BOOK REVIEWS

WATTS, A. B. 2001. *Isostasy and Flexure of the Lithosphere*. xix + 458 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £75.00, US $110.00 (hard covers), £29.95, US $44.95 (paperback). ISBN 0 521 62272 7; 0 521 00600 7 (pb).
Geol. Mag. 139, 2002, DOI: 10.1017/S0016756802216696

After more than 30 years of active and ground-breaking research, Professor Anthony B. Watts of Oxford University has written his first book on the subject of isostasy and flexure of the lithosphere, which is also the title of his new book published by Cambridge University Press. In it, Dr Watts takes us on an entertaining journey from the early ideas concerning isostasy and strength of the outer layers of the Earth to the latest space-based inferences of isostasy on the terrestrial planets. As such, it is a unique book, being the first modern treatise that is fully dedicated to isostasy and how nature strives to achieve it at all length scales. Lucidly written yet mathematically rigorous, the book is beautifully illustrated and contains numerous references to the most pertinent work, and as such will serve as a valuable reference book for researchers in this important field. Intended for use as a graduate-level textbook, the fundamental importance of the subject matter is bound to make the book of great interest to a broad range of scientists studying gravity, isostasy, geodesy, tectonics, and basin analysis.

The book begins by tracing the roots of the isostatic ideas of the early 18th century, including the insights of Pratt and Airy motivated by the geodetic surveys in India, and moves on to introduce the concept of regional isostasy which takes us to the modern models of flexural isostasy. Subsequent chapters detail the competing models of isostasy (local and regional compensation schemes, including Pratt, Airy, and plate flexure) and characterize them using the formalism of gravitational admittance and isostatic response functions. Professor Watts clarifies the connections between the mathematical models being formulated and the rheology of the part of the Earth that is being modelled. With these foundations firmly in place, the author takes us on a fascinating tour of how the nature of isostasy can be inferred at a wide range of geological features in both the oceans as well as on the continents, and how the interpretation of the state of isostasy can provide great insights into their origin and evolution. This odyssey takes us to the boundaries of the tectonic plates where extensional (rifting, rift flank uplift, and evolution of continental margins), compressional (subduction, outer rise uplift, orogenic belts and foreland basins), and strike-slip (transforms, fracture zones, and transform margins) stress regimes deform the lithosphere whose strength often varies in time and space. Far from plate boundaries, we encounter examples of isostasy at intracratonic basins, mid-plate hotspot swells and seamount chains. At all of these tectonic settings, the thermal history of the lithosphere plays a major role in defining its response to the applied forces, and Watts gives a clear picture of how the state of isostasy relates to the evolution of the observed features. The last chapter in the book is concerned with the state of knowledge of isostasy on the terrestrial planets, leading up to the latest results from satellite missions to Mars and Venus. In summary, a superb book which covers a lot of ground on a fundamental topic of general importance to Earth scientists.

Paul Wessel

ALLMON, W. D. & BOTTJER, D. J. (eds) 2000. *Evolutionary Paleoecology. The Ecological Context of Macroevolutionary Change*. xi+357 pp. New York: Columbia University Press. Price US $45.00, £29.00 (hard covers), US $25.00, £16.00 (paperback). ISBN 0 231 10994 6; 0 231 10995 4 (pb).
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The word 'palaeoecology' was once applied to almost any palaeontological study that treated fossils as living organisms rather than simply organic shapes of utility in stratigraphy. There followed a time during which community palaeoecology – the reconstruction of ancient communities and their trophic interactions – took centre stage. We are now entering a new phase of palaeoecology epitomized by the subtitle of this book: 'The ecological context of evolutionary change'. Just as ecologists are becoming increasingly concerned with patterns of biotic distribution on large spatial scales ('macroecology'), so palaeoecologists are looking beyond studies of single assemblages to interpretation of ecological changes across vast stretches of geological time as a backcloth to macroevolution. This collection of 11 papers, dedicated to the late Jack Sepkoski, arose from a GSA Symposium held in 1996. Like most volumes with a similar background, it is an assortment of research papers which are varied in their generality, focus and quality. The editors describe it as a 'benchmark sampler'.

Valentine's article traces the origins of evolutionary palaeoecology and underlines the importance of scaling; it is becoming increasingly evident that certain processes proposed by biologists to account for distributional patterns at the present-day fail in the light of the fossil record. Hierarchical systems for classifying palaeoecological units are reviewed by Miller who strives to correlate entities from different systems, for example, assemblage with biofacies. Whether there is a true hierarchy to be discovered or just a continuum of scales is another issue. Of more importance is the desirability of maintaining a distinction between palaeoecological classifications derived from empirical patterns (e.g. fossil assemblages) and those based on interpreting processes (e.g. ancient communities). Largely through the publications of Sepkoski, changes in taxonomic diversity through the Phanerozoic have been a focus of considerable interest among palaeontologists. However, diversity trends alone go only some way towards encapsulating the history of life; changes in abundance are also part of the story. This is well illustrated by the analysis of Bottjer *et al*. revealing evidence of decoupling of taxonomic and ecological changes during major evolutionary events in marine invertebrates. For example, whereas the end-Permian mass extinction of taxa was accompanied by profound ecological changes, the end-Ordovician mass extinction showed no such ecological restructuring.

Tang reviews coordinated stasis, the theory that communities show long-term faunal stability. She makes a useful dis-

tinction between two causes of stability – resistance and resilience – and explores how time-averaging can complicate their recognition in the fossil record. Sitting a little uneasily among the other papers is Lieberman's molecular phylogeographic analysis of a freshwater bivalve clade in the rivers of eastern and central USA. None the less the finding of genetic instability in this clade is used by Lieberman as an argument against coordinated stasis. The chapter by Aronson & Precht on Caribbean reef corals also tackles coordinated stasis, emphasizing problems of inferring processes over geological time-scales and therefore identifying the mechanisms underlying coordinated stasis.

Nutrient levels exert a powerful influence on the distribution of marine organisms but what effect do nutrients have on evolution? This question is addressed by Allmon & Ross who suggest ways in which nutrients might affect speciation. Although the term nutrient tends to be applied to chemical elements (e.g. Fe, Si) that limit biological population growth, almost any resource used by organisms can be broadly labelled as a nutrient, including food. The chapter by Kelley & Hansen is an excellent review of coevolution between naticid gastropods and the snails they eat by drilling through the shell. They conclude that adaptational escalation occurred episodically and was related to mass extinctions, and find no evidence of increased capability by naticid predators. However, the frequency of failed drillholes points to prey species becoming progressively better adapted.

The final two chapters shift to the terrestrial realm. Raymond *et al.* present evidence from a study of coal-balls that the rate of decomposition of vegetation was slower in Carboniferous than in modern peats, probably due to a lack of efficient detritivores, with a correlated lower level of primary productivity. Correlations between higher taxa of vascular plants and ecological distributions in the Palaeozoic are explored by DiMichele *et al.* using multivariate statistical analysis. During the Mid Devonian to Early Carboniferous radiation, major groups of plants apparently became partitioned ecologically, holding an incumbent advantage which persisted until a major climatic change.

At a mere £16 for the paperback version, *Evolutionary Paleoecology* will find its way onto the bookshelves of many palaeontologists and perhaps even a few enlightened ecologists. Several of the chapters could form the basis of advanced level seminars or tutorials, and there is much here to stimulate future research in palaeoecology, albeit far removed from the early scope of the subject.

Paul D. Taylor

OLLIER, C. & PAIN, C. 2000. *The Origin of Mountains.* xviii+345 pp. London, New York: Taylor & Francis. Price £29.99 (paperback). ISBN 0 415 19890 9.
Geol. Mag. 139, 2002, DOI: 10.1017/S0016756802236699

This book will disappoint most geologists and is not to be recommended. The authors are geomorphologists who believe that the importance of geomorphology in understanding mountain building has been under-appreciated by the geological community. This may be true, but this book will not help their cause. The stated theme of the book is the narrow assertion that all mountain ranges form by vertical uplift of plateaus followed by erosion with or without gravity sliding. This book is basically anti-plate tectonics and, instead of enlightening the reader, we are treated to one-sided views, unsupported assertions, obsolete information and generally sloppy scholarship.

The book is uncomfortably organized between chapters covering mountains on four of seven major continents and topical subjects such as mountains with gravity structures and mountains on passive margins. The overall writing is not concise, nor well organized, and there is widespread redundancy of the authors' opinions. The figures are generally very poor. Many are obsolete cartoons such as a 1965 cross-section of the Alps, a 1972 Taiwan cross-section, a 1976 section across Peru, etc. (why weren't available modern sections used that are constrained by detailed seismic, borehole, and structural data?). In general, the references that are selected to support various arguments are either pre-plate tectonics or anti-plate tectonics, and many figures are crude line drawings that would not be acceptable on a modern undergraduate's exam script. It is hard to see who this book is written for; it is definitely not for students unless one wants our students to learn about geosynclines, 'mushroom tectonics', 'geotumours' and 'polyorifice volcanism'.

The biggest problem with this book is the obvious disregard for research advances made during the last 30 years in active tectonics. There is no discussion of the information derived from the global earthquake record on mountain building. The authors repeatedly maintain that thrusts are actually gravity slides that have moved downhill despite the overwhelming majority of focal mechanism solutions from active fold and thrust belts all over the world showing upslope movements (not to mention well documented surface thrust scarps). There is no mention of the major developments in geodetic research on measured rates of active deformation and uplift. Nor do the authors accept the close link between thrusting and folding (fault propagation folds, fault-bend folds) in contractional orogens. Instead, the authors repeatedly insist that folding and mountain building do not occur at the same time (p. 9 and again in virtually every subsequent chapter). The huge amount of information on orogenic architecture derived from seismic profiling is almost completely omitted. The evidence for the timing of mountain uplift as recorded in foreland basin sediments is also ignored or incompletely described for almost every region discussed. No mention of inversion tectonics is ever made despite its clearly documented importance in so many mountain belts. Transpression is also never mentioned.

The book is full of misleading information such as descriptions of 'diapirs of Precambrian rocks in the Basin and Range' (p. 97), 'the large stratovolcano of Aconcagua' (p. 118), the Andes were uplifted as a 'great horst' (p. 127), 'no evidence for compression along the Andean margin' (p. 125), a decollement is an unconformity (p. 152), and there is 'little evidence for compression due to the Indo-Eurasia collision north of the Himalaya' (p. 140). Plate tectonics is described as a 'fad' (p. 312) and subduction apparently plays no role in mountain building (p. 312). Concepts of trench retreat, arc migration and back-arc extension are generally rejected. The role of asymmetric rifting and footwall uplift to produce passive margin mountains is never properly explored or analysed, except to say that passive margin mountains are not associated with subduction, therefore plate tectonics has no explanation for their existence (p. 193).

The book contains a few mildly interesting sections on erosion and mountain building, peneplains and escarpments, and tectonic controls on drainage patterns. However, the authors have missed a good opportunity to include modern contributions from tectonic geomorphology, especially advances made by analysing morphometric indices of active tectonism. A more balanced and quantitative exploration of the role of gravity in mountain building instead of a simplis-

tic pre-plate tectonics approach would have been welcome. For most readers, the book will lose credibility by page 4 where it is suggested that structural geology should be divorced from the study of mountain building.

The authors do raise important questions about the mechanism of Tertiary uplift in some ranges such as the Appalachians, Caledonides and Eastern Australia. They raise valid points that some areas of plateau uplift (e.g. Guyana Highlands, Colorado Plateau) are not yet well explained by plate tectonicists. However, in trying to ascribe a common and grossly simplistic mechanism of plateau uplift and erosion with or without gravity sliding to explain all mountain belts, they have done themselves and their readers a disservice by rejecting orogenic diversity and complexity. Their dismissive tone about the pitfalls of plate tectonic models weakens their arguments and will alienate most readers.

Dickson Cunningham

SCOTT, D. B., MEDIOLI, F. S. & SCHAFER, C. T. 2001. *Monitoring in Coastal Environments Using Foraminifera and Thecamoebian Indicators*. Cambridge, New York, Melbourne: Cambridge University Press. Price £70.00, US $100.00 (hard covers). ISBN 0 521 56173 6.
Geol. Mag. 139, 2002, DOI: 10.1017/S0016756802246695

This book is aimed at non-specialists (in micropalaeontology) such as environmental consultants and resource managers who are dealing with coastal environmental problems, and at graduate students working with various aspects of environmental sciences. Consequently, the authors have chosen a simplistic way of presenting a topic, which, so far, mainly has been accessible to specialists. Obviously, simplification of such a specialized field as micropalaeontology is a big challenge as most people have hardly ever been exposed to words like 'foraminifera' or 'thecamoebians'! This means that the authors have to start from scratch and carefully explain what these organisms are, the basic terminology that goes with them (including a simplistic approach to their taxonomy), the commonly used methods to collect and handle data, and how (and why) the organisms can be applied in environmental studies. This is partly done in the text proper but also followed up by a glossary without which the non-professional reader would have been rendered helpless. The addition of 'a summary of key points' at the end of each chapter is also helpful.

The book covers 177 pages of which the first 96 introduce the reader to foraminifera and thecamoebians (chapter 1), methodological considerations (chapter 2), and their applications in coastal marine water systems and in marine–freshwater transitions (chapters 3 and 4). The section on thecamoebians in freshwater systems (chapter 5) covers nearly 30 pages. Because this gives an excellent overview of the biology, ecology, and applicability of the group, it is of particular interest to microfossil specialists, as well as to the audience primarily addressed by the book. Most diagrams are simple and informative. The plates consist of line drawings of commonly occurring species but it would have been nice to see some photos of what foraminifera and thecamoebians really look like too.

Short sections on (1) data treatments (statistics and faunal parameters) and how the output data aid interpretations, (2) the most commonly used dating methods (^{210}Pb, ^{137}Cs, ^{14}C), which are of fundamental importance for relating sediment core data to historical events, and (3) the criteria used for interpreting sea-level changes and to accurately determine the position of past sea levels, would have been useful. The authors state that some of the issues dealt with may have been oversimplified due to space constraints. It should be noted, however, that the 'ideal' zonation of salt marsh foraminifera they present does not apply worldwide – actually not even within North America – and that the use of elevation as the primary important parameter is under debate.

This book will obviously be of great help to non-specialists who want to formulate monitoring and assessment strategies. However, they should be aware that the references provided, in places, are rather selective (e.g. the most recent reference to reproduction mode is from 1991; some key references to US salt marsh studies are omitted; and their use of total (i.e. live plus dead) assemblages rather than live and dead separately, is highly debatable). One of the major messages conveyed by the authors is to demonstrate how 'these two groups have a great advantage over most other biological indicators because they leave a microfossil record that permits the reconstruction of the environmental history of a site in the absence of original (i.e. real-time) physiochemical baseline data'. The authors have succeeded in this as the book presents numerous case studies, which clearly demonstrate the unique applicability of these microfossils. After having read the book, nobody can doubt that microfossils should become a standard tool in future environmental studies. Consequently, the great strength of the book is that it demonstrates, to a wider audience, that microfossil data can provide environmental consultants and resource managers with cost-effective and, at the same time, crucial environmental background (long-term) information, which they cannot obtain by other means!

Elisabeth Alve

WOOLLEY, A. R. 2001. *Alkaline Rocks and Carbonatites of the World. Part 3: Africa.* v + 372 pp. London, Bath: Geological Society of London. Price £85.00 (hard covers); members' price £39.00. ISBN 1 86239 083 5.
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During the last decade, alkaline igneous rocks and carbonatites have become of increasing scientific importance. Their significance to our understanding of both small- and large-scale crust and mantle processes has been highlighted by numerous recent detailed, field, petrographic and geochemical studies. These igneous rocks are also of growing economic importance as they are the host of a wide variety of metals (including Nb and the REEs). Because of their relatively small volumes, alkaline igneous rocks and carbonatites are frequently difficult to locate in the field and investigations rely on previous reports of their occurrence. These are often published in local journals and/or historic literature and difficult to find. As the African continent has the greatest number of occurrences of alkaline igneous rocks and carbonatites, *Alkaline Rocks and Carbonatites of the World: Part 3: Africa* is a welcome addition to this series. Earlier volumes have focused on North and South America (Part 1) and the former USSR (Part 2). My only criticism of this and previous volumes is that descriptions of kimberlite localities have been omitted, despite their close association with alkaline igneous rocks, but controversial occurrences of carbonatites and fenites are included.

Alkaline Rocks and Carbonatites of the World: Part 3: Africa has been divided, on a country basis, into 40 sections.

Each of these is accompanied by a locality map and a cross-referenced list of occurrences. Over one thousand localities are listed; the majority are in Ethiopia, Kenya and Tanzania and are related to the development of the East African Rift. Other major provinces of alkaline igneous rocks are in southwest and southern Africa. Each alkaline and carbonatite complex is accompanied by a detailed geological map, geographical co-ordinates, details of the general geology, petrography, ages and economic aspects. A seven-page index at the end of the book provides easy access to sections on individual localities.

This is a unique reference source for alkaline igneous rocks of Africa. As with previous volumes, it is very well presented. I have already found myself and students using *Alkaline Rocks and Carbonatites of the World: Part 3: Africa* as a reference and would recommend this text to the wide community of scientific and economic researchers interested in alkaline igneous rocks and carbonatites.

Sally A. Gibson

MADDY, D., MACKLIN, M. G. & WOODWARD, J. C. (eds) 2001. *River Basin Sediment Systems: Archives of Environmental Change*. Proceedings of the Fluvial Archives Group meeting held in Cheltenham, UK, September 1998. xi+508 pp. Lisse, Abingdon, Exton (PA), Tokyo: A. A. Balkema Publishers. Price Euros 115.00, US $126.50, £77.00 (hard covers). ISBN 90 5809 342 5.
Geol. Mag. 139, 2002, DOI: 10.1017/S0016756802266698

This book comprises a series of papers presented at the Fluvial Archives Group symposium in Cheltenham in September 1998, and aims to highlight recent research investigating the link between river behaviour and environmental change. The book is subdivided into five parts, which present an overview of the research context, a number of case studies focusing on three environmental controls (tectonics, climate and man), and various quantitative modelling and monitoring projects. This wide-ranging approach is the book's strength, and reflects the fact that much of the research presented here straddles the boundaries of traditional disciplines such as geology, geophysics, geomorphology, archaeology and engineering.

Each of the papers in the volume is rigorous and well written, and many present comprehensive new datasets. However, several papers stand out by virtue of their cross-disciplinary approach or broad overview of the subject. A review of alluvial systematics (Lewin) and a comparative study of fluvial responses to external forcing (Blum & Straffin) both emphasize the huge range of timescales and lengthscales over which fluvial systems are studied by different disciplines, and the limitations that these different scales of observation impose on a holistic understanding of fluvial processes. The latter paper also emphasizes the complex response of rivers to external change, and the discontinuous record of this response that is preserved in alluvial stratigraphy. In combination, these papers provide a thought-provoking (and, perhaps, sobering) philosophical viewpoint from which to reassess the research themes covered in this book. Two studies of river terrace stratigraphy in northwest Europe (van den Berg & van Hoof; Westaway) address the link between fluvial landscape evolution and tectonic uplift. Both studies use very large datasets that are calibrated via high-resolution chronostratigraphy to independent sea-level and/or climate records. This approach allows the complexity of the stratigraphic record to be unravelled somewhat, addressing the concerns raised by Blum & Straffin. Other studies emphasize the difficulties of deciphering a complex stratigraphic record that has resulted from the action of various external controls on environment (e.g. Kasse & Bohncke; Houben *et al*.). Monitoring studies of sediment flux and dynamic river channel behaviour, such as those presented here (Passmore & Macklin; Rumsby *et al.*), may provide the empirical data needed to constrain the fluvial response to environmental change. In the meantime, numerical models provide a powerful tool to investigate the implications of competing interpretations of environmental change in the stratigraphic record (Tebbens & Veldkamp; Coulthard *et al.*). Perhaps the most interesting development highlighted in the book is the use of archaeological data to reconstruct river behaviour and environmental change. Although the studies presented here are work in progress (e.g. Thieme; Woodward *et al.*), they offer the prospect of a highly sensitive record of river behaviour, in addition to an improved understanding of man's role in shaping his environment.

In summary, this book offers a snapshot of a very active research field and will be of interest to specialist researchers in several disciplines. For geologists, the most valuable points raised here are the complex response of natural systems to external change, and the incomplete nature of the stratigraphic record from which we attempt to interpret this complexity.

Gary Hampson

WANGERSKY, P. J. (ed.) 2000. *Marine Chemistry. Pollution. The Handbook of Environmental Chemistry, Volume 5D.* xiv+230 pp. Berlin, Heidelberg, New York, London, Paris, Tokyo, Hong Kong: Springer-Verlag. Price DM 189.00, SFr 163.00, £65.00, US $109.99 (hard covers). ISBN 3 540 66020 8.
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The Handbook of Environmental Chemistry is an evolving series of open-ended volumes, initially published as a series of three more than twenty years ago but now expanded to five. Periodic volume updates via the addition of new 'parts' reflect rapid growth in this interdisciplinary field. *Marine Chemistry*, edited by Peter Wangersky, is a recent addition (part 5) to *Volume D: Water Pollution. Marine Chemistry* is arranged into eight chapters covering a wide range of rapidly developing research areas that have important implications for our understanding of the global ecosystem, and which have emerged at the forefront of marine science over the past decade. All chapters are written by leading experts in their fields and the material is concisely presented.

Chapter 1 (C. C. Clark & R. G. Zika) is a review of marine organic photochemistry, and considers recent developments in the important new areas of marine aerosol and sea surface microlayer photochemistry. In Chapter 2 P. E. Kepkay describes the important contribution to the global carbon cycle played by colloidal organic matter, an important DOC fraction previously largely excluded from ocean carbon budgets. Chapter 3 (B. D. Johnson) reviews the limitations of existing models of air–sea gas exchange and examines the potential offered by new measurement methods for facilitating our understanding through model refinement. In Chapter 4 V. Zitko presents an overview of marine pollution, reviews current knowledge, and predicts future developments. Chapter 5 (S. M. Myklestad) discusses the production, release and composition of phytoplankton derived DOC. In Chapter 6 V. Žutić & V. Svetličić examine interfacial

processes on suspended particles in the nanometre to submillimetre range, whose combined surface area exceeds that of the sea surface by several orders of magnitude, and which are described in terms of complex fluids. In Chapter 7 P. J. Wangersky re-evaluates sampling and analytical protocols, not only for those species considered 'problematic', such as trace metals, but also for established techniques long considered to be 'standard'. Chapter 8 (C. C. Parrish *et al.*) considers the increasing use of lipid and phenolic biomarkers as powerful tools in wide ranging applications.

I found this book most instructive. Although no text of this size can hope to address every development in these rapidly expanding fields in detail, the breadth of coverage is nevertheless impressive, nicely underscoring the interdisciplinary nature of marine science and the need for combined approaches to improve our understanding of the marine ecosystem. The work is well referenced, up to date and relatively free of typographical errors. Figures and tables are clear and I liked the overall size format and glossy presentation. This book will be of value both to professional marine scientists and to post-graduate students; however, the material may prove too specialized for many undergraduate programmes.

Rob Upstill-Goddard

ERWIN, D. H. & WING, S. L. (eds) 2001. *Deep Time: Paleobiology's Perspective*. Supplement to *Paleobiology*, Volume 26, part 4. vi + 371 pp. Chicago: University of Chicago Press for the Paleontological Society. Price US $25.00, £16.00 (paperback). ISBN 0 9677554 2 5.
Geol. Mag. 139, 2002, DOI: 10.1017/S0016756802286690

It seems hard to believe that the journal *Paleobiology* is now just over a quarter of a century old. That I can still remember life before *Paleobiology* probably says more about my age than anything else but its appearance was a very welcome addition to the relatively small world of academic palaeontological journals back in the mid 1970s. Immediately upon arrival, each issue was grabbed and scanned to find out what new interests and arguments were included. The succession of editors from Thomas J. M. Schopf, Ralph G. Johnson, James A. Hopson, John J. Sepkoski Jr, Peter R. Crane, Philip W. Signor, Richard Cowen, Geerat J. Vermeij, David L. Meyer and Arnold I. Miller says much for the scope and ambitions of the journal.

If any one of these is to be picked out, it should perhaps be the late John J. Sepkoski Jr, to whose memory this volume is dedicated. With his successive attempts to develop a more reliable taxonomic database for marine Phanerozoic fossils he made it possible to get a better view of the patterns of diversification. In doing so, he was one of the main architects of the palaeontological renaissance in the way we have come to view the fossil record. His untimely death in 1999 robbed the community of a particularly stimulating 'player'.

Attempts to portray such patterns of changing life through time as depicted by the waxing and waning of different fossil groups has a long history, going back to the early and remarkably prescient portrait given by William Smith's nephew John Phillips in 1860. In modern times, the first edition of *The Fossil Record* (eds W. B. Harland *et al.*, 1967, published by the Geological Society of London) led the way in attempting a reappraisal on a statistical basis of such changes in the past and how they looked depending on the taxonomic level chosen to view them through. Then there were contributions in the late 1960s, such as Valentine's 1969 paper on patterns in *Palaeontology* (vol. 12, pp. 684–709). The great debate following Sepkoski's landmark compilations of the 1970s has not finished by any means but it has greatly informed us and raised so many questions about the nature of the fossil record. Palaeontologists no longer have to be quite so apologetic about the deficiencies of the record and if Darwin were writing today he would not be able nor I suspect would he want to pass off the fossil record as being too gappy and problematic to use as evidence for the path of evolution in the past. But the debate is not over; the current issue of the journal contains papers which continue to pick over the problems presented by the nature of the sample of past life. To what extent are the patterns of diversity and change influenced by extent of available outcrop and the fossil sample obtained from it?

Deep Time is a collection of essays which pick up on a number of the major themes of interest whose progress the journal has tracked over the years. As the editors Douglas H. Erwin and Scott L. Wing say, the 15 invited papers in this volume represent 'the diversity of approaches and current activities in the field of paleobiology: the mechanical and functional properties of extinct organisms, the chemical composition of fossils, the implications of fossils for genetics and development, the factors affecting interpretation of the paleontological and stratigraphic record, the influence of environmental change on ecological systems and the evolution of lineages, the use of fossils in reconstructing phylogeny, and the implications of the fossil record for the processes that generate the largest-scale patterns in the history of life'. The 26 authors of these 15 essays range from John Alroy, through Derek Briggs, to Susan Kidwell, Karl Niklas and James Zachos.

Each contribution provides an overview of recent advances in its subject and raises questions which remain to be answered. By providing such an overview this selection of essays will be very useful for advanced students of palaeontology and anyone interested in 'Paleobiology's Perspective'. Pity there is no index.

Douglas Palmer

ALSHARHAN, A. S. & SCOTT, R. W. (eds) 2001. *Middle East Models of Jurassic/Cretaceous Carbonate Systems*. SEPM Special Publication no. 69. iv + 364 pp. Tulsa: SEPM (Society for Sedimentary Geology). Price US $140.00 (non-members), US $100.00 (members), plus shipping and handling; hard covers. ISBN 1 56576 075 1.
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This is a volume in the prestigious SEPM 'red-book' series, based on an international conference held in Al Ain (UAE) in December 1997. There is no need to justify compiling a volume such as this because the Middle East contains two thirds of the world's recoverable oil reserves and about one third of the recoverable gas reserves, most of which are held in Jurassic and Cretaceous carbonates. However, I have approached reviewing this book with a specific academic agenda which I feel more appropriate to the readership of this journal. My agenda focuses on an apparent anomaly. Despite the economic importance of these carbonates, and the vast research effort they have attracted, why have models derived from Middle Eastern carbonates made such a minor impact on the development of our understanding of carbonates, compared with a dozen other subsurface or exposed basins? Does this volume contain new models or approaches

which can be used for interpreting carbonate deposystems or diagenesis, warranting a wider readership?

The editors are very well respected researchers in the Middle East, and they have skilfully edited 22 papers covering a wide range of carbonate geology. I note that nine of the papers have the editors as first authors or co-authors. The editors state that the papers were selected in order to illustrate generalizations and are grouped into three themes: sequence stratigraphy, chronostratigraphy and tectonic influences; depositional and diagenetic models; hydrocarbon habitat and exploration–development case studies.

The first paper is by Ken Glennie and provides an introduction to the Cretaceous evolution of the Arabian Plate. The other papers in this first section divide themselves into those that are regional, and those which use Middle Eastern examples to assess broader stratigraphic issues. De Matos & Walkden document the mid Jurassic of UAE, and Toland the Tithonian of Lebanon. Walkden & de Matos provide, using the Lower Jurassic of the UAE and Oman, an example of how careful study of a variety of omission surfaces can improve our understanding of cyclothem frequency. Kendall and co-authors compare Aptian sections in the UAE (Shuiba) and Alaska to assess the use of the sedimentary record for dating against global sea-level charts and use simulations of spatial patterns. Mid Cretaceous eustatic events across the Tethyan Realm are analysed by Scott and coworkers, and the section ends with Skelton & Masse assessing the use of rudists for biostratigraphy in the Lower Cretaceous of Arabia.

The second section, on depositional and diagenetic models, includes several papers devoted to microfacies studies, and although not a glamorous branch of sedimentology it is an essential element for interpretations. Holail discusses Jurassic oncoids of Egypt, whereas Shebl & Alsharhan describe the microfacies of the Berriasian–Hauterivian of central Saudi Arabia, although they seem to create some terminological ambiguities. This is followed by a short paper documenting microfacies of the Maastrichtian of Oman, by Alsharhan and co-workers. Schumann provides a distinctive paper on the palaeoecology of late Cretaceous rudists of central Oman, from the famous Saiwan outcrops, and questions several widely held views about rudist aggregations, growth and their potential for reef building.

The next four papers focus on diagenesis and cover topics such as the diagenetic history of the Jurassic of Yemen (by Al Thour), exposure-related, macro- and microporosity development in the Aptian Shuiba Formation of Oman (by Al-Awar & Humphrey), stylolites in the Lower Cretaceous reservoirs of UAE (Alsharhan & Sadd), and disconformity-related diagenesis of the mid Cretaceous of Oman (Immenhauser *et al.*).

The remaining papers are devoted specifically to hydrocarbon habitats and case studies. These include two papers on the Upper Jurassic of Abu Dhabi (by Ayoub & en Nadi, and Al-Suwaidi and co-workers), the Lower Cretaceous of Kuwait (Davies *et al.*), Abu Dhabi (Saotome *et al.*) and UAE (Alsharhan *et al.*). Sadooni & Aqrawi provide a review of the Cretaceous of Iraq and the editors close the volume with a review of the Mesozoic of the UAE.

The book will be of wide use to those working on the Middle East, but I am disappointed by two aspects. Firstly, although many of the papers are of high quality several are not of the standard one has come to expect of the 'red book' series and would not have been accepted by even minor international journals. Secondly, I found very little in this volume to change my mind that the academic benefit of all the research on Middle East carbonates has been virtually negligible. Were this a publication for one of the petroleum-related organizations I would not complain but this is one of the 'red books', which have been the leading academic publications in sedimentology. Therefore the price (US $140) is not justified. Of course it is so high because the publishers see the main market as the oil industry. Knowing what is in it will I be recommending my university library to purchase it? No, because the academic content does not justify the excessive price. However, it contains a wide range of regional papers which will justify its purchase by oil companies and Middle Eastern universities and research institutions.

Paul Wright

TAYLOR, S. R. 2001. *Solar System Evolution. A New Perspective*, 2nd ed. xxiv + 460 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £60.00, US $90.00 (hard covers). ISBN 0 521 64130 6.
Geol. Mag. 139, 2002, DOI: 10.1017/S0016756802306691

Stuart Ross Taylor's first edition of this book was published a decade ago, and has become a standard reference for anyone interested in solar system evolution. It tackled the problems of planetary formation head on, unflinchingly, and in a mere 330 pages.

Much has happened in the sphere of planetary science since it was written: there have been new spacecraft missions to Mars, Venus, the Moon and the outer planets that have made major contributions to our knowledge; research into extra-terrestrial meteorites and small bodies has forged ahead; new theories of planet formation have emerged. This new edition is therefore most welcome and, some might say, overdue. Its expanded format – it is half as long again as the first edition and has double the number of chapters – reflects the extent of new data and ideas; however, the layout of the book is broadly similar, the major change being the placing of 'role of impacts' at the end of the discussion. In the light of new data the author has deemed it desirable to separate discussion within the building planets and solar nebula sections of the earlier book into distinct chapters; he has done the same when moving on to discuss individual planets. This adds to the clarity of the discussion.

I cannot fault Ross Taylor on his approach; it is a model of succinctness and the illustrations are well chosen and reproduced. He marshals the mass of chemical and physical evidence into a well-ordered structure and, although no scientist can be entirely unbiased, to my mind argues his case fairly and with considerable skill. On the basis that the gaseous giants formed early in solar system evolution, the author argues that there must have been numerous Moon-sized planetesimals left buzzing around close to the Sun, most of which were swept up to form Earth and Venus – twin worlds – but others of which survived the early battering by both impacts and solar wind to find stable orbits; these 'survivors' became Mercury and Mars. For this reason they are treated in the same chapter.

The chapter on Venus is much expanded as a result of Magellan results and there is extended discussion of water on Mars but, regrettably, no mention of Global Surveyor results (meaning, presumably, that the manuscript reached Cambridge prior to results from this important mission). Recent chemical results from Lunar Prospector are included in the Moon chapter, but not Clementine data; this I find surprising, but, in the great scheme of things, relatively unimportant.

One of the thrusts of the author's argument is that 'clockwork'-type models for solar system evolution just do not stand up to the test of modern scrutiny. Nature simply is not that orderly and no two planets within the solar family are alike. I like the statement concerning the Earth, to be found near the end of the book: 'So were formed three continental masses on which the later evolution of land animals proceeded independently … Africa alone managed to produce our unique species. So that even when everything else in the environment was perfect, blind chance still ruled the development of intelligent life. When the remote chances of developing a habitable planet are added to the chances of developing both high intelligence and a technically advanced civilization, the odds of finding "little green men" elsewhere in the universe decline to zero.'

Read this book – it deserves a place on the shelf of every planetary scientist.

Peter Cattermole

ERNST, W. G. & COLEMAN, R. G. (eds) 2000. *Tectonic Studies of Asia and the Pacific Rim. A Tribute to Benjamin M. Page (1911–1997)*. International Book Series, Volume 3. viii + 328 pp. Columbia, MD: Bellwether, for the Geological Society of America. Price US $40.00 (members), US $50.00 (non-members); paperback. ISBN 0 9665869 2 1.
Geol. Mag. 139, 2002, DOI: 10.1017/S0016756802316698

This book is a tribute volume to Benjamin M. Page (1911–1997) who spent most of his career at Stanford University, California and who was primarily a field geologist who studied the California Coast Ranges. After his official retirement from Stanford in 1976, he was editor of *Tectonics* during its early days, and later was recognized by the Geological Society of America with a Career Award in Structural Geology and Tectonics. The papers in the book are divided into two sections: Pacific and Asian Regions, and California Coast Ranges, presumably reflecting Benjamin Page's interests and those of colleagues and friends who contributed to the volume.

The first section of the book is a diverse set of papers without an obvious theme except for that of the section heading, Pacific and Asian Regions, whose range can be best conveyed by listing the topics covered. 'The geomorphology and geodynamics of the Cook–Austral Islands' discusses the history of a South Pacific seamount chain which has a long evolution requiring an explanation more complex than that of a plate travelling over a single plume. 'Armageddon's earthquakes' links the last few millennia of earthquakes to the archaeological and written history of a strategically vital part of the ancient world, now in Israel. This is followed by three papers concerned with northern Asia: one giving an account of the geochemistry of Siberian flood basalts, another discussing the stratigraphy and sedimentology of Palaeozoic sedimentary basins and volcanic arcs of Mongolia, and the last describing the largely late Cenozoic history of crustal shortening in the Tien Shan Mountains, China. The final two papers in the section discuss different aspects of the development of Mesozoic active margins: the first is concerned with the geochemistry of exotic blocks in a Cretaceous subduction complex on Taiwan, and the second discusses a petrological and geochemical study of a Cretaceous ophiolitic melange in Pakistan. Most of these papers have the flavour of research theses or monograph studies with many detailed tables of data, field maps (including several foldouts), cross-sections, and stratigraphic logs which will be of great value to workers specializing in these regions.

The second section of the book is more focused on different aspects of the development of the California Coast Ranges, a theme clearly close to Benjamin Page's heart. One paper, on the geology of Lick Observatory Quadrangle, is a quadrangle map description written by Page and prepared for publication by his colleagues. A second, by Page and two others, discusses the tectonic emplacement of serpentinites in the San Jose area and includes some of the detailed field observations which characterized his work, clearly influenced his colleagues, and provided part of the foundation of our present understanding of Californian geology. The remaining papers deal with the structure and kinematics of the San Andreas fault, the seismic structure of the California Coast Ranges, geophysical constraints on Coast Range tectonics, Neogene deformation of the San Francisco Bay area, the Franciscan geology of Mount Hamilton area, and landslide hazard information in the San Francisco Bay area. Like the first section of the book, the papers include many detailed maps, cross-sections, and field photographs.

The whole is a neat little paperback volume which will be of considerable value to specialists in the areas discussed, and a worthy tribute to a traditional and careful field-based observer who trained others and provided basic data by which our science has grown.

Robert A. Hall

SIEGERT, M. J. 2001. *Ice Sheets and Late Quaternary Environmental Change*. xv+231 pp. Chichester, New York, Weinheim, Brisbane, Singapore, Toronto: John Wiley & Sons Ltd. Price £19.99 (paperback). ISBN 0 471 98570 8.
Geol. Mag. 139, 2002, DOI: 10.1017/S0016756802326694

The study of former ice sheets is of growing importance with the realization that predicting global environmental change requires an understanding of the relationship between the cryosphere and climate as recorded in the geological record. Within this context, the last great ice sheets which covered much of North America and Europe have received a considerable amount of attention, both from the point of view of documenting ice-marginal and subglacial landforms, and in developing numerical models to ascertain their scale and dynamic behaviour. This book by Siegert of the Bristol Glaciology Centre is the first attempt to review our understanding of Late Quaternary ice sheets since the now classic work *The Last Great Ice Sheets* by Denton & Hughes, published in 1981. As such, the book represents an important contribution to the literature concerned with the relationship between ice sheets and environmental change.

The aims of the book are threefold: (i) to explain how Late Quaternary ice sheets can be reconstructed; (ii) to present the dimensions and dynamics of these former ice sheets and show how these changed through the last ice age; and (iii) to indicate how Late Quaternary ice sheets were an interactive element of the global environment. The target audience for the book is senior undergraduates and researchers, particularly for those in Geography and Earth Science departments.

The book comprises 13 chapters, the contents of which are as follows. Chapter 1, 'Causes of ice ages', first outlines the temporal scope of the study, effectively the last glacial cycle from 120 000 to 10 000 years B.P. It goes on to deal with

the principles of growth and decay of glaciers, and explains the Milankovitch theory which links climatic change to Earth's orbital variants. It also deals with amplifying factors of ice sheet growth and feedback mechanisms such as surface albedo, CO_2 in the atmosphere, ice sheet elevation and oceanic circulation.

The second chapter evaluates the indicators of ice volume and climatic change, giving examples of the records from ocean sediments, ice cores, of which the spectacular results from the Vostok (Antarctic) and Greenland ice cores figure prominently. Chapter 3 focuses on the theoretical background to glacier flow, and outlines the basis for developing numerical models of ice sheets, including how geological data provide crucial input to the modelling process.

The next three chapters (4–6) outline the geological basis for inferring the scale and dynamics of ice sheets, dealing successively with the terrestrial glacial, continental shelf and deep sea records. The first two themes are dealt with in a selective and cursory fashion, and are no substitute for the reader developing a fuller understanding of processes and products. However, as the author points out, such information can be acquired from a selection of other textbooks. The third theme, covering the continental slope to deep ocean, is a more thorough review, dealing with research that has really only emerged in the last five years or so.

Two chapters now deal with palaeoclimate and palaeoceanography. Chapter 7 shows how palaeoclimates are derived using general circulation models, and reviews ice core data and makes comparisons with other proxy data. It also examines the climatic controls on ice sheet development with reference to the modern situation, and explores how models are developed based on atmospheric changes, rather than using geological data. Chapter 8 reviews how palaeoceanography data are incorporated into ice sheet models, examines the role of oceanic currents originating from the polar regions, and demonstrates how these regions are connected by the 'global ocean conveyor'.

The last group of chapters (9–13) provides a thorough review of the ice sheet reconstructions that have been published in recent years for the last glacial cycle, dealing successively with Antarctica, Greenland, northern Eurasia, North America and 'remaining areas' (Iceland, South America, New Zealand, Tasmania, Central Europe and Tibet).

Each chapter summarizes the principal characteristics of present ice masses (where appropriate), and assembles the geological and geomorphological data used in reconstructing former ice sheets. For each of the principal ice sheets, maps showing late glacial maxima configurations for both area and thickness are given, which will be particularly useful for Quaternary specialists. Limitations in modelling ice sheets and uncertainties in the input data are evaluated, so that the reader can judge with confidence the validity of the models presented.

Overall, the work is an impressive digest of a considerable amount of information relating to Late Quaternary ice sheets. Many of the principles outlined apply also to earlier ice sheets, so even readers not interested in the last ice age specifically will find much of value. The book is well referenced (to the tune of nearly 600 entries) and sources include an excellent balance of old and new. The book is more than a review of the topic, but demonstrates that the author has a keen awareness of the limitations of ice sheet modelling, giving the reader confidence that the text is authoritative.

The text is generally highly readable, but the writing style could have been improved by tighter editing. All figures are black-and-white line drawings, giving the book a rather bland appearance, and some with grey tones of shading are unclear, probably being designed for colour reproduction. However, these are minor quibbles, and the author is to be congratulated in producing a text that conveniently summarizes a vast body of information.

So, is this text going to meet the needs of undergraduates and Quaternary researchers? I believe it does so in full measure. The book should become essential reading in any Quaternary, glacial geology or glaciology course. For researchers entering the field for the first time, there is no better introduction to the topic.

M. J. Hambrey