BOOK REVIEWS

SKELTON, P. W., SPICER, R. A., KELLEY, S. P. & GILMOUR, I. 2003. *The Cretaceous World*. 360 pp. Cambridge, New York, Melbourne: Cambridge University Press for the Open University. Price £75.00, US $110.00 (hard covers), £27.95, US $50.00 (paperback). ISBN 0 521 83112 1; 0 521 53843 2 (pb).
DOI: 10.1017/S0016756804219434

The Cretaceous World is a well-constructed book with the high level of production values we have come to associate with offerings from the Open University: lucid text with explanations that bend over backwards to be systematic, logical and enlightening; well-designed diagrams exhibiting a deft use of colour; exemplary photographs; carefully chosen references; and a useful index. Edited and partly written by Peter Skelton, the book also contains key contributions by Iain Gilmour, Simon Kelley and Bob Spicer. There is an accompanying website that hosts sample pages, some illustrations to download (though not perhaps the most valuable ones!) and worked exercises.

The book comprises thirteen chapters covering such topics as Cretaceous palaeogeography, climate, marine and terrestrial biota, carbonate platforms, biogeochemical cycles, volcanism, the carbon cycle and the Cretaceous–Tertiary boundary event. Cretaceous strata from around the world are visited, and the tour takes in places as far apart as Gubbio, Italy and Prudhoe Bay, Alaska. All the topics are well introduced, usually with a quick dive back into the history of the subject in question, spotlighting particular scientists and the seminal role they played.

As with many Open University books, a number of questions (and answers) are sprinkled through the text. An example: 'From the discussion of the controls on sea-level change . . . how would you explain the difference in the importance of antecedent karst development between Cretaceous and Quaternary platforms?' Answer: 'The platforms of the Quaternary world were subject to large-amplitude glacio-eustatic oscillations of sea-level, hence repeated emergence and submergence . . . would not have occurred – at least on anything like the same scale – in the largely greenhouse world of the Cretaceous.' If your fleeting mental response to this is 'Not a lot of people know that!' you will realize that this book attempts to integrate key but disparate phenomena of the Cretaceous Period and project their inter-relationships as an example of earth-system science for a dominantly ice-free world. In this aim the authors have succeeded admirably and I do not know of any other geological period that has been examined in a similar way.

Although generally a model of lucidity, detailed examination of the text does throw up at least one inconsistency that might puzzle a perceptive student. On page 190, we are told that calcareous sediments form from shells and skeletons created by organisms from CO_2 dissolved in seawater as HCO_3^- ions: i.e. that secretion of carbonate is a sink for carbon dioxide. In line with this bit of chemistry, we further note, on page 200, that subduction of pelagic carbonate will cause it to break down to release CO_2. However, on page 261 we are told that, *in the short term at least* (an important caveat, this, but not further explained: my italics), calcification pushes CO_2 back into the atmosphere because for every molecule of $CaCO_3$ formed a molecule of CO_2 is released. And by page 267 it is suggested that the decline of carbonate platforms – major sites of $CaCO_3$ precipitation and secretion throughout much of the Cretaceous – could have led to a global reduction of CO_2 expulsion into the atmosphere, rather than the reverse. Although it is true that precipitation of calcite or aragonite may lead to immediate effusion of CO_2, the fact remains that, ignoring potential pH changes and buffering effects that complicate the issue, two molecules of the gas potentially combine with water to produce two molecules of bicarbonate (HCO_3^-) and only one of these is returned as CO_2, the other being fixed as $CaCO_3$. Carbonate fixation has to be a long-term sink for carbon dioxide. Here, clarification of short- *v*. long-term effects would have been helpful.

But this is a minor quibble. I particularly like the melding of key field observations, classical palaeontology and sedimentology with up-to-date geochemical, geophysical and petrological data. The book offers a well-rounded and extremely informative view of the Cretaceous world and I recommend it highly for teachers and students alike.

H. C. Jenkyns

DONOGHUE, P. C. J. & SMITH, M. P. (eds) 2004. *Telling the Evolutionary Time. Molecular Clocks and the Fossil Record*. Systematics Association Publication no. 66. viii + 288 pp. Boca Raton, London, New York, Washington D.C.: CRC Press (Taylor & Francis), for the Systematics Association. Price £72.99 (hard covers). ISBN 0 415 27524 5.
DOI: 10.1017/S0016756804229430

J. B. S. Haldane, famous for his quip about the Creator's inordinate fondness for beetles, is also well known for his reply as to whether anything might make him abandon his belief in evolution. The response was to the effect that a rabbit found fossilized in Ordovician strata would shake his faith to the core. Haldane's reply was hardly surprising; we do not find Ordovician rabbits any more than we do Devonian tulips or Cambrian dinosaurs. To the first approximation, the history of life shows an overall order that investigations of the fossil record continuously refine, but these days very seldom overthrow.

In recent years, however, and perhaps as a distant echo of the corrosive relativism of the Kuhnian world picture of paradigm shifts, the old securities seem to have been eroded. One topical instance is the renewed questioning of whether the effect of the available sediment in a given geological interval, as well as other factors, such as Raup's 'Pull of the Recent', do not conspire to distort completely any original diversity trends. Of equal, if not greater, importance, is the rather extraordinary fact that with few exceptions the estimated times of divergence that are based on molecular 'clocks' significantly exceed the palaeontological data points of first appearances. The implications are as obvious as they are intriguing. Could it be that the fossil record is far worse than we feared, with either cryptic or unpreserved intervals of geological time radically misleading us as to the real course of

events? Or are the molecular 'clocks' horological nightmares sometimes running absurdly fast, and other times scarcely ticking? As depicted, this is a stark contrast. Nevertheless, if one theme emerges from this book, it is that a consensus will be difficult but ultimately there is no reason to think that it will not be achievable.

This is, therefore, a timely and in places provocative volume. To the first approximation, however, the majority of the contributors are confident that while the fossil record is not perfect, we do know enough that in at least some cases something must be awry with the molecular 'clocks'. For example, Wellman (on the origin of land plants), Budd & Jensen (on bilaterian metazoans), Donoghue and colleagues (on early chordates) and Ruta & Coates (on early tetrapods), as well as Benton and Paul considering the overall quality of the fossil record, are all upbeat about the role and validity of the fossil record. Not that they, nor a number of other contributors, reject the ever-present possibility of range extensions. So too they freely acknowledge the many problems inherent to phylogenetic analyses and upon which depend the estimates of origination times. What is striking about these contributions is the range of careful arguments and a lively awareness that in each case the story is far from finished.

So is there something wrong with the molecular 'clocks'? What is obvious is that the rates of substitution, for example at an amino acid site in a protein, are widely variable, sometimes enormously so. In the planktonic foraminiferans, for example, Pawlowksi & Berney demonstrate astonishingly rapid rates of substitution, at least one hundred times faster than the most sluggish of benthic foram lineages. The forams are also particularly interesting because the substitution rates in the stem lineage appear to be greatly accelerated. This is potentially a most important observation, but the central difficulty is that to date we have no real idea why there is such wide variation. Factors such as body size and generation time almost certainly play a role, but the story is far more complex. As Rodriguez-Trelles and colleagues show, not only is the range of substitution rates quite remarkable, but there seems to be no rhyme nor reason as to why some go so much faster than others.

Of all the contributors, Hedges remains the most committed to molecular data providing the only realistic framework to establishing diversification times. In doing so he offers some provocative thoughts, such as his proposal for a biotically driven origin for the Neoproterozoic 'Snowball Earth' episodes. Nevertheless, as a number of the other contributors point out, Hedges' approach crucially depends on a number of assumptions, some of which have a degree of circularity. This point is made most forcibly by Donoghue and co-workers (p. 207), although many of the other chapters have important critiques of the many assumptions that underlie molecular clocks. So too there is the recurrent problem of relying on information that lies beyond the author's area of expertise. Thus, in support of his notion of early divergences of metazoans, Hedges refers to 1.2 Byr (now known to be *c.* 1.6 Byr) traces from West Australia as 'The most convincing evidence for the existence of [ancient] metazoans' (p. 31), yet the supposition that these remains are any sort of metazoan trace fossil is the subject of a withering analysis by Budd & Jensen.

Although most of the authors adopt positions that they have previously fought for, this book is very much a set of dispatches from the front line. It is, however, in general considerably more confident as to the veracity of the tangible fossil record than the many uncertainties of extrapolation that accompany the use of molecular 'clocks'. Even so it is a very timely contribution to one of the most vigorous areas of evolution. And there is no sign of the debate ending. Just as I was finishing writing this review, my eye was caught by two important papers. The first is by Stéphane Aris-Brosou & Ziheng Yang in the last issue of the 2003 *Molecular Biology and Evolution* (vol. **20**, pp. 1947–54), where they provide what seems to me compelling evidence for molecular data being consistent with a major diversification of animals close to the Precambrian–Cambrian boundary. The second, a shorter review by Dan Graur & William Martin, is cheekily entitled 'Reading the entrails of chickens' (see *Trends in Genetics*, vol. **20**, pp. 80–6; 2004). It provides an apt counterpart to the first paper with a robustly sceptical view of the reliability of molecular clocks. No doubt others will find these papers less compelling, but to this reviewer the direction of thinking is now clear. In hindsight, what may seem the most peculiar is the degree of special pleading that has accompanied some claims for cryptic intervals of evolution.

In conclusion, if the end resolution is still difficult to see of one thing we can be sure. We are on the way to being much better informed both about evolution and the still problematic links between molecules and morphology. In helping to lead us to this destination *Telling the Evolutionary Time* will have played a valuable part.

Simon Conway Morris

DILEK, Y. & NEWCOMB, S. (eds) 2003. *Ophiolite Concept and the Evolution of Geological Thought*. Geological Society of America Special Paper 373. xii + 504 pp. + map in folder. Boulder: Geological Society of America. Price US $90.00 (members' price US $72.00); paperback. ISBN 0 8137 2373 6.
DOI: 10.1017/S0016756804239437

This book is a collection of 23 papers following a Special Pardee Symposium held at the annual meeting of the Geological Society of America in Boston during November 2001. The book provides a fascinating insight into the development of thoughts by many of the key figures in the past on what ophiolites are, how they form, and how they become emplaced onto continental margins. Ever since the first definition of an ophiolite by the French mineralogist Alexandre Brongniart in 1813, ophiolites have been recognized as key components of most orogenic belts throughout Earth history. It was Gustav Steinmann who first described the famous 'trinity' of serpentinite, spilite and chert in the Alpine–Appennine mountain belts, and his original 1927 paper has been translated, with extensive explanatory footnotes, by Bernoulli & Friedman in this volume.

The history of science is always extremely important. Modern concepts stand on the shoulders of earlier theories, ideas and data. The quality of the historical aspect of ophiolite research in this book is apparent from the list of authors, including such eminent geologists as Fred Vine, Eldridge Moores, John Dewey, Ken Hsü, Adolphe Nicolas, Joe Cann, Julian Pearce, Thierry Juteau and Paul Robinson amongst others. One paper by Davis Young describes the great debate between N. L. Bowen and Harry Hess, which gives a fascinating perspective on thoughts concerning ophiolites prior to the plate tectonic revolution. Another paper by Thierry Juteau gives an excellent insight into the development of models for the origin of ophiolites,

particularly the mantle component. Foremost amongst the modern models has been the application of structural petrofabric analysis, developed mainly by Adolphe Nicolas and his colleagues. Another paper by Martin Flower reviews the influence of ophiolite models which were at the very heart of the plate tectonic 'paradigm shift' of the 1960s.

Two papers by James Hawkins and Julian Pearce nicely summarize the development of ideas relating to 'supra-subduction zone' ophiolites. These ideas really stemmed initially from the ground-breaking paper by Dewey & Bird in 1971, and took off with the advent of trace element discrimination diagrams pioneered by Pearce and Cann in the 1970s. Hawkins' paper gives great insights for ophiolite interpretation using studies on island arcs and forearc regions, particularly in Guam and Saipan, and trenches, notably the 9km 'stratigraphy' from deep drill sites on the Mariana trench. The significance of high-pressure and ultra-high-pressure metamorphic studies on ophiolite emplacement models is very nicely discussed in a paper by Gary Ernst. Final mention must go the epic historical paper by Celal Sengör, which deals with the repeated rediscovery of mélanges associated with ophiolites, particularly the Ankara mélange.

This is an excellent collection of historical and review-type papers on all aspects of ophiolite research that is highly recommended. The editors Yildirim Dilek and Sally Newcomb must be congratulated, not only on getting a roll-call of the most eminent ophiolite researchers to write papers, but also for putting the whole volume together. It will forever be of lasting historical value for sure. It is particularly fitting that this book is dedicated to Bob Coleman, the larger-than-life figure who has accomplished more field work on ophiolites around the world than just about anyone. His studies of the Californian and Oman ophiolites in particular have resulted in ground-breaking ideas, numerous scholarly papers and a wonderful book, all based on massive data collection, exploratory field geology and insightful scientific thought. This book is a very fitting tribute to the legacy of Bob Coleman, a great geologist and a great person.

Mike Searle

GARRISON, E. G. 2003. *Techniques in Archaeological Geology*. xiv + 295 pp. Heidelberg: Springer-Verlag. Price Euros 79.95 + VAT at local rate, SFr 133.00, £56.00, US $89.95 (hard covers). ISBN 3 540 43822 X.
DOI: 10.1017/S0016756804249433

This compact book is a compendium of geological methods used or deserving to be used in archaeological field or landscape history research as well as for geological materials used for artefacts of various kinds. It contains eight chapters including the first which lays out the organization of the book.

Chapter 2 discusses field surveying and mapping under two headings: (i) geomorphology and principal landforms; and (ii) Geographic Information Systems (GIS) and a full range of mapping techniques. The emphasis in the first section is on phenomenology rather than history and evolution and is astonishingly brief, a little over one page for fluvial landscapes for example and less than that for the coastal zone. Chapter 3 covers a nearly complete range of geophysical survey techniques including data display and, rather cursorily, some notes on advantages and disadvantages, but for the uninitiated the arrays could be bewildering and little guidance is given regarding the choice of methods relative to circumstances and objectives.

Chapter 4 covers field observation methods for sediments and soils, and a little about the concept of stratigraphy and sampling methods. It is amplified in Chapter 5, restricted to unconsolidated sediments, with a comprehensive review of laboratory analytical techniques ranging from particle size to (perhaps oddly in this text) palynology. An unusual feature is the attention paid to the scales of variables such as grain size in various countries, so emphasizing the current confusion which makes comparisons unnecessarily difficult. Chapter 6 covers 'hard rock' techniques with emphasis on thin sections, but like nearly all others it is too concise to help with applications to ceramics, a non-trivial subject. The understanding of optical properties, which is critical to so much of this chapter, fails in both theory and practice.

Chapter 7 deals with advanced instrumental analyses that demand expensively equipped laboratories with expert staff. Although much of it is promising, not enough is said about the insights that can be expected from those expensive techniques. This area more than any other except geophysics is out of reach of archaeologists, even those equipped with M.Phil. degrees, unless they have access to both advisers and practitioners of the various approaches.

The book closes with 30 pages on statistical methods, a triumph of brevity but not of enlightenment. Misuse of statistical methods is all too common amongst archaeologists and geologists, especially due to the handy computer programs available. Like the advanced methods of chemistry and physics cited above, statistical analysis should not be attempted without a proper choice of methods, a task reserved for professional statisticians. Uncomfortably often nonsense is generated by the application of insufficiently understood statistics. Those luscious programs should always be labelled with strong health warnings on two aspects: (i) are you, potential user, sure that your data are of the kind that is amenable to statistical analysis? And (ii) do not ever use a method because someone else did; it is likely to be the wrong one for your purpose.

Bewildering? Yes, this book is bewildering. Its vast amount of information is compressed into dense subsections, on average a page or a page and a half long, which almost always fail to inform the seeker of education whether the approach does or does not fit his needs, nor does it enable him to go to the field or laboratory to practise it. Thus it is little more than a catalogue, limited to the 'what?' of its subject matter, but poor on the 'how?' and rarely clear on the 'what for?' question.

The author is silent or at least vague regarding the kind of readers he expects to benefit. Is it the archaeologist who, inspired by the term modern science-based archaeology, will take book in hand to undertake a ground-penetrating radar survey? Is it intended to help the geologist to show his survey director how he can develop a fluvial landscape history? Or is it a handbook that should accompany archaeologists with an M.Phil. in geoarchaeology when they put into practice any or many of the things the book offers?

It is an amazing compendium that must have required a great effort; even after a quarter century in geoarchaeology I did not realise how many different things one might offer to assist our archaeological colleagues. But in its brevity it is unlikely to improve the mutual understanding between those who need the science but do not quite know what can be done and those who can offer it but do not know what is needed.

T. H. van Andel

LeTourneau, P. M. & Olsen, P. E. (eds) 2003. *The Great Rift Valleys of Pangea in Eastern North America. Volume One: Tectonics, Structure, and Volcanism*. xi + 214 pp. New York: Columbia University Press. Price US $79.50, £55.00 (hard covers). ISBN 0 231 11162 2.

LeTourneau, P. M. & Olsen, P. E. (eds) 2003. *The Great Rift Valleys of Pangea in Eastern North America. Volume Two: Sedimentology, Stratigraphy, and Paleontology*. xxv + 384 pp. New York: Columbia University Press. Price US $89.50, £62.00 (hard covers). ISBN 0 231 12676 X.

DOI: 10.1017/S001675680425943X

Rift basins of Triassic and Jurassic age contain a lithological record of the break-up of the Pangaea super-continent, and so they give us a window onto the physical and biological changes that were occurring at this important time in Earth history. Some key events about which we seek to know much more were: the appearance and diversification of dinosaurs, the early evolution of mammals, global reorganization of climate belts, a change from rift to drift tectonics, and the development of what might be the largest igneous province on the planet, which itself is coincident with a major faunal extinction at the Triassic–Jurassic boundary.

This pair of books is aimed at these big questions. They supply new information about one half of the proto-Atlantic system, the set of rift basins on the eastern side of North America that stretch from the state of Carolina in the south up to Nova Scotia in Canada and offshore Newfoundland in the north. While most of the studies are from the exposed basins onshore, interesting material is included that comes from offshore basins and the subsurface as revealed through coring and seismic surveys. The investigations in these basins are stimulating geological activities as diverse as the development of a global magneto-stratigraphic timescale, understanding of astronomical forcing of climate and sedimentation patterns, the nature of life at this time, and the influence on it of bolide impacts.

The word that best sums up these volumes is diversity. It describes both the content and the quality. It is both the strength and the weakness, and is what makes it difficult to arrive at a simple recommendation about them. The diversity shows how we need an integrated approach to understanding our planet, but in turn means the coverage of any one topic is limited and frustratingly incomplete as a starting point for finding out about these basins.

This character of the books is understandable when one realises they grew out of a conference in 1995 with the title 'Aspects of Triassic–Jurassic Rift Basin Geoscience'. Most of the contributors work at, or are closely associated with, Columbia University in the USA. The texts are a worthy attempt to record and communicate the new science, though inevitably the treatment is uneven. What they are not is a systematic synthesis of current understanding, and in this regard the titles might be a little misleading.

Volume One includes six papers on tectonics and structural analysis, and four on the igneous activity. The first part includes: a regional review of the break-up history; a short discussion on the mobility of Pangaean continental fragments and the implications for early Mesozoic climate; the use of vitrinite reflectance data to elucidate the duration of synrift sedimentation and reveal structural inversion; determination of the stress regime during rifting in two sub-basins; and an analysis of mesoscale structures in a single quarry, that usefully throws light on the size-scaling laws of natural fractures and fracture propagation (unlike most of the book, this material has previously been published in journals). The second part looks at the regional extent and geochemical trends of flood basalts of this time; the use of magnetic susceptibility anisotropy to discriminate lateral from vertical magma flow and deduce the linkage between intrusions; and includes a geochemical comparison of the Pangaean break-up basalts to those produced during the break-up of the previous large-scale plate reconfiguration, the late Precambrian supercontinent known as Rodinia.

Volume Two has seven papers on sedimentology and stratigraphy, and eight papers on the insect and tetrapod fauna, the latter group greatly outweighing the former in paper length and detail. This volume also includes an appreciation and bibliography of the meticulous work of John F. Hubert on the successions in these basins, and a history of the quarrying and use of the early Jurassic Portland Formation Brownstone of Connecticut, which although interesting in itself contributes solely to the cultural not the geological understanding of these rift basins.

This volume commences with new stratigraphic detail for the offshore parts of two basins, followed by a conventional provenance study of the Upper Triassic in a third, onshore basin. All three add to the regional knowledge base but produce no surprises and the sedimentological interpretations are insufficiently justified. Next follow three papers on individual basins that together illustrate the value of studying the soils in a sedimentary succession. They reveal increasing climate aridity through the Triassic and help elucidate the channel–floodplain architecture for a meandering river in the Hartford Basin (in so doing reminding us that not all rivers in drylands are braided). This first part of Volume Two ends with an organic geochemical analysis of some of the lacustrine shales in the Hartford Basin. What is frustrating about all these chapters is the lack of integration and a regional comparison. There is little or no discussion of the bigger picture and implications. One has to go back to the review by Smoot (1991) and work it out for oneself.

The remainder (over half) of Volume Two is on palaeontology and biostratigraphy. A long and useful paper sets the scene with a comprehensive correlation and proposed biochronology for Late Triassic non-marine strata. Two papers document new discoveries of Jurassic and Triassic insect fauna, revealing a hitherto unappreciated level of diversity. The remainder of the book (121 pages) comprises five papers on dinosaur trackways and footprint analysis. Whilst providing much taxonomic detail, these papers feel rather detached from the remainder of the two volumes as there is almost no analysis of the significance of this material to the global problems.

Presentation quality is generally good, but not flawless. Several figures have errors in the captions, arrows are missing on one, scale is unspecified on some others, and geographic setting is often inadequately specified for the non-USA reader. A number of the photographs lack contrast, making it hard to see the point of the illustration. A common problem, especially with maps, is the use of indistinguishable shades of grey.

These volumes seem most suited for library purchase at research institutions. The disparate nature of the treatment means that, unless you are working on these particular sedimentary basins, it is unlikely you would find more than a small proportion of the material of generic value. The absence of anything other than a superficial synthesis of the results makes them an inadequate starting point for studies on rift basins in general, Pangaean ones in particular.

Colin P. North

Reference
SMOOT, J. P. 1991. Sedimentary facies and depositional environments of Early Mesozoic Newark Supergroup Basins, eastern North-America. *Palaeogeography, Palaeoclimatology, Palaeoecology* **84**, 369–423.

SMITH, W. 2003. *William Smith's 1815 Geological Map of England and Wales with Part of Scotland (reproduction)*. Flat sheet 1330 × 930 mm. Keyworth: British Geological Survey. Price £15.00 (rolled in tube). ISBN XWS1815.

THACKRAY, J. C. 2003. *To See the Fellows Fight. Eye Witness Accounts of Meetings of the Geological Society of London and its Club, 1822–1868*. BSHS Monographs no. 12. xvii + 243 pp. Faringdon: British Society for the History of Science (orders to: BSHS Monographs, 5 Woodcote Green, Fleet, Hampshire, GU51 4EY, UK). Price £15.00, US $26.00 (paperback). ISBN 0 906450 14 4.

TORRENS, H. (ed.) 2003. *Memoirs of William Smith. Ll.D., author of the "Map of the Strata of England and Wales" by his nephew and pupil John Phillips, F.R.S., F.G.S., first published in 1844*. 1 + 230 pp. Bath: Bath Royal Literary and Scientific Institution. Price £18.00 (hard covers). ISBN 0 9544 9410 5.
DOI: 10.1017/S0016756804269436

Without wishing to 'sex up' the evidence, there is no doubt that 'Strata', Smith's 1815 map – *A Delineation of the Strata of England and Wales, with part of Scotland; exhibiting the collieries and mines, the marshes and fen lands originally overflowed by the sea, and the Varieties of Soil according to the variations in the Substrata, illustrated by the most Descriptive Names* – is an outstanding achievement in the history not just of British geology but of the science in general. And, now we can all afford a beautifully produced composite copy at a remarkably affordable price. All geologists ought to get one, all departments with any pretence of teaching earth science ought to have one prominently displayed and encourage students to buy their own copy; after all it costs not much more than a round of drinks these days. It can be put on show and illuminated without worry about the colours fading because it can be replaced easily, unlike the original copies, which do not often come on the market these days and will cost somewhat more than a round of drinks.

In order to fully appreciate the technical, scientific and visual accomplishments of Smith's map, you should read his nephew's (Professor John Phillips) 1844 biographical memoir and the accompanying essays by Hugh Torrens republished together in a limited hardback edition by The Bath Royal Literary and Scientific Institution. A number of softback copies were also printed and are available from the Institution. Here we can get a glimpse of the reality, stripped of the hype, behind Smith's achievements. Although, as Torrens point out, Phillips' account has to be read with some care since 'he could not be expected to be much informed about any Smithian matters before November, 1815, when he joined Smith in London'. By then Smith (1769–1839) was 46 years old and again as Torrens remarks 'was one who 'did' things, not one who, at that time, was much inclined to write down his thoughts'. Phillips' account is, not surprisingly considering the date, somewhat bowdlerized, especially when it comes to Smith's bankruptcy and anything to do with his wife.

Smith's 1815 map was originally published at a scale of five miles to the inch. At this scale, the whole map was 8 × 6 feet in size and could not be printed in one go. Consequently, it was divided into 15 sections, each folded into six panels. The British Geological Survey has done an excellent job of reassembling the panels and photographing the whole as one map. The joins between the sections have been digitally enhanced so that they are not so obvious and then the whole composite map reprinted at half scale (133 × 95 cm). Even the smallest lettering is still visible and the colour is remarkable even considering that the originals were all hand coloured and must have shown a bit of variation from one section to another. The map also has 'stratigraphic' explanation and a vertical cross-section from London to Snowdon.

The Survey has also produced a facsimile of Smith's 1820 map with its significant additional information. At 79 × 65 cm, it is certainly a more convenient size and has extra geological information about southern Scotland, a bit of northwest France and the east of Ireland plus more detail in Wales and southwest England. However, I do not find it as aesthetically pleasing as the 1815 map.

But while there is a resurgent interest in important early geological maps why not reproduce Griffith's 1839 wonderful Railway Commissioners' Map of Ireland (N.B. before the religio-political carve up) and Macculloch's map of Scotland published posthumously in 1840? Poor Macculloch died in 1835 aged 62 on his honeymoon as a result of a coach accident. And have the French reproduced Cuvier & Brongniart's 1811 map of the Paris Basin?

Phillips' biography was part of a wider rehabilitation of his uncle and perhaps the need to create a British 'hero' and pioneer of geological mapping to counter French claims. The 'great and the good' of London's Geological Society, figures like Sedgwick and Lyell, led the 'charge'. To get an insider view of the shenanigans of mid-Victorian British geology, read the late John Thackray's compilation of eye-witness accounts of Society meetings. *To See the Fellows Fight* is an entrancing reminder of the days when there were even politicians and the odd archbishop who involved themselves in matters geological.

Modelled on the parliamentary debating chamber, the Society's meeting room was famous for rancorous arguments and star-studded casts. Meetings in 1849 were attended by the likes of Brunel, Sir Robert Peel, and, according to the eminent geologist Charles Lyell, 'a great many M.P.'s'. According to Thackray, the Society's Council 'refused to record or report the discussions; they were for internal consumption only'. But word spread that there were verbal squibs and fireworks regularly illuminating evenings in Burlington House and leaks were appearing in the press. Apparently 'editors of both *The Athanaeum* and *The Geologist* had their knuckles rapped for mentioning discussions in print, both expressing puzzlement at the decision'. This is why Thackray made such strenuous efforts to recover these snippets from an amazing diversity of sources – a labour of love indeed. Eventually in 1868 the Society relented and took to publishing a very abbreviated version of discussions (without the fun and games) in the *Proceedings*. Sadly Thackray died in 1999 before the compilation was complete but his friends and colleagues Janet Browne, Jim Secord and Hugh Torrens have worked hard to see this fascinating literary 'lagerstätten' published.

Douglas Palmer

Reference
SMITH, W. 2002. *William Smith's 1820 Geological Map of England and Wales (reproduction)* . [Original title: *A New*

Geological Map of England and Wales, with the Inland Navigations; Exhibiting the Districts of Coal and other Sites of Mineral Tonnage]. Size 76.5 cm × 63.5 cm (portrait format). Keyworth: British Geological Survey.

FOWLER, C. M. R., EBINGER, C. J. & HAWKESWORTH, C. J. (eds) 2002. *The Early Earth: Physical, Chemical and Biological Development.* Geological Society Special Publication no. 199. viii + 360 pp. London, Bath: Geological Society of London. Price £85.00, US $142.00; members' price £42.50, US $71.00; AAPG members' price £51.00, US $85.00 (hard covers). ISBN 1 86239 109 2.
DOI: 10.1017/S0016756804279432

This book contains a collection of papers that consider various aspects of the Hadean, Archaean and Proterozoic Earth. The book arose from a discussion meeting in February 2000, sponsored by the Royal Astronomical Society and the Geological Society of London. It is the newest addition to a collection of periodically appearing books that attempt to present the latest views on the early history of the Earth. As stated in the preface to the book, 'much of the character of the Archaean is still unknown', and this book is a valuable contribution for two reasons: it's the most recent book on the subject, and it includes papers which address the Earth's biological and atmospheric development as well as its geological development. Having said that, the book also has two downsides: firstly, it necessarily consists of a *pot pourri* of papers, and secondly it is affected by the same affliction that affects all books on the Archaean, in that the authors cannot resist the temptation to speculate widely about the big Archaean picture.

The book is well produced, with the figures mostly being clear, although a few appear to suffer from the problem of being black and white reproductions of colour figures. It is divided into three sections and all papers are peer-reviewed and of high quality. The first section contains seven papers, which address the geophysical and petrological constraints on the Archaean and Proterozoic lithosphere; the second contains three papers, which present models of Archaean cratonic evolution and modification; and the third consists of six papers, which discuss various geological, chemical and biological constraints on the Hadean and Archaean environment.

Some of the papers in Part I illustrate the uncertainties associated with studying the Archaean. James & Fouch present an excellent summary of the seismic component of the Kaapvaal project, and the results should be required reading for anybody studying Archaean craton formation. Nevertheless, they can't resist invoking the MIT doctrine that komatiites are subduction zone magmas, without citing the counter arguments. Priestley & McKenzie discuss the structure of the upper mantle beneath southern Africa and using shear and surface waves argue that the present day seismic lithosphere does not exceed 160 km. This result is in contrast to the conclusions of James & Fouch who use body wave tomography to argue that high-velocity mantle roots extend locally to depths of 250–300 km beneath southern Africa, a similar conclusion to that of Kendall *et al.* for the Western Superior Province. Pearson *et al.* use PGE and Re–Os systematics to argue that the Kaapvaal lithospheric mantle formed at 2.5–3.0 Ga following the cessation of major crustal differentiation events at 3.1 Ga, whereas James & Fouch claim 'comprehensive Re–Os isotopic studies on peridotite xenoliths on and off the craton in Southern Africa have similar ages to the overlying crust'. In addition, Arndt *et al.* present the thought-provoking conclusion that the Kaapvaal continental crust is chemically allochthonous to its underlying lithospheric mantle.

In Part II, Bleeker presents his over-view of Archaean tectonics and addresses the controversial question of in what tectonic environment Archaean granite–greenstone terranes formed. His reflections are derived largely from studying the Slave Craton of northern Canada and he eschews 'the common emphasis on the superficial similarities with modern plate tectonics'. Jelsma & Dirks review the evolution of the Zimbabwe Craton and also conclude that tectonic styles cannot be entirely reconciled with modern plate tectonic processes.

In Part III, the formation, maintenance and development of the Archaean surface environment is discussed. Marty & Dauphas consider the formation of the early Hadean atmosphere and suggest 'the contribution of comets to the volatile inventory of the Earth was very limited'. Zahnle & Sleep somewhat controversially argue against a massive CO_2 atmosphere and warm climates during the Archaean and the Hadean, whereas Kramers considers the more traditional view and predicts when the drawdown of the massive CO_2 atmosphere might have occurred. The keynote paper by Nisbet is an excellent discussion of both the physical and biological controls on the Earth during the late Hadean and Archaean, and reminds the geologist that 'to a significant extent life has helped shape the physical evolution of the planet'.

In summary, the papers contained in this book exemplify the unknowns and disagreements associated with the study of the Hadean and the Archaean. Nevertheless, the book does provide a selection of well-written, up-to-date research papers on the early Earth. It would make a valuable addition to the shelves of any geological library, and could possibly serve as a course text for a graduate seminar.

Mike Cheadle

YOSHIDA, M., WINDLEY, B. F. & DASGUPTA, S. (eds) 2003. *Proterozoic East Gondwana: Supercontinent Assembly and Breakup*. Geological Society Special Publication no. 206. x + 472 pp. London, Bath: Geological Society of London. Price £110.00, US $183.00; GSL member price £55.00, US $92.00; AAPG/SEPM/GSA member price £66.00, US $110.00; hard covers. ISBN 1 86239 125 4.
DOI: 10.1017/S0016756804289439

Seeing back into geological history is an intellectually exciting but often difficult exercise. The modern paradigm of Plate Tectonics explains much of what we see in the Earth's oceanic and continental crust. The paradigm is underpinned by a whole variety of geophysical, structural, petrological, geochemical and geochronological data. Geologists who try to look far back into Early Earth history ask when did plate tectonics as we know it today commence. Was it at the Archaean–Proterozoic boundary, during the late Archaean or even earlier? The incomplete Archaean rock record is an unreliable witness and hence the argument continues. Many undergraduates might find it hard to believe that Plate Tectonics started before the break-up of the Pangaean

supercontinent sometime after 200 Ma. This would be a clearly erroneous suggestion but essentially it represents a desire not to look too far back into geological history. This collection of papers attempts to see back into that period of time when Gondwana, the southern part of Pangaea, was assembled.

In the early 1990s lan Dalziel and Paul Hoffman separately suggested the evolution of a Meso-Proterozoic supercontinent now known as Rodinia. In their model Rodinia (which eventually formed East Gondwanaland) formed during the Meso-Proterozoic. The West Gondwanaland supercontinent was assembled during the Neo-Proterozoic and collided with Rodinia during the Neo-Proterozoic to form Gondwanaland. However, recent data suggest that both East (Rodinia) and West Gondwanaland were assembled during the Pan-African orogeny and that Gondwanaland was thus assembled at that time.

This volume attempts to address the question as to which of these two models is correct. I am unconvinced as to whether or not it does so. Unfortunately, as far as I can see, the majority of papers do not address the fundamental question. I would have liked to have seen a critical review of the question presented in the preface. This could have been a full introductory paper written by the editors but sadly there is no such overview. One would also have hoped that the four review papers that open the volume would have addressed this key issue directly. However, Condie in his review paper on the Neo-Proterozoic record of supercontinents, superplumes and continental growth, starts from the basis that Rodinia grew during the Neo-Proterozoic whereas Windley, in his review paper, does not address the question at all. The other two review papers, by Pisarevsky *et al*. and Yoshida *et al*., purport to provide critical reviews of the key question. The former supports the Neo-Proterozoic story and the latter the Meso-Proterozoic one. Having read both I am left with a feeling of frustration. There are two main emotions. One is that data is being used selectively to argue a case and that there is no real critique here. The other is that the Meso-Proterozoic supporters are on the back foot while defending their case against new data. This does not mean to say that they will not eventually be proved to be right. Ultimately the preface and the four review papers do not provide a critical analysis of the question that this collection of papers attempts to address. It is up to the reader to try to divine the answer and that is not a trivial exercise on the basis of the data presented here.

The bulk of the volume is made up of papers that describe rock series from Australia, southern Asia, Antarctica, and east and south-central Africa. The science reported in all of these papers is data rich and may be impeccably interpreted but it tends not to address the central question specifically posed by the editors in their, all too brief, preface. In this respect the book is a disappointment. There is too much small scale or local detail and not enough on the regional implications. The latter could have been pulled out by the editors in a wide ranging critical review chapter had they chosen to do so. Sadly, they didn't, although that could have been because although can clearly identify the question they cannot identify the answer.

There is some good material in this book. The review chapters are interesting and well worth reading, and as a long term student of the geology of southern central Africa I personally found Hanson's paper fascinating. Others will doubtless find the new data published here of interest to their own regions of study. However, this volume does not present a state of the art review of the topic area and will not be highly cited.

Peter J. Treloar

RENAULT, R. W. & ASHLEY, G. M. (eds) 2002. *Sedimentation in Continental Rifts*. SEPM Special Publication no. 73. iv + 329 pp. Tulsa: SEPM (Society for Sedimentary Geology). Price US $140.00; members' price US $100.00 (hard covers). ISBN 1 56576 082 4.
DOI: 10.1017/S0016756804299435

This book adds to a number of previous publications concerned with sedimentation in rift basins. It contains 19 individual papers together with a brief introduction to the volume, and is split into three main themes: (1) Volcanic, Tectonic and Hydrological Controls; (2) Fluvial and Alluvial Depositional Systems; and (3) Lacustrine, Spring and Wetland Depositional Systems.

The first section contains a variety of papers. The first three are concerned with large-scale, predominantly structural aspects of rift development. The next paper by Hinderer & Einsele on modelling sediment supply and accumulation in rift basins illustrates how much we still do not know about rift basin filling. The four remaining papers are concerned with case histories of specific rift basins and include three Pliocene to Recent examples: a high-resolution archaeological study of the last million years of sedimentation at Olorgesailie, Kenya; a Plio-Pleistocene example from Olduvai Gorge, Kenya; and a hot spring deposit from the Turkana Basin, Kenya. The last paper in this section is concerned with a detailed case history from the Permian Mid-Zambezi rift system. The first two papers by Ebinger *et al.* and Morley provide useful up-to-date reviews of the structural development of rift basins, whereas the remaining papers contain elements of interest that are specific to their study areas.

The second section contains four papers. The Rio Grande Rift paper of Mack *et al.* continues the high-quality detailed stratigraphic analysis of this area that these workers have undertaken in recent years. McCarthy *et al.* synthesize much of the published information on the Okovango delta and this is a useful contribution to this important and commonly referenced depositional system. The two other papers in this section are concerned with the identification of mud aggregates (Gierlowski-Kordesch & Gibling) and climatic variations as deduced from Triassic soil profiles in north Carolina (Driese & Mora).

The remaining seven papers which comprise the final section of the book are, with the exception of the last paper, concerned with modern lacustrine, spring and wetland sedimentation in East African rift basins. The last paper looks at lacustrine and spring carbonates in Mesozoic basins of eastern North America.

In summary this book provides a useful up-to-date analysis of structural models for rift basins and the influence of structure on sedimentation. It also provides a number of detailed case histories of sedimentation in rift basins. Of the 19 papers nine are concerned with Pliocene to Recent sedimentation in East African rift basins. Many of the papers appear not to be specifically focussed on continental sedimentation in rift basins, but rather to be studies that happen to be located within a rift basin. The

volume is well produced with high-quality diagrams and is well edited. It is recommended to researchers interested in rift basins, particularly modern rift sedimentation in East Africa.

Adrian Hartley

SAMPSELL, B. M. 2003. *A Traveler's Guide to the Geology of Egypt*. xi + 228 pp. Cairo, New York: The American University in Cairo Press. Price US $22.50 (paperback). ISBN 977 424 785 X.
DOI: 10.1017/S001675680430943X

Having recently reviewed *Geology of Egypt and Libya* by Edward E. Tawadros (*Geological Magazine* Volume **140**, pp. 362–3), the opportunity to review a book that might detail specific localities and outline the geological history of the Land of the Pharaohs for the geotourist seemed too good to miss – particularly as the author sets out to provide a new perspective on the links between the evolution of Egyptian culture and the geological processes that had shaped the area. My hope was that the *Traveler's Guide* would act as a detailed road map through both Egypt and its geology, something akin to a Geologists' Association fieldguide.

The book is set out as a geological journey travelling down the Nile from Lake Nasser to the Nile Delta. The first two chapters are devoted to the explanation of important geological concepts and the origin of the various rock types found in Egypt; the aim is to introduce the traveller to concepts such as geological time; continental drift; the different types of rocks that form under igneous, metamorphic and depositional regimes; stratigraphy and the effects of weathering, erosion, transport and deposition. The assumption is that the traveller has little or no previous knowledge of geology, let alone of the use of geological materials in relation to the development of Egyptian culture over time. If this assumption is true then the author has set herself an almost impossible task as few travellers will try to master these concepts whilst moving from temple to temple or between quarries from which the building materials were extracted thousands of years ago. The lack of detailed geological maps, measured sections and directions to localities strengthens the assumption that the book is aimed at the group traveller who will observe large- or small-scale geological phenomena from a bus, boat or on a march between sites of historic interest.

If one ignores the first two chapters then *A Traveler's Guide to the Geology of Egypt* has much to offer the traveller with more than a passing interest in magnificent historic sites. The reader will learn much about the role of the Nile and its tributaries in the evolution of the Egyptian landscape and the agricultural skills evolved over a period of 6000 years. The role of the Aswan Dam, the problem of salt accumulation in rich agricultural areas, the changes in river patterns and the utilization of modern technologies in the opening up of Red Sea tourism are clearly explained and Ms Sampsell ably defines the various landscapes that exist in both mainland Egypt and the Sinai Peninsula.

Her knowledge of the utilization of geological resources by the engineers and craftsmen of successive kingdoms and dynasties is clearly expressed over thirteen chapters. I am not sure that every traveller will benefit from a book which tries to cover such a vast and varied part of Africa and the Middle East on a single trip; however, I am convinced that one with an interest in the earth science background of a holiday destination will find it a fascinating read. Even then, there are many amateur geoscientists who wait for a book with a more hands-on approach to guide them over the various terranes of the Land of the Pharaohs.

Richard Moody

Reference

TAWADROS, E. E. 2001. *Geology of Egypt and Libya*. Rotterdam: A. A. Balkema. 468 pp.

BENNISON, G. M. & MOSELEY, K. A. 2003. *An Introduction to Geological Structures and Maps*, 7th ed. xii + 160 pp. London, New York, Sydney, Auckland: Arnold (Hodder Headline Group); distributed in the USA by Oxford University Press. Price £14.99 (paperback). ISBN 0 340 80956 6.
DOI: 10.1017/S0016756804319436

This little book is one of the great survivors of geological textbooks. Since the first edition published 40 years ago, this excellent textbook has provided generations of A-level and first year undergraduates with a simple introduction to the techniques of geological map interpretation and the construction of cross-sections.

This is a very practical book in which short descriptions of different types of geological structures are interspersed with numerous map-based exercises. In this manner, the book successfully explains the close clink between structural geology and geological maps. Although the scope of the book has broadened with successive editions, the emphasis remains on structure contours for representing structural surfaces. This approach comes at a price because not many published maps are amenable to this treatment, and invented idealized maps are required for the exercises. On the other hand, structure contours provide a way of dealing properly with three-dimensional geometry, and therefore facilitate the all-important training of the student in 3D visualization.

Publishers urge authors to produce new editions because it helps with the promotion of the title. For this reason there is a temptation for the authors to add new material with the risk that the book exceeds its original remit and the price exceeds the budget of the target readership. This seventh edition has avoided these pitfalls. The inclusion of 16 field photographs of geological structures is a welcome addition to a text already generously illustrated with some 50 line drawings. New problem maps have also been added, increasing the total to 46 and making the book very good value. Teachers giving a course on map interpretation will welcome the fact that, as well as the answers to numerical exercises, the book now incorporates the completed cross-sections of the problem maps. From a marketing point of view this may backfire, because inclusion of the answers may dissuade some instructors from adopting this book as a course text.

There is room for some minor improvements, especially in the definition of some terms such as *asymmetrical folds*, *throw* and *heave* and the inclusion of other redundant terms such as *want* and *hade*. These can be easily rectified in the eight edition of this excellent book.

Richard Lisle

COX, B. M. & SUMBLER, M. G. 2002. *British Middle Jurassic Stratigraphy*. Geological Conservation Review Series Volume 26. xvi + 508 pp. Peterborough: Joint Nature Conservation Committee; distributed by NHBS Ltd, 2–3 Wills Road, Totnes, Devon TQ9 5XN, UK. Price £70.00 (hard covers). ISBN 1 86107 479 4.
DOI: 10.1017/S0016756804329432

The aim of this large-format volume, as the back cover tells us, 'is to provide a public record of the features of interest and importance at localities already notified, or being considered for notification as 'Sites of Special Scientific Interest' SSSis'. The volume describes more than 100 such sites, exposing Aalenian–Callovian sedimentary rocks, over the whole Middle Jurassic outcrop of Great Britain: an elongated area that stretches from the Dorset Coast, through the Cotswolds, Midlands to Yorkshire and also takes in the Hebrides. The authors involved are B. M. Cox, N. Morton, K. N Page, M. G. Sumbler and R. J. Wyatt. The localities are identified by map references, together with other locality details and further described with measured sections and, in some cases, outcrop photographs (not particularly well reproduced) and graphic logs. Maps of some areas, sketches of fossils and the occasional photograph of pioneers in Jurassic stratigraphy complete the illustrative material. As well as detailed lithological description of each locality, there are interpretations, drawn from relevant literature, of the sedimentary environments pertaining at the time of deposition.

For students of the Jurassic, who wish to sample particular strata of a particular age, this is an invaluable resource. With this book in hand you can readily find the localities in question, you can identify key horizons and have instant access to – in many cases – more than a century's worth of accumulated biostratigraphic information. The reference list is compendious and I could find no obvious omissions. Of course, you have to know and love the Jurassic, or know enough about the Jurassic to know that you might love it were you to know it more, in order to get the most from this book. In its own way it is a labour of love on the part of the authors and they are to be congratulated for having assembled so much useful data in one place. This volume deserves a place in every Geology/Earth Sciences library in this country, whether in Museum or University, and stratigraphers elsewhere will find it invaluable if they have serious intentions towards the British Middle Jurassic.

H. C. Jenkyns