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# BOOK REVIEWS

STÜWE, K. 2002. *Geodynamics of the Lithosphere. An Introduction*. xiii + 449 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 69.95 (+ local VAT), SFr 116.50, £49.00, US $69.95 (hard covers). ISBN 3 540 41726 5.
DOI: 10.1017/S0016756803217842

This is a rather admirable book. Its author is a person involved in metamorphic and structural geology in the field, who is interested in how simple physical models and calculations can throw light on the significance of geological observations. In his words, the aim of the book is to 'introduce field based geologists to the quantitative treatment of their field data' and 'to the beauty and simplicity of descriptions with equations'.

The book is wide-ranging, covering topics as diverse as map projections, heat and temperature, topography and isostasy, stress, strain and rheology. Towards the end are two chapters on geodynamic processes in basins, collision belts and volcanic provinces, as well as *P–T–t* paths in metamorphic terranes. The word 'simple' is used misleadingly and often at the start of the book, in a manner that will make the worldly-wise tighten their seat belts. This book by no means shies away from mathematics, but carefully and rigourously explains the derivation of results whose practical use to geologists will usually be as a rule-of-thumb. At the end is an excellent Appendix (a 'maths refresher') explaining the basics of differential equations, finite difference methods, vector and tensor algebra, and Fourier analysis. There are questions and exercises posed throughout, with answers provided at the back. It is all done very well, and is in no sense dumbed down. The author is good at explaining why equations have the form they do, and what the different terms within them mean. Anyone who can really follow and master this book in detail will be a very good all-round quantitative geologist indeed.

I have not come across a book like this before, in Earth Sciences. It makes no attempt to provide real observations or data, or to provide an overview of how the Earth works, or to push a particular point of view or result. Nor is it at all critical of the interpretations it does discuss as examples. In these senses it is different from other geodynamics textbooks: you would not read this book for a summary of geodynamical knowledge and currently accepted interpretations. Instead, this book is about the physics, maths, and 'simple' quantitative models you can apply to the Earth. It is about how the physics works, rather than the Earth, and its usefulness will not rise and fall with the favour of currently fashionable geodynamical points of view. This book will be an excellent starting point and introduction to many topics in geodynamics. It is not as comprehensive or as mathematical as Turcotte & Schubert's *Geodynamics* or as concerned with observations and interpretations as Fowler's *The Solid Earth*, both of which are also fine books. This one, as its author intended, is more focused towards providing geologists with a background understanding of physical processes. I think it fills a need.

The book is short, concisely explained, and well-produced. It's a pity it is so expensive for its size, which will price it out of the smart undergraduate market. I would certainly recommend it for graduate students, and will use it myself.

James Jackson

*Sheet Explanations of the British Geological Survey*: 1:50 000 sheets. 32–36 pp. £9.00.
*Sheet Descriptions of the British Geological Survey*: 1:50 000 sheets. £15.00–£25.00. Keyworth, Nottingham: British Geological Survey.
DOI: 10.1017/S0016756803227849

The demise of 'The Memoir' as the standard description of British 1:50 000 geological maps has been viewed by many, including me, with nostalgic regret but with an acceptance of the inevitable. It is many years since the memoir could aspire to be a comprehensive record of field observations and interpretation. The Survey archives have always held unpublished supplementary data. In recent decades, the range of technology both for collecting and storing these data have meant that any hard-copy memoir is incomplete. The memoir has always been too detailed a buy for the geological tourist, but it was no longer detailed enough for the professional user – the planner or civil engineer – needing access to raw survey data. In any case, with the shift in the Survey's rôle from public servant to commercial provider, such detailed data became a source of income and not to be sold cheaply in memoir form. The memoirs are replaced by two new formats – Sheet Explanations and Sheet Descriptions – both of which now have enough published examples to review generically.

*Sheet Explanations* are A5 paperback booklets about 32 pages long. This review is based on examples for the Alresford, Guildford, Bristol, Loughborough and Kilmarnock sheets, but about three times this number are now available. The explanations provide a compact but detailed overview of the sheet geology. The layout is very consistent, comprising an introduction, a geological description (stratigraphy then structure), a generous section on applied geology, a detailed guide to information sources, and a list of references. Illustrations comprise the same mix of tables, line drawings and photographs familiar from the later memoirs, and all produced, in colour as far as possible, to a high standard. Although presumably aimed partly at the amateur as well as professional geological visitor to each area, the reader will need to be geologically well-informed. There is little or no attempt to avoid complex terminology, probably because BGS see their existing 'Holiday Geology Guide' series as catering for the geological beginner. However, the Explanations will be most used by geology students and professionals. The booklets are affordable by individuals, especially if bought as a package with the corresponding folded map at £18.00. Good geological libraries in Britain will want to acquire a set.

Complementing the Explanations are the new *Sheet Descriptions*. Not available on bookshop shelves, these are print-on-demand A4 reports providing a more comprehensive account of the geology of a 1:50 000 sheet. On the basis of the Keswick and Loughborough volumes provided for this review, the Descriptions are going to be Memoirs in all but name. Maybe somewhat shorter (48 and 92 pages for the

two examples), and with figures bound at the end of the text rather than integrated with it, but having a similar style and information content. The Descriptions inevitably repeat much material from the Explanations and, for many users, the extra detail will not justify even the modest cost of the Sheet Description. Certainly, they do not provide the level of site-specific information that some commercial users might require. Time will no doubt be the judge of whether the niche market they service will be worth the effort of their production. Meanwhile, those with lingering nostalgia for the BGS Memoir will find the Descriptions a useful and cheaper substitute.

Nigel Woodcock

WALTHAM, T. 2002. *Foundations of Engineering Geology*, 2nd ed. vi + 92 pp. London, New York: Spon Press. Price £45.00 (hard covers). ISBN 0 415 25449 3.
DOI: 10.1017/S0016756803237845

This is an excellent book that will be invaluable not only as a textbook for students taking an engineering geology, geology or civil engineering course but also as a reference book/aide memoire in later years as they (and we more advanced practitioners) follow their careers. The relatively modest price for the hardback (£45) should be affordable by the meanest librarian and, at £13.99, the excellently priced paperback leaves no excuse for the most hard-pressed student to ignore this mine of information.

Its great strength is its comprehensive coverage of the essential facts, techniques and data that form the core knowledge of engineering geology. Each topic is encompassed within a single or double A4 sheet, is well illustrated with clear black-and-white photographs, diagrams, tabulated data and graphs. Thus the use of an itemized, summarized format enables a rapid understanding to be achieved easily. Illustrations and short case histories are taken mainly from the UK and the USA but with a fair number from the rest of the world where they make a point to greater advantage. Thus it will be an appropriate text for users throughout the world.

First published in 1994, the sections concerned with ground investigation have been extensively revised to reflect changes in organizations, technical capability, data availability and costs. A new section on 'Understanding Ground Conditions' has been added that complements these sections by placing them in a wider context and emphasizing the need to establish a conceptual ground model that can be developed as more information becomes available during ground investigation and construction. In this section Dr Waltham states 'Unforeseen ground conditions are, in most cases, only unforeseen because nobody has looked for them'; if you read this book you will know when, where and what to look for. Another major improvement in the second edition is the significant expansion of the reference list for further reading that now has over 150 up-to-date key references that will support more detailed study, or commercial project work, in engineering geology and civil engineering.

It has also been thoroughly revised with improved diagrams, such as a 3D representation of fold types replacing a less informative 2D one, and minor corrections such as placing the start of the Quaternary at the currently favoured 1.8 Ma rather than the 1.6 Ma favoured in 1994. More important are the revisions where knowledge has advanced, such as the recognition that effort put into earthquake prediction is better placed in designing more survivable earthquake resistant structures; or where research has made significant progress, such as the latest stabilization work on the leaning tower of Pisa; and where policy has changed, such as the realization that the Mississippi floods could not be controlled by engineering thus leading to a policy whereby future flood plain development will be restricted and less land will be protected from flooding. The attention to detail in this revision is exemplified by the addition of a 2002 coastline to the diagram demonstrating coastal erosion in Holderness that showed seven earlier coastlines between 1852 and 1995 in the first edition.

What could be improved? Nothing of significance has been left out and not much could be added if the size and price are to be maintained. When a third edition is printed, and if the cost of colour printing falls, perhaps the use of a little colour in the illustrations would be welcome. Perhaps the increasing importance of Europe might be reflected in a brief description of European geology to go with that of the UK and the USA. But for the moment *Foundations of Engineering Geology* is as good as it gets.

Alan Forster

BRUNTON, C. H. C., COCKS, L. R. M. & LONG, S. L. (eds) 2001. *Brachiopods Past and Present*. Systematics Association Special Volume 63. xiii + 441 pp. London: copublished by Taylor & Francis with The Systematics Association. Price £80.00 (hard covers). ISBN 0 748 40921 1.
DOI: 10.1017/S0016756803247841

The editors' foreword is exceedingly brief and also exceedingly forthright, as they remark: 'far more delegates [to the Millennium Brachiopod Congress] offered written papers than are published here, and this is because we wanted a structured book which would stand alone in its own right and not just a mishmash of symposium contributions linked only by the single word "brachiopod"'. How well, then, have they succeeded? At one level, well enough. The 41 chapters are gathered into five thematic sections, each with a short introduction. As such this book reveals the range and interests of the brachiopod specialists, which in their different ways demand expertise with high resolution electron microscopy and palaeoceanography.

The thematic structure certainly provides a useful structure, but this book has a more serious drawback which is simply for the most part the contents are one brachiopod specialist talking to another. Well, that is in the nature of science, but the shame is that, maybe, many other evolutionary (palaeo-) biologists would actually have a great deal to learn from a number of the contributions. Some are precautionary tales. Maggie Cusack and Alwyn Williams, for example, present a helpful overview of rhynchonellate shell structure. Even so, they admit that 'The precise relationship between the mineral and organic components of the. . .shell is presently elusive' (p. 25), with a distressing lack of precision concerning protein specificities. This is no criticism of the investigators, merely an acknowledgement that in this case (and many others) one-to-one matching of molecule to phenotype, even at the level of a crystal, is problematic. Another hot topic in the last few years has been the phylogenetic position of the brachiopods, with decisive evidence placing them close to the annelids and molluscs (as lophotrochozoans). Here Alexandra Stechmann takes a rather cautious, if not inconclusive, view of molecular data relevant to this proposal, whereas in the succeeding chapter Yoshi Endo drives the story forward by reference to mitochondrial data, in good agreement with not only the lophotrochozoan hypothesis but also evidence from the

Cambrian 'explosion'. One important consequence of a possible brachiopod–annelid relationship is that the chitinous setae/chaetae may be homologous. Carsten Lüter provides a fascinating analysis of the setae in larval brachiopods, and on this basis arrives at some important conclusions concerning ancestral life cycles. On a related theme, Andrzej Balinksi presents evidence on the shell embryology of Devonian linguloid brachiopods, with an interesting conclusion that its embryology differs quite significantly from its living descendants even though *Lingula* is the parody of a 'living fossil'.

Other highlights of the book, again deserving wider notice than they may possibly receive, is the functional analysis of early patterns of shell articulation by Mike Bassett and colleagues, where questions of transformation, functional efficiencies and homoplasies should be of the widest interest. So too the complexities of evolution in the thecideide (by Glenn Jaecks) and more generally the rhynchonelliform brachiopods (by Sandra Carlson and Lindsey Leighton) are not only of general interest, but reiterate the conclusion that not only is homoplasy important but both processes of evolution and stratigraphic order are not to be ignored. Both these papers offer some useful reality checks. Origins of a rather different sort are addressed by David Mackinnon, who considers the evolution of dwarfed taxa, suggesting that super-warm oceanic water in the Cretaceous equatorial zone of Tethys is a cause. Such torrid episodes are, of course, already well known as a possible causative agent in the death of Cretaceous reefs and suggest that perhaps these counterparts to 'Snowball Earths' require more comprehensive study. Palaeoclimatic implications are also explored by Juan Benedetto who ties community evolution in the Palaeozoic, including the well-known onshore–offshore pattern, to latitudinal position. In brief, brachiopods were principally low latitude beasts, and the route to occupation of cooler waters was not direct but via the faunas already displaced into deeper (and colder) waters. Again this palaeogeographic dimension should be of interest to all palaeobiologists. In conclusion, this is a welcome volume, which will be pored over by the brachiopod specialist, but deserves to be pored over by their colleagues as well.

Simon Conway Morris

CRISS, R. E. 1999. *Principles of Stable Isotope Distribution.* x + 254 pp. New York, Oxford: Oxford University Press. Price £47.50 (hard covers). ISBN 0 19 511775 1. DOI: 10.1017/S0016756803257848

More years ago than I now care to remember, at the beginning of my career as an isotope geochemist, I was told by Ian Swainbank that I would never properly understand the behaviour of stable isotope systems unless I understood the statistical and quantum thermodynamics that described these processes. He was right, and I found this out after enrolling on a course in statistical and quantum thermodynamics and working my way through the early classic papers on isotopic chemistry by Urey, Bigeleisen and others. Whilst this process may well have been good for my 'geochemical soul', I sorely wish that I could have had this book at that time!

The first two chapters of this book provide an exceptionally thorough and entirely lucid introduction to the physical chemistry of stable isotopes and the mass-dependent processes that fractionate them. This is by far the best explanation of these phenomena that I have encountered.

Robert Criss is one of the foremost researchers in isotope hydrology in its broadest sense, from understanding stormflow and flooding, to high temperature fluid–rock interactions. These are all fields that he has contributed to in consistently innovative ways over many years, and his enthusiasm for and understanding of these subjects comes across in the later chapters of the book. These chapters focus on the variations of oxygen and hydrogen isotopic composition that occur in a wide variety of natural environments. The chapter on isotope hydrology uses numerous well-explained examples to illustrate the practical application of isotope studies and the theory underpinning their interpretation. The chapter on non-equilibrium fractionation and isotopic transport is more theoretical, and investigates the use of kinetic theory to model non-equilibrium situations where gradients are unimportant and the use of diffusion theory where isotopic gradients are the important feature. The final chapter of the book covers igneous rocks, meteorites and fluid–rock interaction, and again does a fine job of illustrating the application of fundamental theory and models to the interpretation of stable isotope distributions in these systems.

Throughout this book, the approach is to demonstrate how an understanding of the basic principles of isotopic behaviour can be used to properly understand and interpret stable isotopes in nature and thereby learn more about our world. To me, this book is a classic and a must for anyone regularly working in stable isotope geochemistry. At £47.50 (hardback) this isn't a cheap book, but is the best advanced text that I have seen in this field. Whilst the initial chapters on fundamental processes are probably beyond the requirements of degree and even masters courses in earth or environmental sciences nowadays, the later chapters would suit students on appropriate masters courses (though a considerable level of mathematical aptitude is assumed in much of the book). I would certainly advise anyone embarking on Ph.D. or other research using stable isotopes to read, and preferably buy, this book if they wish to properly understand the behaviour of stable isotopes in nature.

Simon Bottrell

ZANDA, B. & ROTARU, M. (eds) 2001. *Meteorites. Their Impact on Science and History.* Originally published in French as *Les Météorites* (Bordas, 1996). Translated by Roger Hewins. 128 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £11.95, US $18.95 (paperback). ISBN 0 521 79940 6. DOI: 10.1017/S0016756803267844

Fascination with meteorites has pervaded human history. From our early ancestors' awe and fear of meteorites we have moved gradually, over millennia, to an understanding of their meaning to the origin of the Solar System, and possibly to us. Meteorites are an unique source of information on some of the greatest unanswered scientific questions of our time, not least of which is the origin of life on Earth.

This interesting book grew out of a special exhibition of meteorites at the Muséum National d'Histoire Naturelle in Paris. However, the book is not a catalogue of the exhibition, but an up to date summary of the knowledge that scientists have acquired from meteorites over two centuries of study. Although edited by two notable French planetary scientists, Brigitte Zanda and Monica Rotaru, the book contains contributions from another twenty leading experts, some from countries other than France. Originally published in French as *Les Météorites!*, this English translation by Roger Hewins (also an authority on meteorites and a contributor) opens the book to a much wider audience, and provides a delightful addition to the popular literature on meteorites.

Twelve chapters deal with the fall of meteorites, their impact with the Earth and possible effects, processes that led to the formation of the rocks we see today as meteorites, and the important link between the study of meteorites and interpreting the origin and early evolution of the Solar System. All of this is nicely set against the history of the development of the science. Other contributions deal with the study of grains, extracted from meteorites, that formed in the atmospheres of stars that ended their lives before our Sun was lit, and that has brought astronomy, astrophysics and meteoritics much closer together.

Apart from a few minor quirks that undoubtedly arose from the translation, the text is generally straightforward, clearly written and engaging – all hallmarks of a good popular book. The authors do not shy away from the more complex aspects of space science, such as nucleosynthesis and radiometric dating, but skilful writing and good graphics make all this accessible to the uninformed reader. More than two hundred excellent photographs and informative colour illustrations support the text. Unfortunately, no formal subject index is included which would have added great value to the book. However, an extensive indexed glossary, and a chapter by chapter summary of key words go some way to alleviating the deficiency.

I can strongly recommend this modestly priced book as an excellent introduction to the subject for the public and students alike.

Alex Bevan

MURAD, E. & WILLIAMS, I. P. (eds) 2002. *Meteors in the Earth's Atmosphere. Meteoroids and Cosmic Dust and their Interactions with the Earth's Upper Atmosphere*. x + 322 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £60.00, US $80.00 (hard covers). ISBN 0 521 80431 0.
DOI: 10.1017/S0016756803277840

Chicken Little was right, the sky is falling, and as this volume informs us at the rate of $40 \times 10^6$ kg per year globally. Most of this incoming material is interstellar dust (50–700 $\mu$m diameter), about 4% of which reaches the surface unaltered. Other dust particles and meteoroids melt or are ablated on atmospheric entry, scattering metal ions 85–120 km above the surface of the Earth. Both the ions and particles are rich in carbon and iron, adding to planetary inventories of these biologically significant elements. This edited volume presents technical summaries of what and how we know about these phenomena, which have far-reaching implications for space travel, Solar System evolution, origin of life, oceanic sedimentation, soil science, and marine and terrestrial ecosystem nutrition.

I was interested to learn, for example, that most planets with moons have thin dusty rings (Grün *et al*.). Lidar now allows ground-based chemical analysis of selected metal ions 80–105 km above the surface of the Earth (von Zahn *et al*.). These remote analyses do not reveal dust and meteoroid compositions, because different elements ablate at different rates, and these fractionations are not well understood. Radar and optical observations of meteoroids (by Baggaley and Hawkes respectively) also have come a long way. Earth's naturally orbiting dust is exceeded by a factor of three by man-made paint, plastic, aluminum, titanium and excreta, but that is a smaller amount of man-made space debris than earlier estimates (Foschini). The bigger pieces continue to fall to Earth. Computer refinements of arguments from celestial mechanics (Williams) and refined optical observations (Hawkes) confirm that most meteorites are from asteroids, but most meteor showers are from comets.

Of most interest to geoscientists are summaries of the chemical composition of interplanetary dust (by Flynn and also by Rietmeijer), which can be contrasted with the better-known composition of meteorites, also summarized here with updated information on Antarctic meteorites (by Rietmeijer). Some interstellar dust particles have bulk density as low as 0.27 g cm$^{-3}$ and porosity as high as 95%. Many meteorite compositions can be found in interstellar dust particles, which also include grains with 2–3 times the carbon found even in CI carbonaceous chondrites. These are also the fluffy, low-density grains that in larger sizes do not survive passage through the atmosphere to be collected as meteorites. These observations seem contrary to the traditional view (also argued by Rietmeijer) of CI carbonaceous chondrites as remains of the primitive solar nebula, with their hydrous minerals such as clays created in comets during close passes with the Sun by 'hydrocryogenic' alteration in thin fluid rinds. If there are processes adding carbon and clay to CI chondrites, then why could they not have formed from other carbonaceous and even ordinary chondrites? Rietmeijer also tabulates average masses of meteorites of different compositions, which were much larger for irons (579 kg) than for most carbonaceous chondrites (CO, CV, CR all 290 kg), and ordinary chondrites (24.5 kg), and small for CI carbonaceous chondrites (4.3 kg). These estimates are compatible with alteration as opposed to a bulk production process for CI chondrites. I do not agree with Rietmeijer that hydrolytic alteration in meteorites could not destroy chondrules, or that CI carbonaceous chondrites are genetically unrelated to other carbonaceous chondrites. My observations of thin sections of meteorites show all stages of chondrule conversion to clay. I prefer the explanation advanced in 1980 by Ted Bunch and Sherwood Chang, that carbonaceous chondrites formed by hydrolytic weathering on the surface of planetismals of asteroidal dimensions. I was disappointed to find no mention in this book of their hypothesis, which implies that many carbonaceous chondrites are fragments of primordial Solar System palaeosols.

As is common in edited volumes, and this one especially, individual chapters are uneven in style, do not shirk technical details, and are tough sledding in places. This is not bedtime reading, but can be rewarding to the persistent. This book is a useful current reference volume, but it is not a book that I would have to own.

Gregory Retallack

WHITELEY, T. E., KLOC, G. J. & BRETT, C. E. 2002. *Trilobites of New York. An Illustrated Guide.* xix + 380 pp. Ithaca, London: Comstock (Cornell University Press). Price £36.95 (hard covers). ISBN 0 8014 3969 8.
DOI: 10.1017/S0016756803287847

This guide rests on the highly skilled photography of Whiteley and the knowledge and technique of Kloc, revealed in 175 plates. These show principally complete trilobite specimens from rocks in New York State and occasionally from adjacent areas in the United States and Canada. Some 500 species recorded from finds in New York State are listed with the author's name, date and bibliographic reference, the types and the institution in which they are held, and comments on specific characters and occurrence. This detail is prefaced by a discussion of naming trilobites, descriptive terms used, and the morphology, growth, anatomy and mode

of life of these animals. Two valuable chapters by Brett discuss firstly the death, decay and preservation of trilobites, and secondly the Palaeozoic geology of the State. The latter is well illustrated, with comments on faunas and facies, and listing the trilobites which have been found in particular formations and members.

Cornell University Press is to be congratulated on this excellently-printed volume, which will be an eye-opener to the teachers and collectors to whom it is primarily aimed. To those, both inside and outside the United States, whose special interest is trilobites, the very complete documentation of known species and the selection of rare specimens illustrated provide a new and valuable guide. A considerable number of specimens are figured for the first time, in a large format, and it is to be hoped that the unique examples from private collections will be passed on to permanent repositories. Particularly noteworthy are the 107 plates devoted to trilobites of the order Phacopida and Proetida, which show new and old examples of the remarkable variety occurring within the State, and form an original supplement to recently published systematic work. This book provides for the general reader a first-rate view of the variety of trilobites known from a long-explored region, and basic information about them. For the collector there is much vital information, and for the specialist excellent photographs of previously unknown, type or exceptional examples of particular species.

H. B. Whittington

FRIEND, P. F. & WILLIAMS, B. P. J. (eds) 2000. *New Perspectives on the Old Red Sandstone.* Geological Society Special Publication no. 180. ix + 623 pp. London, Bath: Geological Society of London. Price £85.00, US $142.00; members' price £39.00, US $65.00; AAPG members' price £51.00, US $85.00; hard covers. ISBN 1 86239 071 1.
DOI: 10.1017/S0016756803297843

A landmark for studies in the British Devonian was the 1978 PADS meeting when not only were two important field guides produced but also an important volume of key papers (House, Scrutton & Bassett, 1979). Two geologists, J. R. L. Allen and D. Dineley, figured prominently in these, and the present volume is dedicated to them. Our understanding of the Old Red Sandstone was revolutionized by the work of J. R. L. Allen in the 1960s and 70s and further progress was made in the 1970s and 80s leading to several major publications which until now have remained the key references. This new volume, comprising 31 papers and edited by Peter Friend and Brian Williams, represents a new benchmark for this new century. Twenty-six of the papers were presented at a Geological Society meeting. The papers are divided into seven sections; the first comprises a section of 'state-of-the-art' reviews and the other six are arranged into geographical regions.

In the first section Williams *et al.* review Devonian time scales and include new data. In particular they consider aspects of isotopic age and databases underpinning the Devonian geological timescale. Importantly 14 calibrations of the Devonian time scale are discussed including new U–Pb time scales. The late Michael House provides an important chronostratigraphical framework. The Devonian is significant as both the Silurian–Devonian and Devonian–Carboniferous boundaries have been internationally agreed. There is a most useful table showing the internationally agreed series and stage boundaries for the Devonian System together with biozonations and the broad stratigraphical terminology used in five areas of the UK. Friend *et al.* provide a broad review of the dynamics of the Old Red Sandstone basins and include a consideration of basin-forming mechanisms. These are useful diagrams showing the British and Irish basins together with their sediment dispersal directions. The paper considers basins from the whole ORS continent including the Catskills of the Appalachian USA. Overall this is a most useful review putting the later papers into context.

The section on Eastern North America comprises only two papers but they are both important. The paper by Griffing *et al.* considers the palaeoenvironments of the significant deposits of Gaspé in Canada. In addition to sedimentology these authors also consider plant palaeoecology. The area of Gaspé has been important both for the discovery of plant macrofossils first studied by Sir William Dawson in 1850 but also for the occurrence of beautifully preserved spore floras. More details of the floras have been published in what might be seen as a companion volume to this by Gensel & Edwards (2001). The authors show that these early Devonian sediments comprised coastal and fluvial deposits which contain abundant remains of early land plants. There is a range of environments represented and these are well documented, though I would have liked to have seen the photographs enlarged a little. A number of distinctive plant communities are identified.

Bridge discusses the rocks of the Catskill 'delta' of northeastern USA, of middle and late Devonian age. He documents a wide variety of facies types which are found in a broad range of sedimentary environments, and provides detailed lithological logs of important sections together with simpler more regional diagrams. It would have been useful if there had been increased integration of more of the palaeobotanical data for this region as it represents the time of the first forests, first seeds as well as containing evidence of early wildfires. More reference to the work of Scheckler and others would have been useful.

The next two sections comprise ten pages on the Irish ORS. Many of these are very welcome additions to the literature with a number of new perspectives. The dating of some of the sediments can be problematic as shown by McSherry *et al.* on their study of the sequences at Ballymastocker. There is a good summary of the Dingle Basin by Boyd & Stoan in a unique tectonic setting; this uniqueness is highlighted by the study of Richmond & Williams who propose a name of Northwest Dingle Domain for a newly identified terrain. This is a fascinating paper blending sedimentology with structure, well illustrated by colour photographs and clear diagrams. Detailed studies of some of the conglomerates are provided by Todd. This is a very well produced in-depth study.

The Munster Basin development is documented by Vermeulen *et al.* who use wide angle seismic control. The extensional subsidence is documented by Williams who provides a useful overview. Together with co-workers Williams provides chronostratigraphic constraints using U–Pb zircon geochronology of silicic tuffs. The sediments described are mid–late Devonian age. Controls on magmatism are discussed by Pracht from the Devonian to the Carboniferous. The marine incursion into the basin is described by Higgs *et al.* This work is underpinned by good biostratigraphic control, predominantly from the study of palynomorph assemblages. The palynological work also underpins the palaeoenvironmental interpretations. The palaeobotanical theme is continued by Jarvis who presents

new data on the classic sequence at Kiltorkan. He provides new palaeoecological interpretations of the flora.

The next section comprising five papers provides new data from classic sequences in Wales. This builds upon the excellent work published particularly by Allen and Williams. Hiller provides new data on the marine Old Red Sandstone transition in Pembrokeshire, documenting the relationship between tectonism and sedimentation. The paper provides both general and detailed reconstruction of the depositional environments described. A more detailed palynological/palaeobotanical paper is provided by Edwards & Richardson who illustrate for the first time two plants which produced the distinctive and widespread Devonian spore *Emphanisporites*; the plants may belong to *Horneophyton*. Detailed studies on sedimentological architecture are provided by Love & Williams, particularly from the Moor Cliffs Formation. The proposal is that the unusual sediment geometries preserved are intimately related to the timing of land plant colonization. The significance of the 'Senni Bed' facies is discussed by Owen & Hawley. They relate some features of the sediments to the activity of strike-slip faults. Tectonic control is a theme also developed by Marshall in his study of the Strinkle Sandstone of SW Pembrokeshire. This sequence is late Devonian–Lower Carboniferous in age and records the Carboniferous marine transgression.

There are five papers on the Scottish Old Red Sandstone. Bluck summarizes his lifetime of work on the alluvial systems of the Midland Valley of Scotland. This is a very useful overview. Another classic area receives a new look. Powell *et al.* discuss the palaeoecology and plant succession in a borehole through the Rhynie Cherts. This is a very interesting paper with new data and there is an interesting discussion on whether the Rhynie plants are typical of Early Devonian assemblages. Studies on the Midland Valley are also highlighted by Armstrong & Owen who consider the geological history of the Midland Valley terrain. North Scotland is represented by a study by Marshall on Givetian miospores from the Walls Group, Shetland. Calcrete formation in the upper Old Red Sandstone is documented by Balin.

The final section of six papers concerns Norway and the Arctic. These papers provide interesting data from areas perhaps not so familiar. Osmundsen *et al.* continue the theme of sedimentation and tectonics describing the architecture of the Middle Devonian Kuamshesten Group in Norway. Hartz describes early syndepositional tectonics in East Greenland. Fossil vertebrates are described by Clack & Neininger which contribute to our knowledge of the origin and evolution of limbed vertebrates. Piepjohn considers deformation of the Old Red Sandstone and Piepjohn *et al.* provide new age data on this deformation.

This is an excellent volume full of new data and useful syntheses. I believe that all geological libraries should have at least one copy and anyone interested in the Devonian or non-marine sediments in general should own their own copy. I highly recommend the book and believe this is a worthy benchmark for the beginning of a new century.

Andrew C. Scott

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DEFFEYES, K. S. 2001. *Hubbert's Peak. The Impending World Oil Shortage*. xi + 208 pp. Princeton, Oxford: Princeton University Press. Price US $24.95 (hard covers). ISBN 0 691 09086 6.
DOI: 10.1017/S0016756803307848

To provide a quick impression of *Hubbert's Peak*, imagine the Iliad written not by Homer, but by Homer Simpson: *Hubbert's Peak* describes an epic topic written in colloquial American. More specifically it is written in Oklahoman, a piquant dialect that this reviewer well remembers hearing from his Okie line managers when working in the oil patch.

In 1956 M. King Hubbert published a graph showing US oil production from 1875 to 1956. He used this to predict that US production would peak in the early 1970s and thereafter decline at a rate defined by a Gaussian curve. Hubbert's prediction has largely proved correct, and the '70s production acme was eponymously termed Hubbert's Peak. In this book Deffeyes uses Hubbert's method to demonstrate that global oil production is peaking at about now, and will decline along a Gaussian curve thereafter. This prediction broadly agrees with the conclusions of earlier studies such as those by Ion and Campbell. Deffeyes reassures the reader that, though the world will run out of petroleum, it will not run out of energy. A major mind-set change is urgently required, however, to deal with the potential energy deficit.

The author is well qualified to write a book on this epic theme, having spent a lifetime in the oil industry, first employed by Shell, and then later as an academic at Princeton, from which ivory tower he intermittently descends in the role of a consultant.

*Hubbert's Peak* takes the reader through the construction and implications of the two graphs. But it also describes the geological and economic context within which they should be interpreted. Thus, after an opening executive summary, chapters are titled: The Origin of Oil, Oil Reservoirs and Traps, Finding it, Drilling Methods, and Size and Discoverability of Fields. These precede the core chapters that take the reader through the statistical gymnastics used to construct the twin peaks. The following chapters offer an analysis of the future of fossil fuels, and alternative energy sources. The book concludes with references, some relatively innocuous mathematical formulae and an index. The book is written in a snappy style, interspersed with many anecdotes, some bizarre, some humorous, many both. *Hubbert's Peak* is well illustrated with graphs, photographs, and line drawings.

Hubbert's twin peaks of US and global petroleum production have been part of the background scenery of the energy industry in general, and the petroleum industry in particular, for years. This book presents nothing new to such an audience. It should be read however, by all politicians, by all students, no matter what their discipline, and indeed by anyone concerned about their grandchildren's welfare. Reading *Hubbert's Peak* is the intellectual equivalent of bungee jumping, being simultaneously exhilarating and terrifying. Hopefully it will be widely read, and not left on bookshop shelves in the 'Climbing and Mountaineering' section.

R. C. Selley

SHANNON, P. M., HAUGHTON, P. D. W. & CORCORAN, D. V. (eds) 2002. *The Petroleum Exploration of Ireland's Offshore Basins*. Geological Society Special Publication no. 188. vi + 473 pp. London, Bath: Geological Society of London. Price £79.00 (hard covers). ISBN 1 86239 087 8.
DOI: 10.1017/S0016756803317844

This book appears six years after its near identically titled predecessor (Croker & Shannon, 1995), during which time not much exploration success has accrued save for the discovery of the Corrib gas field.

The offshore Irish basins occupy a huge area, much in deep water. All have experienced a polyphase history of extension and inversion, with associated problems in estimating the timing of thermal maturation and the degree of seal integrity. Source rocks are commonly unproven. Well calibration is sparse and patchy, seismic quality is commonly poor. Despite this, licensing is currently at a high level, probably buoyed by the recent successes in the deep-water Voring and More basins in Norway which lie, admittedly 1500 km, along strike.

Highlights of the 27 papers fall into two classes. First there are several excellent overviews, notably those authored by Statoil staff on the regional setting of the Irish basins along the Northeast Atlantic margin and on the Mesozoic evolution of the southern North Atlantic. There is good coverage of the tectonic evolution of the deep water Rockall and Porcupine basins and a comprehensive overview of source rocks in the Lower and Middle Jurassic. The role of the Iceland Plume in regional epeirogenesis is convincingly argued. Second are the papers giving new data in more local context, notably for the Kish Bank and Brona basins, the development of the Southwest Kinsale gas accumulation and details of an Upper Jurassic reservoir in the Porcupine Basin. The necessity of combining Vitrinite Reflectance with Apatite Fission Track data is well illustrated (unfortunately without the extra constraints afforded by wireline log calibration), as are the shortcomings of using Vitrinite Reflectance alone.

Of the other papers, most are broadly relevant but the final two, on present-day sea-floor features, demonstrate no relevance to hydrocarbon exploration and might better have been omitted. By contrast, there is intriguing documentation of sea-floor carbonate 'mounds' (vent-controlled growth or intrusions?).

Production is to high standards on good quality paper with extensive use of full colour illustrations. Textual glitches are few although seismic and sidescan sonar reproduction is not always adequate. Seismic interpreters (and shareholders!) may blanche at some of the interpretation, notably that facing pages 114 and 116. There is a full index.

Explorationists active in Ireland will need this book and those involved in complex continental margin plays elsewhere should certainly browse it. It is fair value for money and very good value at member's price. For those with a general interest in the petroleum geology of Europe a purchase decision is less clear cut as it is difficult to pin down any major conceptual advance since 1995, and the requisite regional-scale 3D seismic which should determine future activity (and the next major publication) has yet to be acquired. Libraries should endeavour to stock it, but not if this conflicts with buying cutting-edge science.

David James

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CROKER, P. F. & SHANNON, P. M. (eds) 1995. *The Petroleum Exploration of Ireland's Offshore Basins.* Geological Society of London Special Publication no. 93.

COHEN, C. 2002. *The Fate of the Mammoth. Fossils, Myth, and History*. Translated by William Rodarmor. xxxvi + 297 pp. Chicago, London: University of Chicago Press. Price £19.00, US $30.00 (hard covers). ISBN 0 226 11292 6.
DOI: 10.1017/S0016756803327840

After the dinosaurs it is the woolly mammoth that has most captured popular imaginations the world over. The thought of giant furry elephants, roaming the frozen Siberian wastes, conjures up a period of time not so long ago, when our ancestors struggled to survive against all odds in the severest of climates. Claudine Cohen's *The Fate of the Mammoth* is not quite what the title suggests. I thought I would be immersing myself into a natural history of the woolly mammoth, but instead very early on I found that Cohen planned to tell a different history. This book begins with the sentence 'This is not a book about mammoths'. Hardly an encouraging start, but Cohen is up front in explaining that the book is really about the history of palaeontology from the fables and legends of the distant past to the evolutionary studies of today. Cohen uses the mammoth as the underlying pretext to show the changing relationship between humans and their understanding of the natural world from the earliest of recorded history.

If you have overcome your disappointment about the subject matter of this book, you will find that *The Fate of the Mammoth* is divided into three main sections. The first is about our images of the mammoth. It shows how people pictured mammoths from tens of thousands of years ago, when our ancestors hunted them, to how we have interpreted them from the eighteenth century onwards as discoveries of mammoth bones and frozen mammoth carcasses were made and recorded in Siberia.

The second section, 'Myths', deals with the emergence of palaeontology as a scientific discipline. At first large fossil bones were interpreted as those of long-dead giants, including the formidable Cyclops of Greek legend. Siberian folklore identified the mammoth as a giant mole killed by sunlight, thus explaining the presence of large rotting carcasses in the thawing permafrost. By the Middle Ages and the Renaissance our understanding of the natural world, including fossils, was a peculiar mishmash of observation, experiment, myth and legend. For example, the frequent discovery of fossil proboscidean bones was equally frequently explained as the remains of Hannibal's elephantine army, even though perhaps only eight animals made it to Europe. In the 17th century Leibniz was the first to attempt a reconstruction of a fossil, although he had combined the bones of elephants and rhinos to produce his unicorn. In the 18th century Messerschmidt correctly interpreted the mammoth as being closely related to, but different from, the elephant. By the early nineteenth century Cuvier had established comparative anatomy as the method for identifying and interpreting fossil remains.

The final and longest section of the book is entitled 'Stories'. It is less easy to follow the thread of the book here. For example, it deals with the discovery of mastodon remains in Ohio and the emergence of palaeontology in the newly-independent USA, and also the debates of diluvialists, catastrophists, etc., who manipulated the mammoth for their own purposes. The final chapters look at how phylogenies of the mammoth and other proboscideans have changed with new techniques and philosophies, and last of all mammoth cloning is touched on.

Overall this is an interesting book about the history of palaeontology and the natural sciences in general. It is very disappointing about the mammoth, although you were warned from the beginning. However, there is much to fascinate (I even found out where our Alaskan mammoth tusks came from) and the French perspective on palaeontological history is refreshing, although mistakes owing to mistranslation and inconsistent taxonomy are annoying and distracting.

Andrew Kitchener

McGuire, B., Mason, I. & Kilburn, C. 2002. *Natural Hazards and Environmental Change.* Key Issues in Environmental Change Series. xii + 187 pp. Abingdon: Edward Arnold (Hodder Headline Group); copublished in the USA with Oxford University Press. Price £50.00 (hard covers), £19.99 (paperback). ISBN 0 340 74219 4; 0 340 74220 8 (pb).
DOI: 10.1017/S0016756803337847

'A picture of a benign planet characterised by an unchanging or slowly changing environment has always, therefore, been a wildly inaccurate one' (p. 3). That observation is the context for this book's account of natural hazards, those arising from rapid change as a result of physical rather than biological causes. That does not imply that interrelationships are left out, as in the case of increasing flood hazard brought about by devegetation, and of course anthropogenic warming of the climate.

Hazard conflates likelihood with potential death and injury, and economic losses. It is akin to the risk assessment we all now have to plough through in the laboratory and before field trips, but a good deal more important. The whole point of a risk assessment is to seek ways of lessening a hazard's potential effect. Two important factors are growing populations in risky areas and the conditions under which they live – a hurricane in Florida and a storm surge in Bengal, both densely populated, will have very different outcomes. A glance at mortality tables for various hazards brings the socio-economic input to a general 'Beaufort Scale' into sharp focus. Bill McGuire's Preface pulls no punches, for in the opening year of the Third Millennium one in thirty people were affected by one calamity or another, somewhere. That may be an artefact of growing attention to bad news, and its wider, more speedy arrival. However, growing human numbers and a widening gap in living conditions conspire with harbingers of a shift from Holocene equability to present a grim forecast for the near future. The warning is clear: catastrophes are on the increase. A clear account of what brings them and how they might be mitigated, from the standpoint of current understanding, is very welcome, and this is such a book. It is a dreadful indictment of G7 political leaders that it took an entirely human-caused catastrophe on 11 September 2001 for them to realise that Earthly life is precarious. McGuire rightly implies that it will take the obliteration of a major city in Europe or North America to bring home the far greater risks from natural causes that the majority of people face.

It is clear that the urgency and severity of their topic has honed the writing of the three authors wonderfully. *Natural Hazards* contains a wealth of up-to-date theory and data, but remains readable. It has to be, so that its lessons and recommendations sink in to the dim or blinkered consciousness of politicians with the authority to make a material response. Sadly, those individuals slough off the responsibility and are authoritarian in other, less well-meaning ways.

Following a careful set of definitions and a historical perspective in their introduction, McGuire, Mason & Kilburn divide hazards into six chapters: windstorms; flooding; landslides; volcanism; sea level; extraterrestrial impacts. They are linked through the Earth system, so that none can be viewed in isolation. Here are a few highlights.

Middle latitudes are likely to begin experiencing increased severity of cyclonic windstorms, with the better news that cyclones in general may become fewer in number. While global warming, and the attendant increase in ocean-surface evaporation, will increase overall precipitation, where it will fall is likely to become more constrained. Its intensity is also likely to be increased, posing greater risk of flooding. The main climatic driver, the Pacific Ocean, is likely to become more El Niño-like. Not only does that warn of increased floods, but worsening aridity and drought in other places. The present four-year drought in the Horn of Africa, which threatens almost 15 million people, is possibly the first of many set to transcend that of 1984–5, which drew such global attention (but not much from politicians with authority). In economic terms, landslides pose immense hazards, even on the seemingly insignificant scale of a motorway embankment failure. Threats to life come with the largest, whose power rivals that of high-magnitude earthquakes and exceeds most volcanism. Slope stability depends partly on subsurface water, and in a wetter world we can expect a general lessening in security. On the plus side engineers know a great deal more about what makes slopes fail, if not how to prevent the high-power events.

Volcanism is a great draw to unsubtle film makers, and to many jolly geologists, but its greatest hazards are stealthy. Scientists flock with massive toolkits to perch on volcanoes, or peer at them daily using satellite images, in the quest for means of predicting eruptions, as if locals were not fully aware of their precarious lives and livelihoods. Science consequently knows a great deal about how volcanoes work, but has yet to save as many lives as there have been vaporized volcanologists. Truly whopping eruptions have far-field effects that temporarily devastate climate. They add warming and cooling, and sometimes highly toxic matter to the air. It is this kind of threat to which *Natural Hazards* draws our attention, and a table relating Irish tree-ring data to ice-core acidity and world-wide records of social collapse makes scary reading. And, of course, there are never-witnessed and unimaginably awesome volcanic events in the geological record, such as 'super eruptions' of Yellowstone caldera (2 Ma) and Toba (73 ka), and the roughly 30 Ma-period flood basalts, whose effects ranged from 'volcanic winter' to mass extinction.

Sea-level change through global warming seems mostly to frighten insurers and estate agents, because big financial centres are at risk. The authors highlight the possibility that rising sea level might induce earthquakes and volcanism. But they reserve their most serious warning for coastal and submarine landslides and the risk of tsunamis. That is one of Bill McGuire's fortes, and both sea-level change and warming seem to contribute to submarine instability. Explosive release of methane when deep-water gas hydrates break down is a sure way to destabilize sediment deposited on continental margins. One such linked catastrophe was the stripping bare of lands around the Scottish Firths by tsunamis from the Storegga slide zone off western Norway, about 7500 years ago. That was shortly after a post-glacial spurt in sea-level rise. Incidentally, the Storegga Slide has about the same area as the whole of the Scottish mainland. Volcanoes produce lava and debris faster than erosion can remove. So they are always gravitationally metastable, and particularly prone to large-scale collapse. Volcanic islands, whether they erupt or not, now seem to have been responsible for sea-level-linked tsunamis vastly larger than any caused by earthquakes.

For those who enjoy the occasional frisson of mind-numbing fear, the ultimate adrenaline rush is a mountain hurtling from the sky. A thriving cottage industry seeks out signs of past impacts and their effects on life, and peers at, counts and measures asteroids and comets that might eventually hit the Earth. Having once delivered up to $10^{25}$ W,

known impacts in the geological record dwarf any other geological process as regards their power for change. It seems even small ones, which deliver as much power as the simultaneous detonation of all nuclear weapons, are regular occurrences, perhaps as often as once every few hundred years. Speculation is rife about the possible effect of Holocene impacts in disruptions of the archaeological record. Nothing is worse, because an impact can generate all the effects of other hazardous events. And they produce more besides, such as horizon to horizon bursts of hard gamma radiation and stupendous heat flash when they enter the atmosphere in a piston-like manner, because of adiabatic heating of compressed air.

*Natural Hazards* serves as a warning, and a sourcebook for understanding and prediction. It should direct international effort to seeking ways to mitigate disaster. However, the reluctance of governments and multilateral agencies to do little other than hold conferences, without committing resources, sadly spells out the real future.

S. A. Drury

VITA-FINZI, C. 2002. *Monitoring the Earth. Physical Geology in Action.* xii + 189 pp. Harpenden: Terra Publishing. Price £19.95 (paperback). ISBN 1 903544 12 2.
DOI: 10.1017/S0016756803347843

The subtext of this fascinating little book is laid out in its first paragraph: 'Tectonics in almost real time' declared a 1987 editorial headline in the journal *Nature*. To many geoscientists, it has been a slow realization. But the fact is that there is today a plethora of readily accessible tools, or at least the data they generate, with which it is possible to monitor and quantify geological processes taking place over archaeological, historical and even recent timescales. Whatever your interest in geoscience – extra-terrestrial geology, geomorphology, glaciology, sedimentology and global environmental change, to name but a selection of the themes addressed in *Monitoring the Earth* – the impact of ongoing advances in high-resolution ('almost real time') technologies has been profound.

Claudio Vita-Finzi has been at the forefront of research into neotectonics for some three decades, since a time when work on neotectonics was not so fashionable in the UK. Neotectonics addresses Recent deformation (say, post-Miocene) and it therefore deals with a host of processes not usually encountered by practitioners of ancient tectonics. Consequently, Vita-Finzi is ideally equipped to present a text like this. He adopts a notably holistic approach, progressing from excellent chapters on extra-terrestrial particles – from meteorites to dust – and the Sun, through large-scale tectonics, to faults and folds, sediments and surfaces and, finally, life itself. Throughout the discussion of these diverse topics, the emphasis is on quantification of the various processes, particularly rates, and the methods employed to extract such information.

Whilst the condensed nature of the information contained within its 168 pages makes the text quite hard going in places, *Monitoring the Earth* is impressively eclectic. Some subsections would have benefitted from basic definitions of the phenomena they proceed to discuss e.g. comets, precession. Despite the understandable reluctance of authors to include references to internet websites (because of their tendency to change their URL, or worldwide web address), I felt that such references would have added significant value here. The image gracing the cover is a case in point. This is the second general text in as many years whose cover features the distinctive interferometric fringes showing ground deformation associated with the 1992 Landers earthquake (see Burbank & Anderson (2001); note that the caption to the Landers image reproduced on page 118 wrongly states that each full cycle within the fringes represents 28 cm of vertical movement – should be 28 mm!). Beautiful and instructive images such as this abound on many more or less permanent websites, particularly those of US government agencies (e.g. NOAA, NASA), where they provide an essential resource for teachers and researchers alike.

This is a potentially important book that will be enjoyed by a wide cross-section of the geoscience community. Geoscientists are unusually well placed to contribute to the debate on anthropogenic influence on environmental change. In particular, they appreciate that the nature of environmental change is often a function of the superimposition of a diversity of processes operating at different orders of cyclicity. In focussing on the Recent dynamics of a diverse selection of those very processes, *Monitoring the Earth* gives us, perhaps for the first time, a superb demonstration of the sheer complexity of aspects of the Earth system. My enduring impression of the text echoes whoever it was that said that the defining characteristic of geology is the inherent incompleteness of its datasets. Vita-Finzi offers a taste of the interpretational ambiguity of the Recent record and, for those like me used to investigating processes operating over timescales of multiples of $10^6$ years rather than $10^4$, $10^3$, $10^2$, . . ., it can make sobering reading.

Jonathan Turner

*Reference*

BURBANK, D. & ANDERSON, R. 2001. *Tectonic Geomorphology.* Blackwell Science.

HORNE, D. J. & MARTENS, K. (eds) 2000. *Evolutionary Biology and Ecology of Ostracoda*. Developments in Hydrobiology Series no. 148. Reprinted from *Hydrobiologia* **419** (2000). Papers presented at the 13th International Symposium on Ostracoda (ISO97), Chatham, 27–31 July 1997. xi + 197 pp. Dordrecht, Boston, London: Kluwer Academic Publishers. Price Euros 131.50, US $148.00, £90.00 (hard covers). ISBN 0 7923 6396 5.
DOI: 10.1017/S001675680335784X

'Evolutionary Biology and Ecology of Ostracoda' was one of the themes from the International Ostracod Symposium held at the University of Greenwich in 1997. Fifteen papers read at that meeting are included in this volume, with a preface by the editors that provides a good overview of its contents. Ostracods are small bivalved crustaceans that have invaded most aquatic environments and which have a fossil record extending back to the Ordovician and probably earlier. Subjects covered include cloning, parasitism, reproduction, ontogeny, enigmatic light-reflecting organs, the origins of modern non-marine ostracods, and Catastrophe Theory applied to carapace morphology. As suggested by the title, the volume has a strong ecological feel with many of the papers detailing living ostracod species. But fossil faunas from the Tertiary and Cretaceous are also documented. The range of topics covered indicates just how intriguing and interesting relatively humble organisms can be.

Two of the papers are co-authored by the late Katsumi Abe, and it is great to see that his legacy of careful, innovative and

beautifully illustrated work lives on. One of his papers deals with parasites on myodocopid ostracods. The 'egg-snatching' isopod *Onisocryptus ovalis* has a lifestyle that involves anchoring its body tightly to the host and the subsequent loss of its limbs. Finally it positions itself to eat all of the host ostracod's eggs. The other paper co-authored by Abe recognizes an enigmatic 'mirror' organ in the myodocope *Vargula hilgendorfi* which dangles from the ventral edge of the abdomen. This reflects light, and might have a predatory deterrence or signalling function.

Like the fruitfly *Drosophila*, some ostracods can be bred for studies of lifestyle, patterns of behaviour and genetics. One such ostracod is documented by Ikeya & Kato in their paper on the life history of the Japanese shallow marine *Xestoloberis hanaii*. Their beautifully illustrated plates record ostracod reproduction and embryology, themes which are also covered by Butlin & Menozzi's perceptive evaluation of the use of ostracods in the study of reproduction, selection and speciation. Furthering the study of ostracod behaviour and ecology, cloned populations of ostracods are used in the paper by Baltanás and co-authors to study the influence of environment on carapace shape. This theme is also developed by van Harten, who uses Catastrophe Theory to recognise an unspecified 'Factor X', which, in addition to salinity, influences the development of noding in *Cyprideis torosa*.

There are many other papers in this volume that contribute to a greater understanding of ostracod morphology, ecology and behaviour. Though primarily aimed at ostracod specialists, the volume has a breadth of understanding that should draw in ecologists working on marine and lake ecologies, evolutionary biologists, and those more generally interested in arthropod morphology. The only negative point is that at £90 (EUR 131.5, US$148) it is rather expensive, particularly for post-graduate and post-doctoral workers. Nevertheless, the high price no doubt relates to the many high-quality illustrations, including several colour plates.

Mark Williams

KIESSLING, W., FLÜGEL, E. & GOLONKA, J. (eds) 2002. *Phanerozoic Reef Patterns.* SEPM Special Publication no. 72. v + 775 pp. Tulsa: Society for Sedimentary Geology (SEPM). Price US $110.00 members, US $150.00 non-members (hard covers). ISBN 1 56576 081 6.
DOI: 10.1017/S0016756803367846

This is a most impressive book; it is nearly 800 pages of detailed information and synthesis of data on ancient reefs. The objective is 'the recognition and interpretation of patterns recorded by the distribution of ancient reefs and changes in reef attributes' – a bold objective indeed, but one which is achieved in many respects. This book derives from a major project funded by the German Research Council (DFG) and the publication of the book itself was supported by grants from BP, Shell and Robertson Research, as well as NSF and NSERC.

The book is divided into three parts, with the first section dealing with the scope and aims of the book and methods employed, the stratigraphic timescale and plate-tectonic maps of the various timeslices (the Phanerozoic is divided into 32 timeslices based on the supersequences of Sloss). There is a very interesting chapter presenting the reef database the editors assembled during their project. There are some intriguing figures here of reef trends – such as occurrence (number) of reefs and the mean thickness of reefal limestones of each timeslice.

Part II deals with reef patterns through the Phanerozoic with 19 invited authors presenting 14 reviews of 'their' particular reefs. These chapters cover all the Phanerozoic periods and document distribution, biotic diversity, ecological zonation and bioerosion, facies and diagenesis, intrinsic and extrinsic controls, and reservoir potential. These chapters are most impressive with stacks of detail; they are definitely a series of chapters to dip into when you are looking for information – not just on reefs but on carbonate platforms and associated facies too. There are sections on some of the reefal controversies too, such as the periods of reef absence and the effects of mass extinctions and changes in seawater chemistry. There is no specific chapter on Quaternary and present-day reefs, but comparisons of ancient with modern are made throughout.

The third part is concerned with an analysis of the Phanerozoic reef patterns involving a discussion of the secular variations in reef ecosystems and the patterns of reef crises. One interesting conclusion is that one of the major controls on reef development is an intrinsic evolutionary component – the recruitment capacity of the macrofauna. Physicochemical changes, such as palaeoclimate, sea level and nutrient supply, are important but cannot explain the long-term trends. There is a final short chapter on the future of reef research.

The authors are to be congratulated on seeing a fascinating project come to fruition. They should be pleased with the result and would have deserved a well-earned rest after the job was completed. There is a lot of text, but many useful figures and photos including the palaeotectonic maps and tabled stratigraphic data which will be of use to many soft-rock geologists other than just reef specialists. Many carbonate sedimentologists and palaeobiologists will be grateful for this book. It is a little expensive for non-members of SEPM but I am sure all carbonate lovers will want their own copy – there is so much useful information here.

Maurice Tucker

CARTER, D. R. & BEAUPRÉ, G. S. 2001. *Skeletal Function and Form. Mechanobiology of Skeletal Development, Aging and Regeneration*. xii + 318 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £45.00, US $80.00 (hard covers). ISBN 0 521 79000 X.
DOI: 10.1017/S0016756803377842

How the function performed by a skeleton, or a portion of a skeleton, relates to the form of that skeleton or individual bone is the focus of attention of this neat and well-organized book. This type of subject has been covered on other occasions by doyens such as R. McNeill Alexander in a number of books – notably his *Animal Mechanics*. However while Alexander's book takes an unashamedly physical and engineering peek at animal design, the materials used as well as their properties, by looking at examples from *across* the animal kingdom, this book takes a narrower and more specialist perspective. It concentrates on a portion of just one subphylum – the bony vertebrates; however, it does so in a more catholic fashion by incorporating not only the purely physical, but also properties associated with the living organism, notably development, aging and regeneration.

The book is clearly intended, by the authors, as a reference work for a wide range of academic disciplines from the most obvious, bioengineers and those studying orthopaedics,

through to broader audiences such as zoologists, anthropologists and vertebrate palaeontologists.

As a vertebrate palaeobiologist interested in animal design and function from a number of perspectives I was interested to read this book. Overall it is a masterly treatment of the subject and very useful as background for parts of my area of research and I think, in most respects, fulfils the reader's expectations. There is a short, but useful introductory chapter that helps place the vertebrates and their study in context in terms of their phylogeny, and also in terms of the history of mechanical speculation or genuine experimentation. However as a palaeontologist I have to admit that the range and variety of examples explored is decidedly limited. It would have been more genuinely truthgful to have altered the title by the insertion of *mammalian* at some point, because this book is all about mammalian skeletal biology. This is a minor gripe, in truth, and one that will only find sympathy among vertebrate palaeobiologists with my particular range of interests. It is too expensive to feature as recommended reading by undergraduates, but has its place on library shelves and in the offices of genuine specialists. Despite a twinge of disappointment (explained above) I am still very pleased to have a copy of this book.

David Norman

BROWN, C. E. 2002. *World Energy Resources.* xxv + 810 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 199.00 (+ VAT at local rate), Sfr 322.00, £139.50, US $225.00 (hard covers). ISBN 3 540 42634 5.
DOI: 10.1017/S0016756803387849

It is difficult to be up-to-date when writing about the world energy scene. Oil and gas prices, in particular, can change markedly over short periods of time, often for unexpected reasons. This book review was written as the world waited to see if the US would invade Iraq, ostensibly to ensure UN resolutions are upheld (though to many people this looks more like an attempt to protect future US oil supplies than support for international law). Does this expensive book, which is written from a distinctly US viewpoint, offer anything that is not already available?

The book is divided into four sections. Part I, Introduction to primary energy – nonrenewable sources (153 pages); Part II, Renewable energy sources and alternative energy technologies (82 pages); Part III, United States – energy forecasts and modelling (78 pages); Part IV, World regional energy overview (466 pages). It also has 13 pages of references and author and subject indexes. Some of the papers in the reference list are not mentioned in the text, and there are papers mentioned in the text that are not in the reference list. The list itself is revealing in that, apart from US government publications, most of the papers are from the 1970s and 80s. There is also no consistent order to the listings. The book contains a number of figures, mostly from US official publications. Several are used more than once. In some cases figures referred to in the text do not show what is claimed for them, or simply do not exist. This lack of editorial input is also seen in the number of typographical errors, and the use of politically-charged terms such as Persian Gulf.

For a book that devotes so many pages to energy forecasts and modelling there is very little on international concerns about global warming (the greenhouse effect is attributed solely to carbon dioxide and water vapour). In Part IV the discussion of environmental issues for any particular country concentrates more on pollution from mining and smelting than on attempts to reduce greenhouse emissions. The impression given is that fossil fuel use will continue to rise, and that coal is the fuel of the future.

Parts I and II are rather basic introductions to the subject, covered better in many cheaper student textbooks. Many of the definitions are imprecise, such as the distinction between a mineral resource and a mineral reserve, or the use of the terms kerogen and bitumen, and this lack of clarity is also seen in places in the text. Much of the thinking is outdated, for example the assertion that 'the distribution of crude oil and natural gas occurrences was determined long ago by geological factors during the formation and evolution of long linear and subsiding geologic basins called geosynclines'. Part III is almost entirely based on the 1995 annual energy outlook report of the US Department of Energy. Though this may have been interesting in a book published in 1996 or 1997, it is almost irrelevant to the world of 2002. Part IV, the majority of the book, is a rather dated country by country review including all mineral production rather than just the energy sector.

The introduction to Part IV claims that the summaries in this section are based primarily on several annual or semi-annual published governmental reports (all US publications). It begs the question of what is meant by 'based'. In many places paragraphs of the text seem to be directly copied from the USGS Minerals Yearbook 1995. There is no indication that these are direct quotes. In one case I did note a change from the original text – the substitution of 2002 for 1995, presumably to try to make the text look more up-to-date. Anyone wanting the kind of data provided in this part would be better advised to go directly to the original sources, and to look at the most recent volumes.

It must be obvious from the above that I would not recommend purchase to anyone interested in energy questions.

Antony Wyatt

CAMPBELL, W. H. 2001. *Earth Magnetism. A Guided Tour through Magnetic Fields*. Complementary Science Series. xxi + 151 pp. San Diego: Harcourt-Academic Press (Elsevier Science). Price £16.95 (paperback). ISBN 0 12 158164 0.
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This is an interesting, rather quirky little book, written by a great expert in the so-called 'external' magnetic field – that is, the field generated above the Earth's surface. Its five chapters are entitled 'Nature's Magnetism', 'Vistas of lives in the fields', 'Sailing the magnetic seas in calm storms', 'Umbrella for magnetic storms', and 'Harvesting the fields', which I think gives a good indication of the flavour. Chapter 1 is a lovely introduction to the subject of magnetism, with some history, and the basic definitions and physics needed to proceed. Chapter 2 covers how rocks acquire magnetic fields, the uses and applications of magnetism (e.g. medical applications, navigation, geological exploration), the problems it can cause (e.g. with power transmission lines, for high altitude aircraft and satellites), and concludes with a section examining what he calls 'Pseudoscience, Old Wives' Tales, and Frauds' (e.g. the Bermuda triangle, earthquake prediction). To de-bunk the myths in this final section, he first introduces some basic statistical measures, and ways of testing effects (e.g. double blind studies). Again, it's full of fascinating information encompassing a wide range of topics. Chapter 3 looks at the field under magnetically quiet conditions, concentrating partly on the meanings and locations of the various magnetic poles geomagnetists concern themselves with. Chapter 4 describes the causes and

consequences of magnetic storms, including a section at the end on the various indices geomagnetists use to describe the level of magnetic storm activity. Finally, Chapter 5 indicates the types of instrumentation used to measure the field (including a simple magnetometer that can be made at home), some examples of research using geomagnetic data, and references (both websites and books) for further study.

The book has many illustrations: some cartoon-style sketches, portraits, formal diagrams, plenty of examples of actual data, and some beautiful colour photographs. These really help bring the subject alive, and keep at least this reader's attention. The material is presented without mathematics, and, the author claims, with the minimum jargon. However, I have to say that there were a good many technical terms used without explanation in the later chapters of the book that I suspect the average lay person would not understand. Examples include 'low-field anomaly', 'low-order multipoles', 'closed' and 'open' fields, 'singular solar field polarity', 'field-aligned currents', and 'Universal Time'. I wondered even about the use of 'crust', 'mantle' and 'core' without explanation; they are illustrated on plate 8 and fig. 3.1, but the plate isn't referred to in the text when the terms are used. Despite this, he does give useful descriptions and analogies to explain most of the concepts and terms he uses. The units are a bit of a mess: he quotes in both metric and imperial units, with exact conversions of numbers that are themselves only approximate, e.g. 'about 500 to 800° Centigrade or 932 to 1472° Fahrenheit'. Also, for the two equivalent units, the gamma and nanoTesla, he chooses to use the old-fashioned gamma rather than the SI nanoTesla, but in at least one instance, a figure has the abbreviation nT rather than $\gamma$. This is complicated further because the text mentions that the gamma honours Gauss, one of the pioneers of geomagnetism; however, there is also a non-SI unit with wide use in geomagnetism that some readers may have heard of, called the Gauss, which is 100 000 $\gamma$ (or nT).

In Chapter 2, I found the leap into the generalities of significance testing rather sudden and unexpected. It would have been helpful to begin with some motivation for introducing this material, namely that it will allow us to examine purported relationships between the magnetic field and other phenomena. Likewise, in Chapter 4, a short preamble explaining the value and uses of magnetic indices in general would have helped put the descriptions of the various indices and their derivation in context.

There are very few typographical errors. I spotted a couple of factual errors; for instance, he says measurements since the time of Gilbert in 1600 show the decrease in the dipole field strength, yet we have only been able to measure the field strength since about 1820 (a development he describes!). In fact, it is possible to deduce the dipole strength from measurements on archaeological artefacts. He also describes the decrease rate as 'constant', but the known acceleration of the rate at around the beginning of the last century can be discerned from his figure. He says that palaeomagnetists devised dynamo theory to explain how the magnetic field is generated in the Earth's liquid iron–nickel outer core, but this work is actually the province of a special breed of applied mathematician; palaeomagnetists study the fields locked in rocks that provide the data dynamo theory has to explain. It's not true (caption to plate 8) that gravitational accretion takes place at the core–mantle boundary; it's actually at the inner core boundary, where gradual cooling of the Earth causes the iron–nickel liquid to freeze. When describing how scientists study Earth conductivity to depths of 650 km, he says this is a little over one-tenth of the way to the Earth's highly conducting centre. This implies that it is only the centre that's a good conductor, whereas it would be more helpful to say that this is a quarter of the way to the core–mantle boundary, where conductivity dramatically increases due to the transition from silicate-based minerals to an iron–nickel core.

He presents a map of the fluid flow at the Earth's core–mantle boundary explaining the magnetic field changes unlike any I've ever seen (including those I've produced myself). Its typical speeds are abnormally slow – normally, we deduce values comparable with the rate at which the magnetic field patterns drift westward. He also says the models are matched to tectonic features on the surface such as mid-ocean ridges and subduction zones, but we have no reason to expect surface tectonic features to influence the core–mantle boundary flow directly beneath them (even if slabs do make it all the way through the mantle, they will reach the core–mantle boundary some distance from their position at the Earth's surface). These errors all concern the Earth's internal magnetic field, my area of interest – I suspect that the external field, which is the author's own speciality, is more accurately described.

Despite these criticisms, I believe that the good points of this book greatly outweigh its weaknesses. The author's enthusiasm comes through so clearly, the range of material covered is so great, and the approach is so unusual, that most readers should find something to attract their attention. It can be read sequentially, but can also be used as a reference text to dip into – the index is very good. It would be a handy book for geologists either interested in our magnetic field, or whose friends reckon they should know about the field because they're a geologist, to have on their shelf.

Kathy Whaler

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