useful reminder that we know far too little about our Solar System and while there is the wonderful, there is also the prosaic. And what could be more straightforward than ice, which forms the connecting theme of this useful volume where seven leading authorities take us from Mercury to Pluto and beyond, beyond including the trillions of comets that roam at least half way to the nearest star. It is a grand theme, and while the continuity does not always work, there is much of value in this volume.

The chapters on terrestrial ice, and the origins of our atmosphere (by Tobias Owen) will probably be fairly familiar to most geologists. But thereafter for many readers of *Geological Magazine*, we are likely to be entering less charted territory. Where better to start than with Mercury? Are you mad? Searingly hot, you are looking for ice here? Actually, as Bryan Butler explains the prospects on Mercury (and also the Moon) are by no means discouraging. In deep craters, permanently in shadow, ice may well survive. The evidence comes from radar surveys, and whilst the presence of ice is not proven, it does seem that it, and maybe higher temperature volatiles, are present. The case for the Moon in some ways is the more compelling because any semi-permanent colonization might do well to set up camp by a lunar ice-pack. Hope is running high, but there are several worrying anomalies and the first explorers would do well to take a few extra bottles, just in case.

The two best-known icy worlds are Mars, and the Galilean moon Europa. For the former planet Michael Mellon provides

a timely review, with some extraordinary pictures of the ice-caps. Mars is a frozen planet, and debate continues to rage as to when, and in what quantities, water might have been released in the geological past. What is clear is that a considerable amount of water is locked in a permafrost, and recent images returned to Earth are convincingly quasi-glacial. Europa is in some ways even more extraordinary, with compelling evidence for an immense ocean beneath kilometers of crustal ice. This moon is wrapped into a wide-ranging chapter by Paul Schenk on the ice moons of our Solar System. It is an intriguing catalogue, and overlaps to some extent with the following chapter by John Stansberry. Now that Titan is somewhat better understood, perhaps the focus will shift the Neptunian satellite Triton, famous for its mysterious cantaloupe terrain and geysers of frozen nitrogen. It is now clear that not only is the outer Solar System much more dynamic than once thought, but early in the history of the Solar System there was substantial migration of at least some of the planets. This has a very important bearing on the overall structure of our Solar System, its stability, and probably pronounced dissimilarities to many other extra-solar systems. So too the abundance of ice and other volatiles may, paradoxically, have a very direct bearing on our existence, because it seems very likely that if a small fraction had not been delivered to the inner Solar System more than four billion years ago, the Earth would have little in the way of atmosphere and oceans, and quite possibly no life. So it is that although the comets, ably reviewed here by Dale Cruickshank, have been regarded as harbingers of change and disaster, and so too in the geological past may have caused mass extinctions, yet in the grand order of things they were our lifeline.

To the majority of us ice is most familiar in a gin and tonic, as a surface for skating or an irritant on the winter morning commute, but this useful book provides a unifying theme that should be of interest to all geologists and astrobiologists.

Simon Conway Morris

TAYLOR, P. D. & LEWIS, D. N. 2005. *Fossil Invertebrates*. 208 pp. London: The Natural History Museum. Price £25.00 (hard covers). ISBN 0 565 09183 2.
doi:10.1017/S0016756806242055

It is about time someone came up with a better name than 'invertebrates' for the different groups of non-vertebrate metazoans – but I guess it is too late now for any substitute to catch on. 'Shelly fossils' might be more appealing but is far too muddled and confusing. So we seem to be stuck with 'invertebrates', which is far too negative and latinate to have the general appeal these organisms deserve.

Fortunately Paul Taylor and David Lewis's attractive book will get the readership it deserves despite the title. The format and design of this excellent book is primarily aimed at the general reader but the content, level of detail, accuracy and quality of illustration is also highly appropriate and useful for first-year undergraduates. Hopefully a future paperback edition will make it even more financially accessible for students.

What I particularly like is the underlying zoological approach to this huge diversity of animals, something that many books on fossils tend to underplay. I am slightly surprised that the terminology used is quite technical and yet there is no glossary so a novice might find some of it quite hard going.

The diversity of fossil groups is divided up into 'themes' such as 'Living in colonies', 'Jointed-limbed animals', etc., which gets away from the usual taxonomic roll-call of phyla, classes, etc. This promotes useful discussions of comparative function and morphology and adds a great deal of interest. But each of the major fossil groups is also illustrated by brief descriptions and specific examples of well-known genera. The illustrations are mostly high quality black-and-white photos but there are also 16 pages of excellent colour photos of fossils and their living counterparts.

Quite a lot of the classification within groups is relegated to succinct 'boxes', which is fair enough for a book that aims to have a wide appeal. There is a general introduction – 'What are fossils?' – and overall this is a well-illustrated but still text-led and very readable introduction to the subject. At the end there is a page of further information: books and reliable websites plus an index.

Douglas Palmer

BENTON, M. J. 2004. *Vertebrate Palaeontology*, 3rd ed. xi + 455 pp. Malden, Oxford, Carlton: Blackwell Publishing. Price £29.95 (paperback). ISBN 0 632 05637 1.
doi:10.1017/S0016756806252051

Since the publication of the first edition of this book in 1990, Mike Benton's book has become the default general textbook in this field of palaeontology, and the sister volume to Euan Clarkson's *Invertebrate Palaeontology* by the same publisher. The format is almost identical to the previous edition, with the minor pedagogical refinement of a brief set of 'key questions' at the beginning of each chapter; some change in the range and variety of the informative text-boxes; and a subtle rearrangement of sections within some of the chapters. Armed with these two textbooks you, pretty much, can't go wrong if you want to direct your students toward formidable and comprehensive sets of information.

Benton's book obviously has been delicately pruned, refined and updated since its last edition (1997) so that, despite the extraordinary increase in literature on the topic during the past seven years the book seems to have actually shrunk by one page. This has been achieved not only by pruning and making careful use of the text-boxes, but also by introducing a somewhat lighter and more delicate font.

As a book that is able to support basic courses in vertebrate palaeontology at an undergraduate level this book plays it part. It has few rivals in the field: *Vertebrate Life* (sixth ed.) by Pough, Janis & Heiser does a sterling job of integrating the biology and palaeobiology of vertebrates in a very synthetic way, but lacks the deep and systematic approach of Benton; while *Vertebrates* by Kardong takes a rather more overtly biological approach and pays, by comparison, 'lip service' to the actual fossil record of vertebrates. There are also some better, but in terms of subject matter far more restricted, books in the specialist field of fossil vertebrates, but they clearly lack the breadth of coverage of this book. Benton's book continues (in name at least) a tradition established by A. S. Romer, in his absolutely classic volume *Vertebrate Paleontology* which was last published in 1966 (note the subtle difference in spelling) and followed by a 1988 edition produced by Romer's student Bob Carroll. The main difference however, is in intended audience. The aforementioned volumes tended to be directed more toward a restricted and specialist third-year undergraduate or graduate-level audience; Benton, in using a more 'modern' approach, focused on the undergraduate teaching methods advocated in many colleges, in which

fluency is compromised in order to create 'bite-sized' chunks of information, is aiming at a lower undergraduate course level that is, on reflection, rather interesting. On the one hand the book is really rather comprehensive and uncompromising in content, and therefore requires preliminary courses in the subject to prepare the student; yet, on the other hand courses that I am familiar with in the present day (in departments of zoology or geology) do not on the whole have either the time, the staff expertise or the resources to offer sufficient depth in the anatomical and biological training necessary in order to be able to make full use of this type of book; and, yet again in other places, the 'feel' and accessibility of the content, through the use of text-boxes, gives the impression, rather like tabloid 'news & views' commentaries, that the subject is actually quite fun and therefore easy (which, I hasten to add, it is not). This makes it, in the end, a bit of a curate's egg (for me at least).

It is clearly the case the Benton's 'vertebrates' has a hyge advantage in terms of comprehension and continuity of subject matter, when compared to Clarkson's 'invertebrates'. The phylum Chordata (the larger group [clade] that encompasses the vertebrates in the title of the book) is just one phylum and, in reality, the book is actually devoted to just one subphylum: the vertebrates. By contrast, the range of invertebrate phyla that must be surveyed by Clarkson is so appallingly numerous and anatomically varied that his approach has to be far more carefully structured and parsimonious with information.

This is, in truth, a mammoth undertaking (sorry Mike!) and Benton is to be congratulated on his energy and perseverance in producing this volume and its updates. It clearly strains to be both comprehensive and accessible at the level at which students will need to be able to refer to it, given the constraints of size, length and overall cost. However, it does represent good value for money and provides a solid basis for lecture courses in this field of study.

David Norman

CAVAZZA, W., ROURE, F. M., SPAKMAN, W., STAMPFLI, G. M. & ZIEGLER, P. A. (eds) 2004. *The TRANSMED Atlas. The Mediterranean Region from Crust to Mantle*. xxiv + 141 pp. + CD-ROM. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 79.95 (+ VAT at local rate), SFr 135.50, £61.50, US $99.00 (hard covers). ISBN 3 540 22181 6.
doi:10.1017/S0016756806262058

This book arises out of the TRANSMED Project, which was a scientific consortium set up by the organising committee of the 32nd International Geological Congress and an association of 31 countries from the Mediterranean and nearby regions. Despite this parentage by committee, the book is a compact and accessible summary of Mediterranean tectonics. It lacks the padding of the worthy but very, very dull papers that sometimes weigh down regional volumes arising out of major conferences. To achieve this, the editors must have put in a huge amount of work, cajoling 63 authors into putting their work into a uniform style.

The book is in two parts. There is a traditional 'book' which contains three regional review papers on tectonics, tomography and palaeogeographic reconstructions. The tectonics review by Cavazza *et al.* attempts to cover every region and the main geological and geophysical datasets; this is a very ambitious undertaking and not surprisingly the paper comes across as a bit too brief about everything. However, it serves as a useful introduction for the rest of the study. Papers by Spakman & Wortel on the tomography and Stampfli & Borel on palaeogeographic reconstructions are more successful because they are more focused. However, in both cases you get the feeling that these are iterations of work that has been going on for many years, and has many years to go. Not that there is anything wrong with either paper: they are state-of-the-art views of their respective fields, but I expect both pairs of authors will contribute revisions of their maps to mainstream journals in the future.

It is the second part of the book that is more praiseworthy for originality, both in the scientific content and the presentation. This is a CD-ROM, which self-starts on either a Windows or Macintosh computer to allow access to eight cross-sections (transects) across the Mediterranean region. Overall, this includes a vast area from the Atlantic margin to the Black Sea. The transects have been chosen carefully to cross major basins and orogenic belts, and the section lines jink to cross the structural grain at high angles wherever possible. Each transect can be scrolled and viewed at different scales, and is accompanied by an explanatory text written by the compilers. There is no vertical exaggeration and the geology is interpreted as far down as the Moho. The results form an extraordinary view of the geology across many of the world's most famous structures: the Alps, Red Sea rift, Troodos ophiolite and Pyrenees are all covered, to pick a few places at random. Each transect is represented twice, as tectonic and chronostratigraphic sections. There may have been a good reason behind this originally, but there is actually little to choose between the two versions of each line. It makes sense to stick to viewing one or the other.

The interpretations are very good for their scale, but readers should remember that each section may be a couple of thousand kilometres long, and so not expect the fine detail of any particular area to be shown. Some of the deep interpretations of thrust and rift zones are dubious, given what we know about the deep structure of active fault systems, but any interpretation on this scale to these depths is going to involve a high degree of speculation.

Each transect is complemented by links to field photographs, logs and seismic lines. But neither these linked objects nor the main transects can be readily exported: readers expecting to be able to drop items from the *Atlas* into their own work will have to think again. While this is understandable in terms of protecting copyright, I think it is a pity that hard copies are not readily obtainable: it is always easier to read and annotate a printed page than something viewed on screen.

Experts on any of the individual areas covered in this book should find they are already familiar with the local material presented and synthesized, but there will be very few people so familiar with the whole area that they find the book dull or uninformative, and as such it can be recommended to anyone with a general interest in the regional geology of the Mediterranean.

Mark Allen

BREITKREUZ, C. & PETFORD, N. (eds) 2004. *Physical Geology of High-Level Magmatic Systems*. Geological Society Special Publication no. 234. vii + 253 pp. London, Bath: Geological Society of London. Price £80.00, US $144.00; GSL members' price £40.00, US $72.00; AAPG/SEPM/GSA/RAS/EFG/PESGB members' price £48.00, US $87.00 (hard covers). ISBN 1 86239 169 6.
doi:10.1017/S0016756806272054

This edited volume is the product of a two-day workshop held in Freiberg, Germany, in October 2002. Fourteen

papers are published here, covering such diverse themes as lavas, pyroclastic and volcaniclastic deposits, peperites, sills and various other shallow-level intrusions. This book is, essentially, the successor to Newall & Rast's classic 1970 volume, *Mechanism of Igneous Intrusion* (Geological Journal Special Issue no. 2) and illustrates how far our understanding has come in the intervening 33 years.

Most of the presentations adopt a case-study approach, involving an interesting list of locations from throughout Europe: the Late Palaeozoic Intra-Sudetic Basin, southern Poland (Awdankiewicz); Permo-Carboniferous laccoliths of central Europe (Breitkreuz & Mock); the Ság-hegy Volcanic Complex, western Hungary (Martin & Németh); Late Palaeozoic sills of the Flechtingen–Roβlau Block, Germany (Awdankiewicz *et al.*); Carboniferous lava domes and laccoliths of the Kaczawa Mountains, Poland (Machowiak *et al.*); diatremes and associated intrusions of the Saar–Nahe Basin, Germany (Lorenz & Haneke); the Gavorrano pluton, Italy (Mazzarini *et al.*); sub-volcanic intrusions of the southern Italian Alps (Corazzato & Groppelli); Late Miocene porphyritic granites on Elba, Italy (Westerman *et al.*); together with one paper on the well-studied intrusion(s) of the Henry Mountains, Utah (Habert & De Saint-Blanquat), one on a ring complex in the Kerguelen Archipelago, Indian Ocean (Bonin *et al.*), and a concluding paper on the mechanics of basalt dyke emplacement using laboratory-derived experimental deformation data (Vinciguerra *et al.*). Shallow-level intrusion geometry and mechanisms of emplacement are also explored, with examples from the Atlantic Margin of NW Europe (Malthe-Sørenssen *et al.*; Thomson; Jamtveit *et al.*).

One particularly pleasing aspect of this Special Publication is that it promotes several excellent examples of sub-volcanic intrusions and their links with surface processes, both volcanic and tectonic. I am sure that these papers will cause interest amongst researchers to use these localities to further test new ideas in this important geological environment.

Typical of the Geological Society's house style, the volume commences with an introductory 'guide' by the editors, most useful to readers wishing to understand the scope of the book. Intrusion geometry and mechanism of emplacement are the reoccurring themes and several contributors present intelligent figures illustrating intrusion geometry and their relationships with the contemporaneous (volcanic) land surface.

Breitkreuz (Germany) and Petford (UK) are to be congratulated for a high standard of editing and maintaining a relatively uniform style and level of presentation. Most of the figures are of good quality, with a small amount of colour used in some of the papers. The Geological Society member price is good, although I suspect that only libraries will pay the normal (i.e. double) price for non-members.

In summary, this volume excellently fills a niche which, until now, was last addressed over one third of a century ago! Not all themes are addressed in equal detail and there are some unavoidable gaps. However, my congratulations go to the editors and the chapter authors.

Brian Bell

CONDIE, K. C. 2005. *Earth as an Evolving Planetary System*. xiv + 447 pp. Amsterdam: Elsevier. Price £34.99 (paperback). ISBN 0 12 088392 9.
doi:10.1017/S0016756806282050

Kent Condie has built on his earlier *Plate Tectonics and Crustal Evolution* (1976), by linking the principal dynamic system of whole-Earth heat and matter convection and its surface manifestation in plate tectonics to those of the atmosphere, hydrosphere and biosphere. The fact that only two of its ten chapters lie outside the solid Earth makes it primarily a book for the geoscientist rather than Earth scientists in the broader sense. Intended for 'advanced undergraduate and graduate students' as a wide-ranging reference, *Earth as an Evolving Planetary System* assumes basic knowledge of the physical and life sciences. Its strength lies in its systematic clarity as regards definitions, analytical approaches and interrelationships between processes. That is weakened by the minimal use of colour to enliven its many figures.

Starting by subdividing crustal rocks according to their principal tectonic settings, Condie reviews in the first three chapters the main features of each and their formative processes as inferred from observation and various kinds of data. Two chapters cover the deep mantle and core, yet both seem to be somewhat dated, as the further reading for each ends in 2001. This misses out some fundamental material gleaned more recently from seismic tomography, basalt geochemistry and dynamic modelling, and little is said about ideas regarding chemical heterogeneity and physical circulation from the lithosphere to the core–mantle boundary.

The chapter on atmosphere and oceans covers climate and sea-level change, and to a minor degree changes involving geochemical cycles, but really skates over a great deal of substantial information that has been accumulated over the last few decades. The carbon-, strontium- and oxygen-isotope records are not dealt with as extensively as I believe they should be in this context of changes in surface processes. 'Living Systems' is a chapter following standard lines on the origin of self-replicating chemistry and the development of cellular life, but fails to highlight sufficiently the interplay between living and inorganic chemistry and that between the biosphere and its enveloping and underpinning environments. That is really a *sine qua non* for broad understanding of this planet's evolution and that of others in the last three chapters.

I know how long it takes for a book to pass from final draft to print, but what really dates the final chapter on comparative planetary evolution is the absence of any account of the explosion of information and ideas about Mars that began with the arrival of Mars Explorer and Mars Express in late 2003.

Particularly missed in *Earth as an Evolving Planetary System* are accounts of disputation among scientists involved in the different aspects of planetary evolution, which arguably is central to advanced study of the Earth and engaging readers with the dynamics of scientific progress. As a book replete with established facts it will be useful, but the inattention to the development of ideas, and the excitement, curiosity and motives of those who generate them will not inspire budding Earth science researchers. Despite the preface's intentions as regards readership, it seems not to be at an appropriately advanced level, and I fear that it will leave its audience a little cold.

S. A. Drury

MAYOR, A. 2005. *Fossil Legends of the First Americans*. xxxix + 446 pp. Princeton, Woodstock: Princeton University Press. Price £18.95 (hard covers). ISBN 0 691 11345 9.
doi:10.1017/S0016756806292057

Like many other indigenous people, Native Americans for many centuries have observed fossils and mused about their

origin and significance. Much of this fossil folklore has remained unwritten and the contemporary decline in story-telling means that some oral legends are in real danger of vanishing. Adrienne Mayor, an authority on natural history folklore and author of *The First Fossil Hunters: Paleontology in Greek and Roman Times* (Princeton University Press), here rescues and collates a wealth of stories. Many were obtained during interviews with Native Americans as the author journeyed across the USA, visiting fossil sites, small museums and Indian Reservations.

Meyer begins her book with an account of the first American fossils ever studied by European scientists. These mastodon bones were collected in 1739 from Big Bone Lick in Kentucky by a French military expedition led by the Baron de Longueuil. They were described 23 years later by Louis Daubenton, subsequently redescribed by the great Baron Georges Cuvier, and still survive today in the Muséum National d'Histoire Naturelle, Paris. Big Bone Lick was known to the Native Americans as a source of ivory teeth and tusks and it is highly likely that Indian hunters in Longueuil's party were the actual collectors of the mastodon fossils. Here and elsewhere, Meyer dispels the notion promoted by the vertebrate palaeontologist G. G. Simpson that Native Americans seldom noticed fossils. In fact, they were acute observers of fossils, both body and trace fossils. For instance, ancient Indian rock art occasionally copies dinosaur footprints next to real dinosaur trackways, and the traditional costume of some Hopi Indian dancers incorporates tridactyl dinosaur prints. Native Americans also came up with plausible explanations for the origins of various fossils. They recognized dinosaur bones as the bones of gigantic creatures and, perhaps more remarkably, named the trilobite *Elrathia* 'Timpe khanitza pachavee' meaning 'little stone water bug', implying an appreciation of its broad biological affinities and aquatic lifestyle.

A notable theme, developed especially towards the end of the book, is whether fossil bones should be left in-situ and displayed where found, or excavated and removed to often distant museums. Issues of fossil collecting from tribal lands are raised here too. Many groups of Native Americans are deeply superstitious about the removal of fossil bones. For example, the Navajo believe that fossils represent negative legacies of past worlds; to excavate them carries the risk of bringing the dead animals back to life. Another common notion is that when the world was first created many mistakes were made – some animals found themselves in the wrong environment and ate the wrong food. These unsuccessful 'experiments', including dinosaurs, were destroyed by thunderstones (meteorites), an idea echoing modern scientific theories on mass extinctions and bolide impacts. Alternatively, destruction involved mythical forms of sky-being called Thunderbirds, often reputed to have raged battles with water monsters (as graphically depicted on the rather lurid dust jacket), leaving behind the bones of the slain enemies as fossils in the rocks.

While myths concerning the bones of vertebrates are the mainstay of the book, invertebrate fossils are not neglected. Meyer records medicine pouches containing fossil shells painted with red ochre, crinoid columnals employed as beads by the Arizona people over 500 years ago, and ammonites used by the Cheyenne to locate enemies and by the Blackfeet to corral herds of bison.

There are many fascinating anecdotes in this book. However, their sheer diversity seems to have left the author struggling with how best to structure her material – ordering of the text by geographical region is not entirely successful. More for dipping into than for reading cover-to-cover, this competitively priced volume will appeal to palaeontologists, anthropologists and folklorists. For geologists, the folklore of fossils is a useful tool for engaging an interest in palaeontology, and Meyer here provides excellent ammunition with a book which is unrivalled in its particular focus on Native American fossil folklore.

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PROTHERO, D. R. 2005. *The Evolution of North American Rhinoceroses*. ix + 218 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £60.00, US $100.00 (hard covers). ISBN 0 521 83240 3. doi:10.1017/S0016756806302051

Don Prothero is a well-respected vertebrate palaeontologist who has specialized in the fossil history of rhinoceroses and related forms for many years. This book is monographic in style and provides a detailed review of the history of the group from their appearance approximately 40 million years ago until the present day.

This book, as a consequence, is not for the faint-hearted; it is unashamedly academic in tone and content, but if you want to know about rhinos, their history, their early diversity and ecological plasticity (modern rhinos are not at all like some of their more outlandish forebears) then this is *the* book for you. As an academic text it works reasonably well, serving as a detailed systematic review of the Family Rhinocerotidae, with authoritative discussion of the merits of the currently recognized taxa, and the more problematic forms as well. However, if allowed to quibble, which I will do, I was a little disappointed that this book, which sets a high academic standard textually, is rather poorly served illustratively. The photography in particular is of very variable and in some instances, very poor, quality. It seems to me a great shame that the illustrations were not dealt with to the standard one might have reasonably expected in a monograph of such rarity and relative importance.

All in all this is a book solely for the specialist. Its price guarantees that it will only fill library shelves and those of a relatively small number of Tertiary mammal palaeontologists globally; this is actually a great pity because this type of detailed systematic review should set standards and expectations in a number of areas of the globe that are notable for their rich Tertiary vertebrate faunas.

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