

BOOK REVIEW

YODER, H. S., JR. 2005. *Centennial History of the Carnegie Institution of Washington. Volume III: The Geophysical Laboratory*. xvi+270 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £60.00, US \$80.00 (hard covers). ISBN 0 521 83080 X. doi:10.1017/S0016756805211159

The buccaneering 19th Century steel baron Andrew Carnegie spent the last years of his life disbursing his huge fortune in support of education and scientific research – for his native Scotland as for his adopted United States. The Carnegie Institution of Washington, envisaged by its founder as a grant-giving body, rapidly developed into a corporation supporting research laboratories in widely differing scientific fields.

Founded with the broad intention of promoting quantitative methods of physics and chemistry in the solution of geological problems, the Geophysical Laboratory mainly owed its existence to the political skills of the Director of the US Geological Survey, C. D. ('Burgess Shale') Walcott. A small group of the USGS already experimenting on rock systems formed the nucleus of the staff of the Geophysical Laboratory on its inception in 1906. The philosophy of the new laboratory was to study the simplest problems that could be devised before moving to more difficult and complex cases. Examining the effects of a single variable while holding all others constant was the cornerstone of its approach. Thus it is through the logical and systematic investigation of the melting relations of igneous rock minerals that the Geophysical Laboratory has made its most renowned contribution to geological understanding.

Prior to World War 2 this work was done at atmospheric pressure and the systems essentially simple, but the principles derived established crystal fractionation as the prime agent for igneous rock variation. *The Evolution of the Igneous Rocks* by Carnegie staff member N. L. Bowen (1927) became one of the most influential petrological books of the 20th Century. Following the Second World War the development of high pressure techniques enabling replication of conditions in the deep Earth saw the world-wide flowering of laboratory experimentation but the Geophysical Laboratory has remained at the forefront in equipment design and research performance.

Following Andrew Carnegie's wish to identify and foster the 'exceptional man', the Director of the Geophysical Laboratory has considerable freedom in the appointment of staff members – who are then given wide discretion in the research they pursue. Hence the extensive range of research topics which are, or have been, undertaken in the Laboratory. This book, by a noted experimental petrologist and former GL Director, documents the breadth of scientific interest and the innovative achievements of the laboratory over its century of existence. It does not probe into personalities and despite some photographs of workers most names must remain mere names to readers who have read only this book. Perhaps another book is yet to be written about the brilliant and occasionally eccentric characters who made working in the 'GeeWhiz' Lab such an exciting and enjoyable experience.

Graham Chinner

KARNER, G. D., TAYLOR, B., DRISCOLL, N. W. & KOHLSTEDT, D. L. (eds) 2004. *Rheology and Deformation of the Lithosphere at Continental Margins*. xiii+352 pp. New York: Columbia University Press. Price US \$89.50, £62.00 (hard covers), US \$49.50, £34.50 (paperback). ISBN 0 231 12738 3; 0 231 12739 1 (pb). doi:10.1017/S0016756805221155

There is undoubted excitement and intellectual challenge in trying to understand the Earth's physical and mechanical processes, yet are we always aware that these efforts are bounded by the fact that what we are studying has the characteristics of an underdetermined system? It sometimes seems, with the relative sophistication of modern techniques in Earth science, that there are more variables than there are examples over the Earth that exhibit the full range of parameter space. For example, it is recognized that rifted continental margins fall in a spectrum from 'volcanic' to 'non-volcanic' and numerical modelling leads us to suspect that this whole spectrum of margin development is highly influenced by such diverse properties as mantle temperature, lithospheric inhomogeneities and strain rate; so where can we find enough examples exhibiting the full range of these few variables against which to test our working hypotheses? One answer to the rather pessimistic view expressed above is to support the edifice founded on field observations with the twin buttresses of numerical modelling (remembering the limited assumptions often involved) and laboratory experiments (remembering again that necessarily they involve spatial and temporal scales that may be orders of magnitude different from the real world).

This book grew out of presentations made at a workshop on 'Rheology and deformation of the lithosphere at continental margins', rather grandly named a Theoretical and Experimental Institute, held under the auspices of the US MARGINS Program in January 2000. The meeting adopted the above three-pronged approach of combining results from observations, laboratory experiments and numerical modelling. The 11 chapters are a mixed collection of research papers for the specialist, straightforward literature reviews and some excellent broad-ranging overviews for the advanced student and professional Earth scientist. It is a pity that the authors were not constrained by the editors to keep to a common approach of writing in the latter style. Most papers relate to rifted margins or to subduction zones. Three other chapters specifically relate to intracontinental faults and the strength of the continental lithosphere yet they present and discuss questions of how faults 'work' that undoubtedly are relevant to a broader consideration of active continental rifting. I was delighted to read at one point that a very weak fault may be aseismic because 'Lubrication, after all, is used not only to reduce friction but to eliminate squeaking'. Similarly, two other chapters throw light on the movement of melt and other fluids deep within the Earth.

Publication of this book four years after the workshop, but presumably somewhat less after manuscript submission (we are not told), must mean that some timeliness will have been lost. On the other hand we are presented here with a snapshot of the state of ideas at the beginning of the 21st Century on

the rheology and deformation of the lithosphere. I, for one, will find this a useful summary to which, in large part, I shall return to consult as a work of reference.

Bob Whitmarsh

COSSEY, P. J., ADAMS, A. E., PURNELL, M. A., WHITELEY, M. J., WHYTE, M. A. & WRIGHT, V. P. 2004. *British Lower Carboniferous Stratigraphy*. Geological Conservation Review Series Volume 29. xix+617 pp. Peterborough: Joint Nature Conservation Committee; distributed by NHBS Ltd, 2–3 Wills Road, Totnes, Devon TQ9 5XN, UK. Price £88.00 (hard covers). ISBN 1 86107 499 9.
doi:10.1017/S0016756805231151

The Geological Conservation Review series of volumes provides much useful and important information concerning British rock sequences and their fossils. The present volume is timely in that there is current great interest in the Carboniferous. The title emphasizes the changing nature of our studies of the Carboniferous. In Britain we have traditionally divided the Carboniferous into Lower and Upper (lately equating this to Dinantian and Silesian). However recent international agreements divide the Carboniferous into Mississippian and Pennsylvanian, and the two two-fold divisions do not exactly equate. The summary chronostratigraphical classification figure includes the lowest two stages of the Namurian into the 'Lower Carboniferous Subsystem', implying a recognition that in this volume at least that it is really dealing with the Mississippian.

The volume provides a brief introduction before considering the main Geological Conservation Review sites under geographic regions: The Midland Valley Basin; Northumberland Trough; Lake District Block and Alston Block; Stainmore Basin and Askrigg Block; Craven Basin; Derbyshire Platform, North Staffordshire Basin and Hathern Shelf; North Wales Shelf; South Wales–Mendip Shelf and Culm trough.

Following an introductory section which provides an overview map with localities, a history of research, stratigraphy, geological setting and GCR site coverage, each of the GCR sites is described in detail. The presentation of these is very varied – in some cases maps and logs are provided, in other cases photographs of the sites. In most cases each of the sites is well described and useful data are provided. However I found the lack of integration with previous GCR volumes a continual frustration. For example, in the Midland Valley of Scotland the Kinghorn coast of Fife is described. This overlaps with the section described in the volcanics volume (Stephenson *et al.* 2003) and fossil plant volume (Cleal & Thomas, 1995), and a clearer integration of the data would have been very helpful. In most sites biostratigraphical data are absent from the sedimentary logs and an indication of the position of faunal or floral horizons would have been very helpful.

The variation in authorship has led to some inconsistencies in the volume. For example in the South Wales chapter the chronostratigraphy is added to the logs whereas it is absent in the Midland Valley chapter. Likewise site photographs are helpfully annotated in the South Wales chapter but not in many of the others.

Despite the criticisms, it is clear that anyone with an interest in British Carboniferous stratigraphy needs to have a copy of this volume. A final short integrated volume on the

British Carboniferous sediments, volcanics, fauna and flora would be a useful future addition.

Andrew C. Scott

References

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- STEPHENSON, D., LOUGHLIN, S. C., MILLWARD, D., WATERS, C. N. & WILLIAMSON, I. T. 2003. *Carboniferous and Permian Igneous Rocks of Great Britain North of the Variscan Front*. Geological Conservation Review Series Volume 27. Joint Nature Conservation Committee. 374 pp.
- CULVER, D. C. & WHITE, W. B. (eds) 2004. *Encyclopedia of Caves*. xx+654 pp. Amsterdam: Elsevier. Price £65.00, US \$99.50 (hard covers). ISBN 0 12 198651 9.
doi:10.1017/S0016756805241158

This new encyclopedia follows hot on the heels of John Gunn's *Encyclopedia of Caves and Karst Science* (Fitzroy Dearborn, New York, 2004), but regrettably it does not reach the same high standards. There are far too many omissions for it to be an all-encompassing encyclopedia of caves. However, its coverage does not set out to cover all aspects of karst geomorphology and this important field is limited to entries on closed depressions, sinkholes and underground karren.

The *Encyclopedia* has 107 entries arranged alphabetically, with 106 contributors, including the two editors. A few of the contributors also had nearly identical entries in the Gunn encyclopedia. The book is liberally illustrated with diagrams and photographs, many in colour. Short bibliographies accompany each entry and there is some cross-referencing. However, more than a third of the entries (and nearly half the pages) are on biological topics which fall outside the remit of this geologist's review. The biospeleological entries show duplication with contributions on groups of organisms, on their habitats and evolution, the latter containing explanations of Darwinism and other topics unnecessary in an encyclopedia of caves.

The non-biological part of this new encyclopedia includes 39 topics concerned with caves in general and 15 dealing with major cave systems around the World. The topic entries include fine summaries of the hydrology of cave systems, their morphological development, sediment fills and speleothems, but there are some unfortunate duplications, e.g. speleothems, stalactites & stalagmites, and helictites are three separate entries, though none mentions the common rippled flowstone. A useful summary of the new topic of sulphuric acid cave genesis is included.

However, there are serious omissions. There is no mention of the concept of inception horizons, fundamental to the initiation of cave drainage systems and their subsequent development. The unusual cave systems in marbles in the Norwegian Caledonides are not covered. Both the drowned tower karst and related caves of Phuket in Thailand and the drowned dolines and sea-level caves of Palau in the Pacific are ignored.

An entry on uranium series dating of speleothems should have been included; there are only brief mentions of dates obtained by this method within some cave descriptions. The serious problem of radon in caves gets only passing mention.

In spite of the large number of bone caves around the World, only three entries on archaeology and palaeontology

were included, one dealing with cave dwellers in the Middle East, another on Mayan cave use: a single entry deals with Pleistocene mammals. Surely the Palaeolithic cave paintings of Europe deserved an entry?

Many important cave systems are omitted, including the 190 km long Holloch cave system in Switzerland and the other major cave systems in Western Europe. The submerged caves and cenotes of the Yucatan peninsula in Mexico get only one sentence, and the Blue Holes of the Bahamas are not mentioned. Carlsbad Caverns gets only a paragraph tucked away in the entry on sulphuric acid caves; its neighbour Lechuguilla has an entry but without photographs of its chandelier speleothems. Mammoth Cave in Kentucky lacks photographs, the entry on Mulu Caves in Sarawak is out of date and has only a few non-representative photographs, the many large caves in China do not get a mention, and the Cupp–Coutunn Cave system in Turkestan, with its complex alternation of meteoric and hydrothermal phases of development and unusual mineralogy, gets one short sentence. Entries on ice caves (caves with perennial ice accumulations) such as Grotte Casteret in the Pyrenees and the Dachstein in Austria are lacking. None of the major British cave systems is described; the small Joint Hole in North Yorkshire is hardly representative.

The editing is sometimes inconsistent; for example, measurements are cited in either metric or imperial units, rarely both, scales are missing from some maps, e.g. p. 608, and bibliographic references use italics for journal titles, or not, at random.

In short, the compilers have missed an opportunity for a really comprehensive encyclopedia and John Gunn's *Encyclopedia of Caves and Karst Science* is a much better investment. The lack of data on British or Irish karst and caves will deter most potential British users.

Trevor D. Ford

SASOWSKY, I. D. & MYLROIE, J. (eds) 2003. *Studies of Cave Sediments. Physical and Chemical Records of Paleoclimate*. x+329 pp. Dordrecht, Boston, London: Kluwer. Price Euros 140, US \$155, £96 (hard covers). ISBN 0 306 47827 7.
doi:10.1017/S0016756805251154

As so lucidly explained in this book's preface, cave sediments offer a unique record of palaeo-environments, because they are preserved within the ground, and not eroded on its surface. Though cave sediment studies pose multiple problems, both with the difficult access to many underground sites and also with the correlation of the cave record with surface events, there is undoubtedly a wealth of scientific value in this sediment resource. The subject is often over-looked by hard-line surface investigators, but this book should help promote and develop this databank of geological history. The volume has 17 contributions by a total of 47 authors with impressive credentials (though, sadly, there is no authorship by the second editor).

The half on calcite speleothems (mainly stalagmites) opens with Will White's overview. This usefully reviews growth rates and dating techniques (U/Th, ^{14}C and ^{210}Pb), correlates stalagmite growth with warmer climatic stages at high latitudes and with cold-stage sea-level declines in now-flooded caves in the tropics, delves further into isotope and trace element studies, and then enlarges on high-resolution records from stalagmite luminescence. Uranium-series dat-

ing methodology is more fully described in the next paper by Jeffrey Dorale and colleagues; mass spectrometry of ^{230}Th can now elucidate dates as old as 600 ka (whereas the old alpha-counting was limited to 350 ka), but Protactinium-231 dating can provide parallel data only back to about 250 ka. Then a cautionary paper by Derek Ford's McMaster team (who originally developed stalagmite dating) explains the many hazards and difficulties in the interpretation of palaeoclimate data from the heavy isotopes of oxygen and carbon analysed in cave calcite. The better of the case studies achieve variable levels of detail on Devil's Hole (Nevada), Spannagel (Austria), Lapphullet (Norway) and Oregon Caves (USA).

Though it appears first, the half on clastic sediments struggles to match the excitement of speleothem research. It opens with another useful overview by Will White, which reads well and describes the main clastic facies with reference to some fine examples. Case studies include one on palaeomagnetism in the Buchan Caves (Australia), one on clay mineralogy in Bathers Cave, Virginia, and one on vertebrate remains in Jamaican caves. A surprising omission is any mention of the $^{26}\text{Al}/^{10}\text{Be}$ dating of clastic material that has shown how very old are some caves in Kentucky and elsewhere; this technique was developed over five years ago and should therefore have been included.

This book is attractively presented, except that poor house editing has left an excess of typographical errors, citation errors, rotated figures, swapped captions and poor photograph re-scans, along with peculiar repetition in the few colour pages (that were probably inserted late). Its contents should be compulsory reading for anyone researching Quaternary chronology and palaeo-environments. The volume should also be read by a much wider audience, who may then better appreciate the values of cave sediment studies, but sadly the high price will minimize this reach except through libraries.

Tony Waltham

VALENTINE, J. W. 2004. *On the Origin of Phyla*. xxiv+614 pp. Chicago, London: University of Chicago Press. Price US \$55.00, £38.50 (hard covers). ISBN 0 226 84548 6.
doi:10.1017/S0016756805261150

In his *magnum opus*, Darwin famously evaded saying anything too explicit about the origin of species. Rather, the argument emerged as a consilience of trenchant observation, strategic apology and inspired mistake. A century and a half on, the mystery of mysteries may have inflated to the origin of phyla, but the approach remains very much the same. The only real issue is dealing with the avalanche of accumulating new data – and new kinds of data.

On the Origin of phyla does a superb job of data management and, at one level, serves simply as a review of where we have got to, circa 2003, in addressing the question of early animal evolution. All the pertinent literature is here (72 pages worth of small-font references), masterfully distilled, and accompanied by a surprisingly digestible Brusca and Brusca-type overview of the animal phyla, their developmental biology, and fossil record. Valentine is modest about his palaeontological origins, but this volume speaks with authority across the whole range of disciplines.

The book is divided into three parts with the systematic review (226 pp) sandwiched between an introductory discourse on issues/concepts/data (195 pp), and a concluding discussion (93 pp). Like the systematic part, the introduction

ploughs productively through much of the basics, covering everything from basic anatomy and embryology to molecular and developmental biology, phylogenetic reconstruction and the pros and cons of the fossil record. Valentine also uses it as a vehicle to expand more philosophically on the hierarchical nature of genomes, organisms and taxa, and, in various roundabout ways, to set out his personal view of animal origins. It is clear, for example, that the fossil record will be trumping molecular clocks in this treatment, that molecular phylogenies will provide the primary structure for determining animal relationships, and that the key to polishing out the details lies in a 'judicious' introduction of developmental and comparative biology. Thus, by the end of Part One, we have been fitted out with an Ediacaran to Early Cambrian timeframe for metazoan origins, a modified SSU rRNA phylogenetic framework comprising half a dozen supraphyletic 'alliances', and the insertion of acoel flatworms as basal bilaterians. None of this is hugely controversial, though it does leave a considerable range of views out in the cold.

Part Three continues the discussion with an emphasis on numbers of cell-types, increases in body size, and the central role of evolutionary developmental biology. What it conspicuously doesn't do, however, is say anything too explicit about the origin of phyla. Perhaps by way of explanation, Valentine suggests that he has focused almost entirely on morphological evolution and ecological relationships among organisms, and has largely ignored the physical aspects of the contemporaneous biosphere, despite their 'supreme importance'. From my reading of the book, I'm not at all convinced that Valentine really thinks the physical environment played any particular role – certainly he has little time for the ideas that fluctuating oxygen or ice were factors in early animal diversification (quite right too). And I must have missed the bits covering ecological relationships. Valentine, of course, already wrote the book on palaeoecology, but if there is a running theme to *The Origin of Phyla* it is that evo-devo now trumps ecology, and indeed pretty much everything else. I think this is a mistake, and, as much as anything, explains the slightly disappointing blank spot at the end – where all of the individually launched pieces were meant to have landed up together. After all, it's what organisms *do* that drives adaptive radiation, and that nailed the case in the original *Origin*.

N. J. Butterfield

MILSOM, C. & RIGBY, S. 2004. *Fossils at a Glance*. x+155 pp. Oxford, Malden, Carlton: Blackwell Publishing. Price £19.99 (paperback). ISBN 0 632 06047 6. doi:10.1017/S0016756805271157

For many years Clarkson's *Invertebrate Palaeontology and Evolution* (published first by George Allen & Unwin and now

by Blackwells) has led the field in palaeontology textbooks for undergraduate courses, at least in the UK. Although in recent years a number of new teaching texts have been published, none, in my opinion, can rival Clarkson. Milsom & Rigby's new book, *Fossils at a Glance*, aims to exploit a different niche, one that is much more introductory and stops short of befuddling intricacies.

Fossils at a Glance begins, predictably enough, with an introductory chapter on the processes and vagaries of fossilization. There are then 12 chapters introducing the major groups of fossils. First, there are chapters on major invertebrate taxa followed by those dealing with vertebrates, microfossils, land plants and trace fossils. It is rounded by a chapter on Precambrian life and another on the Phanerozoic, dealing with topics such as the Cambrian explosion and mass extinctions.

The real meat of this book is the 11 chapters dedicated to fossils of particular higher taxa. Each introduces the taxon with information about occurrence and diversity, before giving morphological details and notes on their ecology and evolution. The authors then illustrate examples of some common taxa. Each chapter begins with a box of summary information which give a flavour of the taxon and concludes with a useful glossary of associated technical terms. The book is well illustrated with line drawings, many of them re-drawings of familiar figures from other sources. They are usefully labelled, but many of them could be bigger and regrettably many lack any idea of a scale.

It is not necessarily a book to be read from cover to cover but one which might be used, particularly in conjunction with set practicals or more informal collections, to gain basic familiarity with the most common of fossil taxa. It has been deliberately and carefully designed so that information about a particular group, for example rugose corals or echinoids, is provided on facing pages. It is easy to imagine students using this book in the laboratory or as part of private study and my experience of using it both for first year undergraduates and for adult outreach activities is that it works.

It is easy to feel quite superior and to imagine that 'our first year students do more than this'. In reality I suspect that few do. It is unlikely that many members of any class (unless they are one of the comparatively small band of those who have studied palaeontology before) will have any familiarity with extant invertebrates let alone those which have been dead for millions of years. In a short course of palaeontology embedded in introductory level geology, students can and do get overwhelmed by detail and this book aims, and I would suggest, succeeds, to provide the first elementary steps. It is true that, hopefully, they will soon need more detail. This is clearly not a book that will last for an entire degree course. *Fossils at a Glance* is no rival to Clarkson, but it does not pretend to be. It has an attractive price at which it can succeed.

Liz Harper