

BOOK REVIEWS

EVANS, D., GRAHAM, C., ARMOUR, A. & BATHURST, P. (editors and compilers) 2003. *The Millennium Atlas: Petroleum Geology of the Central and Northern North Sea*. 389 pp. London, Bath: Geological Society of London. Price £248 (book plus CD set); book only – £199; CD only – £199; hard covers, large format. ISBN 1 86239 119 X.
DOI: 10.1017/S0016756803218124

Over the last thirty years the production of hydrocarbons in the offshore licensing areas of the UK, Norway, Denmark and the Netherlands has generated great revenues and arguably great social benefits. At the same time it has pioneered huge strides in exploration and production technology, safety/environmental management and applied geoscience research. This magnificently produced book is at once a, slightly slipped, Millennium celebration of this achievement and scientifically the newly definitive account of the economically most important offshore play, namely the essentially late-Jurassic-sourced traps between 55° and 62°N off Scotland, Norway and Denmark. It results from the collaboration of industry, academe and government bodies and is jointly owned by the Geological Society of London, the Norwegian Petroleum Society and the Geological Survey of Denmark and Greenland, each 'non-profit' organizations. All concerned deserve the greatest credit. In short this is a major publishing event in geoscience.

Not content with just collaboration, generous sponsorship from industry has allowed the *Atlas* to be presented at affordable price in full (and very tasteful) colour in A2 format, at one stroke making for superb clarity and detail in the maps, interpreted seismic profiles, correlation charts and diagrams. It is a nice touch to acknowledge this help by displaying authors' logos at the start of each chapter but is overdone in one case with logos plastered around individual diagrams. The accompanying text makes the *Atlas* something decidedly more than a traditional atlas as a mere source of illustrated fact and something less than a traditional text book. In practice this treatment works well, especially in the play-oriented chapters, and the *Atlas* will be as at home on the boardroom coffee table as alongside the explorationist's workstation, thus fulfilling the intent to appeal to the 'non-specialist professional'.

After an introduction which gives a useful guide to layout and database sources, there follow four groups of chapters. The first group, three chapters, deals with tectonic evolution, crustal structure and structural expression and includes a splendid series of palinspastic maps, each relating to subsequent chapters and setting the *Atlas* area in regional context between Greenland, Fennoscandia and Iberia. Elements of predictive value in exploration are perhaps insufficiently clarified and the explanation of shear stress on page 43 may raise eyebrows. The second group, of twelve chapters, sets out source/reservoir/seal stratigraphy, play concepts and illustrative examples of hydrocarbon accumulations for sub-Devonian to Oligocene–Holocene intervals in exemplary detail supported with core and outcrop photographs to ground the reader in reality. Many data are new and the Devonian chapter is outstanding. The Jurassic and Cretaceous each receive two chapters

and contain detailed sequential palaeogeographic maps of great predictive value. Basic data common to all these chapters include depth and thickness maps and stratigraphic correlations incorporating wireline log data (not always convincingly and, although not stated, presumably accepted as non-faulted). The impact of 3D seismic is present in many chapters. Dramatic seismic attribute maps contribute to the Paleocene and Eocene chapters but the seismic/well calibration on which all interpretation depends is not set out and the explanation of the Alba field is difficult to follow. Treatment of polygonal faults is poor. Three chapters contain new, and detailed, 'sequence stratigraphic' schemes which in practice eschew Exxon terminology and, as presented, seem little more than wireline log-based, seismically uncalibrated, best guesses between faunally controlled maximum flooding surfaces. Clearly the debate as to the relevance of sequence stratigraphy in tectonically active basins is not yet over.

The third group, of two chapters, deals with the generation and migration of late-Jurassic-sourced hydrocarbons and the pressure regimes and salinity variations of reservoir pore waters: all sound and unexceptional although the opportunity to link heat flow evolution to the tectonic history set out earlier is not taken and the treatment of basin modelling thin. The fourth group, also of two chapters, covers exploration history and hydrocarbon resources and reserves in clear and graphic detail. An unillustrated appendix on Lower Cretaceous depositional sequences and micropalaeontology might better have been published elsewhere. The *Atlas* ends with a layman's glossary, a short index and an extensive bibliography.

As the hardback *Atlas* is not easily shelved, weighs eleven kilos and is thus prone to damage, libraries with browser facilities may well feel the CD to be the preferred purchase. Cash-strapped petroleum geology students will probably stick with the final JAPEC text (Glennie, K. W. (ed.) 1998. *Petroleum Geology of the North Sea. Basic Concepts and Recent Advances*, 4th ed. Oxford: Blackwell Science) as their preferred purchase. This contains all the relevant concepts, is arguably better written for course work and has the great advantage of including the southern North Sea between 52° and 55°N with its major Westphalian-sourced gas plays offshore England and the Netherlands and the relatively minor, but instructive, Liassic-sourced oil plays in the Netherlands. Indeed it is curious that the *Atlas* nowhere mentions whether or not it was ever considered to include play data for the entire North Sea, the more so as a Millennium publishing opportunity is unlikely to be repeated in the short term!

Many users will have the occasional interpretational niggle (and probably feel churlish about it) but their abiding impression will surely be of sheer quality and value for money. Now let it be used, not just admired.

David James

CLACK, J. A. 2002. *Gaining Ground. The Origin and Evolution of Tetrapods*. ix+369 pp. Bloomington, Indianapolis: Indiana University Press. Price £37.95 (hard covers). ISBN 0 253 34054 3.
DOI: 10.1017/S0016756803228120

The origin of tetrapods is a topic that seems to grab headlines almost as frequently as feathered dinosaurs, or the fossil

wonders that have been unearthed from the Burgess Shale and Chengjiang. At the centre of studies focusing on tetrapod origins in recent decades has been the Cambridge group headed by Jenny Clack. Jenny began work on early tetrapods under the tutelage of Dr Alec Panchen (Newcastle) who was a Ph.D. student in the Zoology Department in Cambridge in the mid-1950s, so the Cambridge connection is indeed strong. Jenny's early work was on Carboniferous tetrapods, which were fairly regularly retrieved from the coal mines of the North East (prior to the heavy mechanization of extraction in more recent times). However, when Jenny moved to take up a curatorial position at the Zoology Museum in Cambridge in the early 1980s the focus of her research had an opportunity to change. During the first half of the 20th century a series of expeditions by Danish and Swedish palaeontologists had gone to East Greenland to collect from Late Devonian deposits. Their work revealed the earliest known four-footed creatures – animals with legs and feet, but also unmistakable traces of their fish ancestry (fish-like body scales, and more importantly fish-like tail fins). This seemed to be one of those rare examples of animals caught in the act of evolving – fossils that would no doubt have made Charles Darwin smile with pleasure. Frustratingly for us, and the world at large, the details of these early discoveries were very slow to appear, leading to an understandable amount of speculation and hyperbole being generated in the scientific and semi-popular literature over the years.

In the 1980s Jenny's arrival in Cambridge (Zoology) picked up on a time of exploration of the Old Red Sandstone of East Greenland by Dr Peter Friend (Cambridge, Earth Sciences). This was an extension of Peter's studies in Spitsbergen and gave him three successive years of field exploration and a succession of Ph.D. students to study the sedimentology and basinal history of this area. John Nicholson worked on the youngest of these sequences and collected early tetrapod remains – these were offered to Jenny who immediately recognized their palaeontological significance. And the rest, as they say, is history! Further expeditions identified Nicholson's localities, and resulted in the collection of new important material that has since been prepared and published. This work has offered a new and unique insight into the problems of the origins of tetrapods and has taken the whole subject area into realms that could not possibly have been foreseen in the decades beforehand.

Jenny's book summarizes much of this work in some detail, offering a phylogenetic context for the understanding of her work, describing the important discoveries, and showing how they have fitted into a broader understanding of the origin of tetrapods and the invasion of land by vertebrates in particular. The book is accessibly written, well-illustrated, and covers the field with ease and an uncluttered understanding.

In short this book is a very valuable contribution to courses on vertebrate evolution. It is not mainstream, in the sense that it is not comprehensive enough for such courses, but is an essential back-up to any current books in this field, correcting many misconceptions that have been perpetuated for *far too long*. This is a must for all libraries, and for the shelves of dedicated vertebrate palaeontologists – not a snip at the price, but what book now is?

David Norman

OLDROYD, D. R. (ed.) 2002. *The Earth Inside and Out: Some Major Contributions to Geology in the Twentieth*

Century. Geological Society Special Publication no. 192. vi + 369 pp. London, Bath: Geological Society of London. Price £85.00, US \$142.00; members' price £42.50, US \$71.00; AAPG members' price £51.00, US \$85.00 (hard covers). ISBN 1 86239 096 7.
DOI: 10.1017/S0016756803238127

This volume is the latest in a line of books published on the history of geology by the Geological Society of London in its handsome 'Special Publications' series. It follows volumes devoted to Charles Lyell (1998), James Hutton (1999) and the Age of the Earth (2001), and considers the genesis, development and impact of theories, ideas and methodologies of more recent and contemporary geologists and research teams. This book and its contents might surprise latter-day geologists, many of whom would probably not consider examining what was frontier research as little as two decades ago from a historical and philosophical perspective. Indeed, a colleague of mine, who is still research-active, was somewhat amused on being told that he featured in a photograph illustrating one of the essays found in this book. Yet this book gives valuable insights into the construction of some aspects of modern geological thought, such as geomagnetism and thermodynamics; insights which can help the formulation of new research, building on the not-so-distant past.

This volume contains fifteen papers, eight of which were presented at a meeting of the International Commission on the History of Geological Sciences (INHIGEO) held during the International Geological Congress in Rio de Janeiro in August 2000. The additional papers as well as Oldroyd's insightful introductory piece were commissioned specially for this book. INHIGEO is a commission of the IUGS and has 170 members worldwide representing 37 countries. Active in promoting research into the history of geology, it holds annual symposia, the proceedings of many of which are subsequently published.

Early in his introductory chapter David Oldroyd recalls the view of the historian Derek Price who noted in 1965 that the impact of scientific papers was immediate, but that it declined rapidly within three years. Seminal papers could expect a citation life span of a perhaps a decade. If one takes Price's opinion as true then the need for historic assessment of the impact of recent theories in geology is all the more important. Oldroyd goes on to note a sudden shift in geological exploration at the beginning of the twentieth century from terrestrial-based studies to a more inclusive study of the Earth as a whole. There was a realization that the Earth was a dynamic planet, in which and upon which evidence for crustal movement could be seen. Advances in geophysical technologies allowed geologists to examine for the first time the interior of the Earth in any detail so as to allow reasonable interpretation and less speculation. Richard Howarth discusses the rise in the use of graphical information in geological literature from the early 1800s when papers were largely descriptive, through the 1920s when there was an increase in the numbers and type of mathematical data presented graphically, to the 1980s when desk-top personal computers gave geologists easy access to statistical and drafting packages which was reflected in their research papers. Early uses of graphical data included the production of earthquake maps marked with isolines showing the damaged area around Mór in Hungary (1814), to data on the quantity of copper ore mined in Cornwall (1846).

In the early part of the twentieth century isostatic studies were a prelude to the plate tectonic revolution that arrived

suddenly in the 1960s. This collection contains four papers relating to plate tectonics: that by Cherry Lewis focuses on Arthur Holmes; Homer Le Grand writes on the divided geological community, of tectonicists on one side who encompassed a large-scale view of Earth tectonics, as against the terranists who took a closer look at the effects of plate tectonics on geology at a more local level. Cathy Barton of the University of Maryland Baltimore County documents the role of Marie Tharp and Bruce Heezen of the Lamont Geological Observatory in the development of oceanographic geology and mapping which revealed for the first time the Mid-Atlantic Ridge, a feature that is now so familiar to all undergraduates that the significance of its discovery is often overlooked. Le Grand and Barton both demonstrate the value of collecting personal first-hand recollections, verbal or written – in the latter case she interviewed Tharp several times. Victor Khain and Anatoly Ryabukhin outline the Russian reaction to the plate tectonic theory where at one point students at the Moscow State University were being taught from opposite standpoints by several colleagues. Gregory Good's paper deals with the development and subsequent specialization of studies on the Earth's magnetism. From the 1950s onwards this theme had diverged into crustal conductivity, palaeomagnetism and magnetospheric research to name but three; Good argues that consequently it is rather difficult to see the significance of early studies, as the achievements made then were clouded by later advances made in the subject.

The papers by Jacques Touret and Timo Nijand, and Bernhard Fritscher examine the advances made in metamorphic geology in the last century. The latter paper in particular homes in on the relationship between metamorphism and theoretical chemistry which was conjured with between 1890 and 1930 by several men including Victor Goldschmidt and Penitti Eskola who would not be categorized as being geochemists. Davis Young is well known for his book on the age of the Earth, but also for championing the memory of the igneous petrologist Norman Bowen, who is largely remembered for his work on the fractional crystallization theory from which the origins of many igneous rocks could be determined. Ursula Marvin who has done much to advance our knowledge of the history of meteoritical studies, gives an overview of the major strides made in planetary sciences which began in the heady days of the early 'Space Age' in the late 1950s.

Sedimentary geology is not neglected with a contribution by Eugen & Ilse Seibold, while Hugh Torrens writes wearing his stratigraphical hat, and recalls the major and early contributions made to biostratigraphy by Sydney Savory Buckman and Henry Shaler Williams on either side of the Atlantic Ocean. Buckman using Jurassic ammonites provided a precise stratigraphical framework for the area in which he laboured, but also recognized that lithologically identical rocks could in fact be diachronous. In this paper Torrens pulls no punches, as one might expect from him, and bemoans the decline in the last four decades of the teaching of stratigraphy and the rise in perception that as a subject it was outmoded and boring. Of greater worry was the thinking during this same period that greater stratigraphical precision could be garnered from newer analytical methods then and still in vogue. I agree with him when he pleads that geologists today should use these methods but in conjunction with the biological indicators than can yield greater precision.

The advances made in palaeontology in the twentieth century suggest that as a subject it deserves a stand-alone volume, and the editor noted this space-determined

deficiency in the present work. The one area of palaeontology covered in this volume is palynology. Bill Sarjeant, who sadly died in July 2002, had for over four decades a larger-than-life influence in the fields of palynology and history of geology which will no doubt continue, albeit through his writings and his monumental ten-volume work *History of Geology and Geologists*. Here he treats the reader to a scan through his illustrated personal scrapbook of palynologists. The final paper in this collection is by Simon Knell who examines the culture of geological collecting in Britain in the last three decades of the twentieth century, set against the backdrop of conservatism and recession.

The editor, authors, and the Geological Society deserve many congratulations on the production of a fascinating book. Like those in the 'Special Publications' series it is a pleasure to hold and handle, and thus easy to read. I recommend it to all geological researchers who are active in any sub-discipline of the subject, primarily because it reminds us all of the value of thinking. Unfortunately too many of us are now weighed down by the bureaucracy imposed from various quarters in professional life, and have less time to simply cogitate on where we wish to take our research. Settle into a deep armchair, grab a coffee, and take up this book. I am certain that most readers will find inspiration in the story of our recent colleagues that will allow them to take their own research forward.

Patrick N. Wyse Jackson

HOLDSWORTH, R. E. & TURNER, J. P. (eds) 2002. *Extensional Tectonics: Regional-Scale Processes*. Key Issues in Earth Sciences Series Volume 2, part 1. v + 344 pp. London, Bath: Geological Society of London. Price £27.50, US \$46.00 (paperback). ISBN 1 86239 114 9.

HOLDSWORTH, R. E. & TURNER, J. P. (eds) 2002. *Extensional Tectonics: Faulting and Related Processes*. Key Issues in Earth Sciences Series Volume 2, part 2. vi + 322 pp. London, Bath: Geological Society of London. Price £27.50, US \$46.00 (paperback). ISBN 1 86239 115 7.
DOI: 10.1017/S0016756803248123

The Publications of the Geological Society of London have, since its foundation, been an important component of its scientific activities. However, the past quarter century has seen the development of the journal into a major international publication and the parallel growth of the Special Publication series of thematic volumes. Between them, these series host a wealth of influential and widely-cited papers. Now a new Geological Society series aims to compile some of these papers on selected topics into affordable volumes for a wide readership.

Volume 2 in the Key Issues in Earth Sciences series covers *Extensional Tectonics*. Bob Holdsworth and Jonathan Turner have chosen thirty-five papers from the past twenty years of Geological Society publications and republished them in two parts each with its own short introduction. The first part – subtitled *Regional-Scale Processes* – deals with the formation, fill and inversion of extensional basins. The second part – *Faulting and Related Processes* – deals with just what it says on the cover, concentrating on normal fault geometry, seismicity, modelling and fluid flow. Papers in both volumes show some bias towards petroleum-related issues, and the target readership is seen as petroleum geology postgraduates and professionals as well as undergraduates.

Despite the reasonable cost of these volumes and the quality of their contained papers, there must be some doubt as to whether they will sell well. Research libraries will be reluctant to buy them if they merely provide a second copy of papers already on their shelves. Teaching libraries lacking the Journal or the Special Publications may be more easily persuaded. Individual purchasers may also be tempted, but all readers will be frustrated that the selection of papers is limited by the imposed Geological Society provenance. Strong through this source is, such volumes can only contain a minority of the key papers on their chosen topic. Given the Geological Society's links with other publishers such as the AAPG, GSA and SEPM, would it not have been more viable to embrace an even more representative selection of papers including these sources? The sales figures for the Key Issues will answer this question.

Nigel Woodcock

GENSEL, P. G. & EDWARDS, D. (eds) 2001. *Plants Invade the Land. Evolutionary & Environmental Perspectives. Critical Moments & Perspectives in Paleobiology and Earth History Series*. xi + 304 pp. New York: Columbia University Press. Price £46.50 (hard covers). ISBN 0 231 11160 6.
DOI: 10.1017/S001675680325812X

This is an important volume for all who are interested in the history of life on land. Dedicated to Professor Winfried Remy, it contains thirteen chapters on all aspects of early plant life on land, their environment and effects. The volume is well edited and produced with excellent diagrams and photographs.

Following a brief introduction Edwards & Wellman discuss the Ordovician to Lower Devonian records of embryophytes on land and consider the emergence of tracheophytes and their diversification. The chapter provides useful summary tables with all Silurian and Early Devonian land plant records with references, together with a brief description of major localities and photographs of some of the plants. There is an excellent review of the spore evidence and palaeogeographic maps showing the distribution of spore and macrofossil assemblages. To compliment this chapter Shear & Selden describe the early history of terrestrial invertebrates (arthropods). They examine the trace-fossil record as well as the body-fossil record, considering the nature of the evidence, the main localities and the animals themselves. There is an extensive section on animal-plant interactions. My only complaint about this chapter is that I would have liked to have seen some pictures or line illustrations.

Following these two extensive reviews is a chapter by Kerp, Hass & Mosbrugger with new data on the Rhynie plant *Nothia* that includes many anatomical photographs and sketches. They interpret the plant as one that was well adapted to temporary, presumably seasonal, humidity, living on a sandy substrate.

Gensel, Kotyk & Basinger describe the above- and below-ground structures in Early Devonian plants. These studies allow more precise inferences about interactions between plants and soil including the role of plants in soil development, composition and erosion, areas of interest to sedimentologists as well as palaeobiologists. They illustrate, by well chosen photographs and line drawings, the range of plant structures met in rocks of this age.

Shou-Gang & Gensel describe an important Early Devonian plant compression flora from China. They provide excellent line drawings and photographs of the plants with many new data. The Middle Devonian flora is described by Berry & Fairon-Demaret. They provide useful summaries of the plants and their occurrence as well as a discussion of their habits. They highlight the need for more ecological studies of these floras.

In a useful chapter of a controversial topic, Graham & Gray discuss the origin, morphology and ecophysiology of early embryophytes. The chapter focuses on the evolutionary transition from aquatic algal ancestors and the characteristics of the earliest land-adapted embryophytes and the environment that may have led to terrestrialization. The chapter uses much of the controversial material collected by the late Jane Gray over her lifetime and is an excellent summary of this work.

Cooper-Driver examines the role of phenolic compounds in the evolution of early land plants. This evolution, requiring new innovations, was not only morphological and structural but also biochemical. Cooper-Driver introduces us to the striking changes which 'occurred in the biochemistry of these early land plants, resulting in modifications to or extensions of existing biosynthetic pathways. Many of the newly synthesized compounds were important in the way they aided successful invasion of the land.'

The effect of the rise of land plants on atmospheric CO₂ during the Palaeozoic is considered by Berner who has produced many of the CO₂ versus time curves. Berner concludes that the large drop in CO₂ that occurred during the Devonian and Early Carboniferous was due predominantly to the rise of vascular land plants and their spread to upland areas. The comment about upland floras may be more controversial. These plants caused an acceleration of the rate of rock weathering that amplified to CO₂ fall, in turn leading to Palaeozoic global cooling and the Permo-Carboniferous glaciation.

The early Devonian plant assemblages from Gaspé, Canada, have been famous since the nineteenth century. Many important early land plants have been described from these terrestrial sediments, yet little has been published on their taphonomy and ecology. In a welcome and useful chapter Hotton, Hueber, Griffing & Bridge describe the sedimentological context of the floras. With maps, sections, lithological logs and photographs they document the occurrence of the plants. They also provide two landscape reconstructions which are particularly helpful. An appendix illustrates and describes all the major plants from the area, including spores *in situ*.

Another highly significant chapter is that of Algeo, Scheckler & Maynard on the 'Effects of the Middle to Late Devonian spread of vascular land plants on weathering regimes, marine biotas and global climate'. They summarize evolutionary innovations among early vascular land plants and look at their effects on weathering processes, pedogenesis and the hydrological cycle. This is a particularly useful and well illustrated section that should be read by sedimentologists and those interested in terrestrial environments. Two subsequent sections consider global climate change and its causes. This chapter will also be of interest to climate and atmospheric modellers. The subsequent chapter by Driese & Mora develops some of these points and considers the diversification of Siluro-Devonian plant traces in palaeosols and their influence on estimates of palaeoatmospheric CO₂ levels. Many of the data from this study come from the Appalachian Basin. They also include stable carbon isotope data

and suggest that this, from pedogenic carbonate in palaeosols, can be used to estimate palaeoatmospheric CO₂ levels.

All the references are collected at the end of the volume and there is a useful index, although not all the references to pages work.

In summary this is an excellent volume that should be purchased not only by all geological libraries but also by anyone with an interest in the evolution of the biosphere–atmosphere system.

Andrew C. Scott

MEMBERS OF THE DORSET GEOLOGISTS' ASSOCIATION GROUP. 2003. *Coast and Country Geology Walks in and around Dorset (including excursions within the World Heritage Site)*. 208 pp. Price £7.95 (paperback). ISBN 0 9544354 00. Copies available from Alan Holiday, 7 Whitecross Drive, Weymouth, Dorset DT4 9PA, England.
DOI: 10.1017/S0016756803268126

Dorset is amongst the most beautiful parts of England, and one's appreciation of this county is enormously enhanced by an understanding of its geology. For the professional it remains one of the key areas of world geology, and it is absolutely fitting that (like the Burgess Shale) the coastal sections have been designated a World Heritage Site. Interest in the geology extends across a wide spectrum, from admiring the striking land-forms to the pleasure of collecting ammonites at Charmouth, and it is difficult to imagine a more suitable book to take on your geological forays. Here we have 28 excursions, each meticulously documented in terms of access, a route, and key sites to be investigated on the way. For the most part the text is chatty, without being obtrusive, while the details of geology are carefully explained and rarely demanding: not only ideal for the enthusiastic naturalist, but also for those at school and even in the early stages of university.

What is particularly impressive is the amount of information that has been smuggled in, so that the excursionist may become aware (perhaps for the first time) of the effect of deeply buried Variscan faults or the influence on the landscape of the geologically very recent periglacial episodes. Naturally, the emphasis is mostly on the local geology, notably the rich fossil record, the excellent sedimentary sequences and the land-forms, but there are also asides on archaeology, and even reference to local Purbeck words, a still remote and haunting part of Dorset. Many of the excursions are well known, but only the most experienced will be familiar with all of them, especially the inland walks. Nearly all are self-contained, although the last one, on Worbarrow Tout, might have been conveniently expanded to include the spectacular Army Range walks, and thereby serve to connect the separate excursions to Lulworth Cove and Kimmeridge Bay.

Those who already know Dorset will well appreciate that there are unexpected dangers. The hazards are carefully spelt out, even to the extent of the danger of stumbling onto a naturist beach or picking up a stone and so risking a £1000 fine. Budleigh Salterton, it appears, is not quite as safe as it seems. If there is a more serious and recurrent concern, it is the continuing and dramatic erosion along much of this coast. The bonus, of course, is fresh exposures and not infrequently spectacular fossil discoveries. Yet, there is no doubt that a second edition of this Guide will draw attention to continuing coastal retreat and cliff instability that most

likely will be exacerbated in the coming years with sea-level rise and intense episodes of rainfall.

This book is a 'must' for anyone with an interest in Dorset, its geology and landscape. It is rightly dedicated to the memory of Michael House, who like many loved Dorset and its geology. This is a book for amateur and professional, experienced naturalist and the merely curious. It will spark anyone's interest to look more carefully at Dorset, and with its success perhaps encourage future editions that could widen the scope to consider a little more fully the archaeological, etymological and historical riches of this county that owe so much to the backbone of its geology.

Simon Conway Morris

FRANKE, W., HAAK, V., ONCKEN, O. & TANNER, D. (eds) 2000. *Orogenic Processes: Quantification and Modelling in the Variscan Belt*. Geological Society Special Publication no. 179. vi + 459 pp. London, Bath: Geological Society of London. Price £85.00 (hard covers). ISBN 1 86239 073 8.
DOI: 10.1017/S0016756803278122

This book is the culmination of a broad-ranging German-funded series of research projects (*Orogene Prozesse*) concerned with research into orogenic processes using the evolution of the Variscan fold and thrust belt in Europe as an example. The introduction to the volume (Franke *et al.*) admirably sets out the reasons for research into orogenic processes, including the observation that it is not enough to simply describe orogenic settings, but it is also necessary to quantify and model them in order to better understand the complex nature of their evolution. Given that the chosen orogen for more detailed investigation is a Palaeozoic one (i.e. the Carboniferous Variscan orogen), there are – understandably – many problems associated with its elucidation. However, using a wide variety of data types (e.g. geophysical, geological, geochemical), investigative approaches (e.g. geophysics, isotopes, modelling) and examining a range of lithologies from sediments to metamorphic rocks the research workers were successful in presenting a comprehensive analysis of our current understanding of the European Variscides. Following the short introduction, the book continues with a series of 25 research papers which examine, in detail, aspects of Variscan geology in Central Europe.

A series of initial overview papers presents the reader with a relatively easy entry to the complexities of Variscan geology. McKerrow *et al.* provide a short overview of the Palaeozoic time scale where both U–Pb dates and biostratigraphic information are used in combination to construct an absolute time scale for the Cambrian through to the base of the Permian. A very useful summary of the palaeogeography for the Devonian–Carboniferous based on biogeography, palaeomagnetism and facies distributions (McKerrow *et al.*) follows, with more detail on the palaeomagnetism being provided by the Tait *et al.* paper. Final summary papers include a very detailed and informative one by Franke on the various tectonostratigraphic units, terrane boundaries and plate tectonic evolution of the region, and from Franke & Zelazniewicz on the geology of the Western Sudetes and its relationship with the zones defined by Franke.

The following section of the book is taken up with papers that examine the isotopic evidence for various geological

and structural events within the Variscides. These papers tend to fall into one of two groups, sometimes both: those which are restricted to a specific region, or those which use a specific technique. Belka *et al.* investigate the Baltica–Gondwana suture in central Europe while Henger & Kröner review Nd data and xenocrystic and zircon ages from the pre-Variscan basement in Bohemia (which ties in neatly with the work of Finger *et al.* outlining the state of research on the Precambrian evolution of the Brunovistulian, a Peri-Gondwana basement block at the eastern end of the Central European Variscides). Linnemann *et al.* present an excellent review of basin development in Central Europe based on SHRIMP dating of single zircons covering a period ranging from Cadomian subduction through to Early Palaeozoic rifting. This work is complimented by the papers from Floyd *et al.* on the geochemistry of volcanic suites, and Kröner *et al.* on geochronology, from the Bohemian Massif.

The next section begins with an examination of deep-crustal structures from the Belgian/western German part of the European Variscides (Oncken *et al.*) and based on balanced sections from a number of authors in order to investigate the development of passive margin detachment during collision. Finite-element modelling of the collisional process (Seyferth & Henk) is used to investigate the tectonometamorphic history of the region and also strain partitioning within the collision zone, while Littke *et al.* use heat flow variations to investigate basin-forming processes and the heat flow and burial history of the Rhenohercynian fold belt.

Exhumation studies based on geophysics (Krawczyk *et al.*), Ar/Ar ages of metamorphic rocks (Werner & Lippolt), metamorphic studies (O'Brian; Henk *et al.*) and modelling based on geology (Franke & Stein) or finite-element techniques (Henk) form the next section of the volume. Two final papers on crustal studies (Wittenberg *et al.*) and magma mixing (Gerdes *et al.*) complete the volume. There are, however, two additional papers, both of which are concerned with sedimentary basin fill within the evolving orogen. The first of these (Ricken *et al.*) examines orogenic wedge migration and changes in basin architecture, facies types and progradation of turbidite systems while Eisele *et al.* investigate the volcano-sedimentary systems from the Southern Vosges Basin.

One significant factor about the majority of the papers in this volume is the level of interdisciplinary work which is necessary when working on the difficult problems of Variscan geology. For example, Schäfer *et al.* use a combination of seismic interpretation, section balancing, field observations and geochronology in order to reconstruct upper plate deformation during collision.

One minor quibble was the lack of overview papers which drew on a broader view of Variscan geology than that presented within the contained papers. They tend to concentrate very much on 'hard rock' geology, with relatively little work on the sediments which filled the many Variscan-age basins. Any geologist will associate this period, the Carboniferous, with the development of major alluvial and marine successions with their attendant economic deposits. This aspect is lacking within this volume. An additional factor is the relatively restricted geographic extent of the papers within the volume. Apart from the overview papers, all of the studies, with one exception, tend to focus on the Variscan units of Central Europe. It would have been useful, perhaps, if the authors had sought out some additional papers in order to provide a broader view of Variscan geology (e.g. papers from southern Britain, Ireland or Spain). That

said, this volume is an extremely useful addition to any university library, and the book will provide a very thorough background for researchers in this area on the current state of Variscan research.

Tom McCann

DE MEER, S., DRURY, M. R., DE BRESSER, J. H. P. & PENNOCK, G. M. (eds) 2002. *Deformation Mechanisms, Rheology and Tectonics: Current Status and Future Perspectives*. Geological Society Special Publication no. 200. viii + 416 pp. London, Bath: Geological Society of London. Price £100.00, US \$167.00; members' price £50.00, US \$83.00; AAPG members' price £60.00, US \$100.00 (hard covers). ISBN 1 86239 117 3. DOI: 10.1017/S0016756803288129

A key aspect of the behaviour of the Earth is the slow but inexorable flow of solid material at almost all levels in the crust and mantle. We are used to the idea of mantle convection, despite the fact that it is for the most part a solid crystalline material, and mountain belts are replete with strongly foliated metamorphic rocks that are the product of flow and deformation within crustal material. Our understanding of these processes comes partly from large-scale observations and modelling. Attempts have been made, for example, to create models that simulate plate tectonics. Whether such models predict discrete plate-like entities depends critically on the rheology input to the model. Here, rheology is the name for how a stress induces strain in a material. For inelastic, permanent strain, it is usually expressed as a relation between stress and strain rate. This can be expressed mathematically; for example, in Newtonian viscous materials there is a linear relationship between the stress and strain rate.

But what actually controls such relationships? The mathematical link between stress and strain must be the result of atomic-scale processes that allow crystalline materials to change shape. The study of such small-scale processes – the deformation mechanisms referred to in the book's title – is an integral part of understanding rheology and hence how the Earth deforms. Trying to understand rheology without an appreciation of deformation mechanisms would be like trying to understand mantle geochemistry without knowledge of partition coefficients. This book is an up-to-date snapshot of developments and problems in the study of deformation mechanisms in rocks. It is a collection of papers based on work presented at the Deformation Mechanisms, Rheology and Tectonics conference held in the Netherlands in 2001. This meeting itself was one in what is now an established biennial series, the first being in 1976.

So where is the subject going? The book is divided into four themes. The first has seven papers on the effects of fluids on deformation. This is a huge topic, and complex because fluids can have both physical and chemical effects on rock behaviour. Fluids are particularly important in facilitating pressure solution, a deformation mechanism involving dissolution of mineral grains at high-stress interfaces, diffusion, and precipitation at low-stress interfaces; several papers address this. Conversely deformation can influence fluids, for example by altering permeability. The second theme, on interpretation of microstructures, has six papers. The question here is: given only the natural end result of deformation, how can we deduce the rheology? Insight comes from experiments and theoretical models that show

that the rheology of rocks is intimately linked to the way in which the microstructure evolves. So, in principle, we should be able to recreate the rheology from observed microstructures. This is easier said than done, but much recent work has focused on the development of lattice preferred orientations. These can be measured more effectively than in the past, using new optical, X-ray and other techniques. The preferred orientations are often produced by dislocation creep, but can be modified by recrystallization and annealing.

The third section has five papers concerning rheology in the crust and upper mantle, though of these three are on calcite, a well-studied mineral in terms of its rheology, but still capable of producing surprises. Finally we have three papers on crust and lithosphere tectonics. This is where we see the ways in which an understanding of deformation mechanisms on the small scale can be deployed to understand larger scale tectonics – for example, how strain localization (the ‘concentration’ of high strains into small regions such as shear zones) can influence mantle evolution during rifting.

Overall the science in this book is of a high standard; the papers are well presented and smartly illustrated. As someone who researches into deformation mechanisms, I will be reaching frequently for this book. For any scientist interested in how solid materials change shape, though, it provides a fine set of current viewpoints. As the mantle churns away beneath us, it is worth reflecting on the complexities that this process actually involves on the grain scale.

John Wheeler

CERVENY, V. 2001. *Seismic Ray Theory*. viii + 713 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £90.00, US \$130.00 (hard covers). ISBN 0 521 36671 2.
DOI: 10.1017/S0016756803298125

For over 40 years Professor Cerveny and his co-workers have been major contributors to the development and application of seismic ray theory. This book is described in its outline as ‘the most comprehensive treatment of the ray method available’ and it lives up to that description. Who should read it? If you are out to learn the basics of ray theory, don’t get put off by the comprehensive nature of this book, as it is very readable. Also, there is the adage that to truly understand the basics one needs to see how those convert into technical detail. Professor Cerveny focuses on the former and guides the reader into the latter. The length of the book derives from the diversity of ways and environments in which the ray method has been applied. Ray theory is an approximation. As a result, there never will be a uniquely prescribed way in which it has to be used, and yet the concepts are fundamental to much of what is done in processing seismic reflection data, for instance.

Chapter 2 deals with the basics of seismic wave propagation and introduces the reader to some of the ray theory results. Putting aside the ultimate ray theory focus, this is as good an ~100-page outline of seismic wave theory and concepts as I have seen. The remainder of the book is logically divided into three main chapters, followed by a final, shorter chapter cataloguing the ways in which synthetic seismograms can be produced.

The first of the three main chapters (Chapter 3) deals with seismic rays themselves and solution of the eikonal equation

to obtain seismic wave travel times. Cases considered include inhomogeneous isotropic media, laterally varying layered structures, use of curvilinear coordinates, inhomogeneous anisotropic media, perturbation methods, and surface-wave ray tracing. The next chapter (Chapter 4) on dynamic ray tracing and paraxial ray methods is really for software developers who have to know the full technical details, and is comprehensive in its coverage. Chapter 5 at ~200 pages long is the longest chapter and covers the estimation of seismic wave amplitudes, including the use of ray series. As well, it touches on ways in which ray theory can be modified.

Who should buy this book? I thoroughly recommend it as essential reading for software developers in the seismic processing industry, where seismic ray theory is likely to remain a fundamental tool for a good while to come. It is also recommended reading for people wanting to understand the inner workings of classical computer programs used in other branches of seismology. Also, even though the ray method has been superseded at the forefront of seismic wave propagation research, it is good for theoretical seismologists to know about ray theory, as it has been a very fruitful field of endeavour. In summary, I believe Professor Cerveny has produced a worthwhile and very well written book.

John Haines

WINCHESTER, J. A., PHARAOH, T. C. & VERNIERS, J. (eds) 2002. *Palaeozoic Amalgamation of Central Europe*. Geological Society Special Publication no. 201. vi + 353 pp. London, Bath: Geological Society of London. Price £85.00, US \$142.00; members’ price £42.50, US \$71.00; AAPG members’ price £51.00, US \$85.00 (hard covers). ISBN 1 86239 118 1.
DOI: 10.1017/S001675680330812X

The diversity and complexity of European geology owes much to Palaeozoic events. The late Proterozoic rifting of Laurentia from Gondwana heralded a procession of smaller continental fragments, each separating from the high southern latitude of Gondwana and drifting northwards to accrete to a more equatorial Laurentia. Our present understanding of the resulting collage of terranes was nurtured in Western Europe and developed by correlating further west, to the North American Appalachians. In the past twenty years, however, attention has increasingly turned eastward through Central Europe to where the Palaeozoic terranes are wedged out between the Baltic Shield and the Carpathians. The latest Special Publication from the Geological Society comprises papers on this eastern half of Palaeo-Europe, stretching from Belgium to Poland and from Denmark to Bohemia.

The format of Special Publications is long established, and broadly successful in this volume. Fifteen papers on specific sub-regions are loosely organized into genetic sections: biostratigraphic/provenance evidence, isotopic constraints, petrological and geochemical evidence, structural evolution, seismic traverses and deep crustal structure. As usual in such volumes, the collection might lack context and coherence if it were not for an introductory chapter by the editors. This chapter summarizes topical issues well and provides the broadest possible perspective in a helpful series of global palaeocontinental maps. More guidance to the geography of Central Europe would have been welcome, with the area being unfamiliar to most North

American and Western European readers. However, the collection will be welcomed by such readers as a timely and accessible guide to important and inadequately publicized geology.

It is in the nature of tectonic reconstruction that new data often complicate the picture, before unifying patterns emerge. So it is with the Palaeozoic tectonics of Europe. The distinction between Caledonian and Variscan amalgamation events is, even from West European evidence, becoming less certain than it was. The evidence from the east adds further facets to this problem, such as the proposed amalgamation of the Malopolska and related terranes with Baltica as early as late Cambrian time, and the derivation of these terranes, along with Avalonia, from closer to the South American sector of Gondwana than the North African section. Hopefully, the new Special Publication will stimulate yet further work that will start to solve such tectonic puzzles.

Nigel Woodcock

PEUCKER-EHRENBRINK, B. & SCHMITZ, B. (eds) 2001. *Accretion of Extraterrestrial Matter Throughout Earth's History*. xxvi + 466 pp. New York, Boston, Dordrecht, London, Moscow: Kluwer Academic/Plenum Publishers. Price Euros 126.50, US \$110.00, £77.00 (hard covers). ISBN 0 306 46689 9.
DOI: 10.1017/S0016756803318126

Over time, a large amount of natural debris has been released into the Solar System. Mechanisms for this include disturbances in the Oort Cloud and Kuiper Belt, the influence of Jupiter's gravity, collisions between asteroids, meteoroid impacts on moons and planets with thin atmospheres, the slow destruction of comets, and the influx of grains from interstellar space. The objects range in size from asteroids and comets, to smaller fragments and microscopic grains that give rise to recoverable meteorites and micrometeorites, with their sources varying from the inner to the extreme outer parts of the Solar System and beyond.

An estimated 30–40 000 metric tons of extraterrestrial material accumulates on Earth each year. Fortunately for us, the great majority of this material arrives as dust: micrometeorites and interplanetary dust particles that drift gently onto the Earth's surface. Some 3–7 metric tons of meteorites in the range 10g–1kg also land on the Earth each year. Although for climatic and geographical reasons very little of this material is quickly recovered, sampling of the preserved accumulations of meteorites in deserts suggests that these figures have not changed significantly for at least 50 000 years. Moreover, abundant fossil stony meteorites in Ordovician (480Ma) limestone from Österplana in Sweden prove that the most common meteorites seen today have been falling for far longer than any recovered from deserts. At the other end of the size scale, around ten asteroids or comets larger than 1km in diameter collide with the Earth every million years or so. Even larger objects, with the potential to cause global catastrophic events, strike the Earth on timescales of hundreds of millions of years.

This book, edited by Bernhard Peucker-Ehrenbrink and Birger Schmitz, arose from a session on the 'Accretion of Extraterrestrial Matter Throughout Earth's History' at the 1998 Fall Meeting of the American Geophysical Union. Twenty-two contributions from thirty-six leading researchers in the field provide an outstanding overview of our present understanding of the accretion of extraterrestrial matter to

Earth over time. Well referenced chapters cover the nature, origin, orbital evolution and quantification of dust and larger objects falling to Earth; mechanisms for their delivery to Earth; their history in space and terrestrial age; their modification during fall to Earth; and the lengthy record of accretion from sedimentary deposits. Other contributions show how a late accretion chronology and cratering rates can be derived from studies of the Earth–Moon system, whilst a less obvious topic links major glacial cycles on Earth to variations in the flux of interplanetary dust.

Study of the flux of extraterrestrial matter to Earth and its temporal and spatial effects on the environment is an emerging field that has brought astronomers and planetary scientists much closer together. Scientists from a wide variety of disciplines will find this volume an extremely useful reference, and it is an essential addition to research libraries. The presentation is sympathetic to the non-specialist reader, and it is made all the more valuable by a good index. This also makes the book an excellent introduction to the subject for students of astronomy, geology, and atmospheric physics.

Those who thought that the Solar System is no longer a dynamic place would have had their doubts removed by the spectacular collisions of fragments of Comet Shoemaker-Levy with Jupiter in July 1994. More than two hundred years after the first scientific inklings of the interaction of extraterrestrial material with the Earth, this subject, once considered rather esoteric, is now at the forefront of scientific thinking, and a vibrant area of interdisciplinary research. Indeed, the survival of our civilization may one day depend on it.

Alex Bevan

THOMAS, L. 2002. *Coal Geology*. xi + 384 pp. Chichester, Hoboken NJ: John Wiley & Sons. Price £100.00 (hard covers). ISBN 0 471 48531 4.
DOI: 10.1017/S0016756803328122

Coal geology is not widely taught, but in addition most books on the subject have major drawbacks and are expensive for undergraduate use. This volume has been developed for those working in the coal industry and is designed to give background information for the coal geologist. As such, therefore, it should include introductory principles which may be useful for students. The book comprises 14 chapters and includes chapters from the origin of coal, to coal as a substance, to coal exploration, resources, reserves and use. It is illustrated by diagrams and photos many of which have not reproduced well.

Following a brief preview chapter, the origin of coal is considered. The chapter is poorly organized with the sedimentological interpretation of coal sequences coming before the origin of peat. This discussion relies heavily on the older literature and there is no reference to sequence stratigraphy. This is also the case with the peat section which reproduces the same diagrams as many other volumes. There is little discussion of coal-forming vegetation or how this has changed over geological time.

The chapter on the age and occurrence of coal also indicates a lack of in-depth knowledge. The figure on geological age of coals has many inaccuracies. There is Triassic coal in Australia but little late Cretaceous coal in China, for example. The heavy use of Walker (2000) was unwise as this in itself is a highly derived work, especially with regard to the palaeogeographic maps. The section on

the age and geographical distribution of coal should have included reference to Hower *et al.* (1995). The map of coal in China is totally inadequate.

Chapter 4 considers coal as a substance and considers methods of classification and study including coal petrography. Unfortunately this is also out of date, not referring to recent publications of the International Commission for Coal Petrology. Discussion here is totally inadequate with reference to the highly contentious hypothesis for the freeze-dry origin of inertinite but not the widely accepted origin from wildfire. Palaeoecological data relies on 1960s work and there is nothing on the vast amount of recent data. There is a discussion of coalification and its causes and then a consideration of coal quality and combustion properties of coal.

Chapter 5 considers coal sampling and analysis and relies heavily on the author's own work. Chapter 7 considers coal resources and reserves – mainly different techniques for their calculation. This is useful as different countries use different definitions and methods of calculation. Data from the BP statistical review of world energy is widely used here. The chapter on the geophysics of coal is a little out of place and may have been better included in exploration techniques.

There is a short chapter on the hydrology of coal followed by a more extensive treatment of coal mining. This is a fairly standard treatment and there is little imagination with the use of diagrams. Chapter 11 outlines coal as an alternative energy source which includes coalbed methane. There are few references to important recent volumes on the subject. Underground gasification is also considered as is coal liquefaction. The section on coal as an oil-source is rather thin and superficial.

Chapter 12 considers coal and the environment, examining environmental problems both from coal mining and use. There is little here of the vast research on NO_x reduction and other areas of combustion research nor on the problem of coal and combustion particulates in the air. Chapter 13 considers computer applications, mainly using the author's own work, and the final chapter is on coal marketing.

Overall I was disappointed in this volume and feel that it brings little new to the coal geology literature. At £100 I am not sure how many may purchase it and even libraries may find it rather difficult to justify purchase.

Andrew C. Scott

References

- HOWER, J. *et al.* 1995. Coal: availability, mining and preparation. In *Encyclopaedia of Energy Technology and the Environment* (eds A. Bisio and S. G. Boots), pp. 603–84. J. Wiley & Sons.
- WALKER, S. 2000. *Major Coalfields of the World*. London: IEA Coal Research.
- BURROUGHS, W. J. 2001. *Climate Change. A Multidisciplinary Approach*. xv + 298 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £52.50, US \$85.00 (hard covers); £18.95, US \$29.95 (paperback). ISBN 0 521 56125 6; 0 521 56771 8 (pb).
- RUDDIMAN, W. F. 2001. *Earth's Climate. Past and Future*. xxii + 465 pp. New York: W. H. Freeman & Company. Price £45.99 (paperback). ISBN 0 7167 3741 8. DOI: 10.1017/S0016756803338129

Earth System Science is slowly coming of age – or maybe geology is returning to its background in the 'system' of the Earth. That means that undergraduate Earth System Science courses are appearing everywhere. High-level small-number

fourth-year courses on the way the climate tops off the earth system came first, designed for students who already know the grammar and vocabulary of earth science and can read primary literature. But there are as yet few texts for huge-number first-year courses filled with students barely out of high school. Given that most prime-time researchers avoid rocks-for-jocks courses like the plague, by default many such courses have morphed into shocks-for-jocks, ranging from eager young Dr Beaver shrieking 'we're all going to burn up in the greenhouse' to septuagenarian Professor Mumble's message that 'the greenies are a bunch of commies who hate the oil patch'. And there are grains of truth in both. As an aged mumble myself, who for years taught perhaps the largest course in a large Canadian provincial university, I recall the unsupported 'out-on-my-own' feeling. There wasn't a text that fitted, though publishers always claimed the earth. Each year at text-adoption season bebies of what appeared to be retired lap dancers arrived as representatives from the various publishers, smelling of excellent scent but with little else to offer. Good texts are badly needed.

Burroughs and Ruddiman have both written excellent books for this market. Either book would support a fine course, though the styles are very different. Ruddiman has all the visual delights and editorial excellence of a mass-selling US text put together by a well-resourced production team; Burroughs the quieter style of a lower-budget UK book.

To consider Ruddiman first, this is a very well balanced introduction to climate science with an earthy tinge. The first three 20-page chapters focus on climate, with some comment also on biospheric interaction. Then come four chapters on the geological record of the climate, including a discussion of the Gaia hypothesis and the arguments over Tertiary climate. The next five chapters of the book look into links between climate and orbital change, and then come three on glaciation. Finally, Ruddiman surveys in four chapters the past few centuries and the near future. There is an enormous amount of material in the book, in colour, and much of it is reasonably up to date (early 90s). That has risks of course – there is material here that is not necessarily proven, and may not survive a second edition. And some is dated already. But mostly the book is sound and it does make for an exciting read: just right for that large introductory class.

Burrough's book is quite different: it would suit either a more reflective option for an earth science or physics major, or even a higher-level option for a graduate economics or business management student interested in global change. The tilt of the book is more physical, with a strong meteorological bias. The first three chapters examine the basics of weather and climate; then come three chapters looking into the relatively recent geological record, into the consequences of climate change, and its measurement. There is a brave chapter on statistics and maths (which might interest passing economics majors), and then three chapters discussing the causes of climate change, climate models, and predictions of the future. Overall the level is right for a minor option for a physics or engineering major, but is also suitable for a reader with some scientific intellectual equipment and an inquisitive mind, but not necessarily any geological training (which is why it would suit an adventurous economist). There are some problems in the text (just as I do in lectures, Burroughs still limps on with an ancient diagram of the Atlantic conveyor), but in general the science is secure.

Which book to choose? For an introductory class, there is no question that Ruddiman's text is superb, and will carry along even the moderately weak student while providing

wattage for the bright lights. Burrough's text on the other hand would make a fine text for a student majoring in another quantitative science seeking to find out what all the climate fuss is about. It will also interest the inquisitive reader of general science books – an engineer seeking a rest from designing new sewage pumps perhaps, or a software writer bored with computer games. This is a workmanlike, diligent book, with much that is good and thoughtful. Whichever text is adopted, anyone who teaches either a first-year or a higher-level global change class should buy both books before preparing the course (and also add to the personal library *Earth System Science* by Jacobson *et al.*).

E. G. Nisbet

Reference

JACOBSON, M., CHARLSON, R. J., RODHE, H. & ORIANI, G. H. 2000. *Earth System Science. From Biogeochemical Cycles to Global Change*. San Diego: Academic Press.

JURECZKA, J. & PODEMSKI, M. (eds) 2002. *Proceedings of the IV European Coal Conference, September 26–28, 2000, Ustrón, Poland*. Polish Geological Institute Special Papers Volume 7. 280 pp. Warsaw: Polish Geological Institute. Price not stated. No ISBN.
DOI: 10.1017/S0016756803348125

This conference volume results from the coal conference held in Poland in 2000. At the meeting fifty papers were

presented in six thematic sessions. In this volume thirty papers are published, mainly from Eastern European authors. The papers are unfortunately organized by author and not by theme which would have been helpful. All papers are in English and several of the papers have colour illustrations. Most of the papers concern coal and the coal geology of Eastern Europe and are useful in providing an insight into these coal deposits.

A number of themes come through in the volume. There are several papers on the structure of coal basins; the reserves and economics of coal basins and their exploitation are dealt with by a number of papers; the area of coal-bed methane resources is one of current world-wide interest and four papers consider this area.

Increasingly there are environmental concerns about coal mining and coal use. Several papers deal with these and related issues. Other papers in the volume deal with aspects of Coal Measure sedimentology, maturation studies, organic geochemistry and petrology of coal and coal products.

The quality of the papers overall is highly variable. A number of papers lack recent references from Western literature and some potentially useful papers lack references completely. This well-produced volume has limited interest for the general geologist but those institutions where there is active coal geological research may like to have a copy for their libraries. Those individuals working on coals from Eastern Europe may wish to purchase their own copy.

Andrew C. Scott