
Though it is not immediately obvious from the title, this book is a biography of Arthur Holmes, with a particular slant on his lifelong work of deducing the age of the Earth using radiometric decay methods. It is a fascinating story. Holmes (1890–1965) lived in interesting times, as the saying goes, during which the commonly accepted age of the earth increased a million-fold. As he himself commented toward the end of his life, on the occasion of the award to him of the prestigious Vetlesen Prize, 'it is a slight consolation for the disabilities of growing old to notice that the Earth has grown older much more rapidly than I have – from about six thousand years when I was ten, to four or five billion years by the time I reached sixty'.

Cherry Lewis interleaves a history of Holmes' life with a description of the pioneering efforts to date the Earth using the new discoveries of radioactive decay. It is written in a popular style for those with no prior knowledge of radioactive dating techniques. Lewis describes well the basic methods that were developed, including the inevitable blind alleys and wrong turnings along the way. In conventional textbooks those are often not mentioned, so it makes for illuminating as well as entertaining reading.

But perhaps the most interesting side to the book is Holmes' life story. We are accustomed to think nowadays of the life of an aspiring academic as an uncertain and sometimes discontinuous trail (and trial) of short-term and often ill-paid postdoctoral appointments, with no ultimate guarantee of a permanent job on the staff of a university. But, boy, was it worse in Holmes' time. He started his undergraduate degree with a scholarship to the Royal College of Science (now Imperial College) in London. By halfway through his first year of geology he decided that his stipend was insufficient to live on, so he threw himself into six months of study for the exams accompanying a job application as an assistant at the British Museum. When that was unsuccessful, he accepted a job with a slightly desperate nine-month expedition to Mozambique for a mineral exploration company. Holmes almost died from fever on the expedition, they did not find the required minerals, and soon afterwards the company went bust.

On his return to Britain, Holmes continued work on trying to date ancient rocks using uranium–lead decay methods, research he had started soon after he interrupted his degree studies. He never did finish his undergraduate degree. Instead he jumped straight to a position as a demonstrator at Imperial College, with a D.Sc. based on his published books and papers on the age of the Earth. But a few years later, now married and with a young son, he again felt the financial pinch and was not able to get a better paid job in academia. So he accepted instead a seemingly prestigious job as Chief Geologist to a small oil company operating in Burma. Alas, this too proved to be a company in ruinous financial position. Eventually Holmes resigned with a year's arrears in pay, and to add desperation to disaster, his 3-year-old son died in Burma of dysentery shortly before they left.

Their return to the UK brought the Holmeses to one of their lowest points. For 18 months he could not find an academic job, until eventually he was appointed as the sole (and therefore head) geologist in the newly-formed Durham science department. From then on his scientific and academic stature grew rapidly, fuelled in part by his outstanding lecturing style which led to popularity among students and growth of his new geology department. But it was marked, too, by his affair with a petrology lecturer from London, Doris Reynolds, who eventually was appointed to the staff in Durham and shared a desk with Holmes. Some five years later Holmes' wife died of cancer and within the year he had married Doris Reynolds. The Durham authorities took a rather dim view of Holmes' liaison with Reynolds, and even though they were by now married, the Holmeses felt pressured into leaving. Arthur Holmes took up a Royal Professorship in Edinburgh, where he remained until his retirement 13 years later.

For many of us, Holmes' greatest contribution was not so much his work on dating the age of the Earth as his textbook Principles of Physical Geology. It went through three editions written by Holmes himself, the last being finished only shortly before his death, with further editions revised first by Doris Reynolds and finally by one of Reynolds' Ph.D. students. This book influenced several generations of geologists and laid out a way of looking at geology through the quantitative spectacles of the physical sciences which has remained with us and has grown in importance to the present day.

I read the The Dating Game sitting in one of the youngest spots on earth, the Mid-Atlantic rift where it crosses Iceland. Cherry Lewis' description of the twists and turns by which the oldest known rocks in the world came to have their now accepted great age made for a fascinating read, as did the winding tale of one man's part in this.

Robert S. White


By the time they are printed, some conference volumes have congealed like bottled glue, or last night's leftover soup, becoming stickily useless, or inedible, or, worse, sending up an aroma of ancientness. Others are better, and are of historic merit, as they record the state of the science some while in the pre-diluvian: the work began when the editors in their first flight of post-doc youth boldly began collecting articles ... their students then managed to complete the volume as a retirement tribute. Yet other volumes, though delayed, have timebombs in them. Though it took years to come out, the Buddington volume, seen by few even in its day, and stolen from many libraries, carried a paper by Hess on the history of ocean basins that detonated on publication. One of the most important geological papers of the twentieth century, it may only have been publishable in a friend's volume – geo-poetry isn't acceptable in solid journals.

The Carbon Cycle is different. It didn't just change scientific history, in the way the Buddington volume did. The
work in *The Carbon Cycle* changed history-history: everyone on Earth is affected directly (by paying more for petrol) or indirectly (by the economic consequences).

In 1993 a group of atmospheric and ocean scientists, energy specialists and thinkers about the biosphere met in a Global Change Institute at Snowmass, Colorado. The meeting provided the foundation for work of the Intergovernmental Panel on Climate Change, which reported in 1994 and 1995 on the carbon cycle. From that came the scientific underpinning to the debate about the carbon cycle, still continuing, which led to the Kyoto and Hague meetings, though one wonders if the science is now almost wholly ignored in what is mostly a political process of ritual warfare between the US, EU and, from poor nations, elites long divorced from their peasant compatriots.

Although the meeting was in 1993, the book is published in 2000. Despite the delay (well, the authors have been busy), the book is more-or-less up to date, and provides a wide synopsis of what is known of the carbon cycle. Most of the key thinkers in the debate are contributors. The volume begins with excerpts from the 1994 and 1995 IPCC reports, and then covers several main topics. The cast of authors is stellar – many of the papers contain superb work.

There are several major sections to the book. The ‘Missing Carbon Sink’ includes basic data on emissions by the CDIAC team, and then a set of papers on the complexities of the carbon budget. To pick a few, there are papers by Houghton on land-use, Enting on global inversion of the carbon budget, Fung and Takahashi on air–sea exchange, and Keeling and Severinghaus on measurements. The next section of the book is on ‘Palaeo-CO₂ variations’. This section is smaller, but includes work by Stuiver et al., and Opdyke. Then the last part of the book is given over to the modellers and scenario-painters: authors such as Marland, Caldera, Woodward, Wigley, ‘Modelling CO₂ changes’.

Overall, the volume covers the topic superbly. It is dominated by modellers rather than by field scientists, but there is a place for people with muddy boots. Some of the modelling work is so important it should be perused even by geologists whose last maths was in first year. Indeed, it should be studied by advanced student classes, for it is on this work that the future path of the world economy may turn.

To conclude: the book is a ‘must-buy’ for libraries. But it is more important than that. It will obviously be fodder for graduate courses, and for anyone interested in the future of the planet, it is certainly worth buying for a personal library. Dry and not exactly ‘airport purchase’ it may be, but the story it tells is vital to us all. Carbon dioxide is the glue that binds the biosphere, and *The Carbon Cycle* should be pasted onto every final year undergraduate as a final piece of education before they go off to the world.

Euan Nisbet


When this book was published in large format in 1971 it created a tremendous impression on the glaciological community, through the beauty and clarity of the photographs contained therein. The book was destined to become a classic, but until now has long been out-of-print. In view of its impact, the International Glaciological Society joined forces with the University of Washington Press in order to make the book more widely available in smaller format, paperback form, at a price that most people could afford. At the same time the authors were given the opportunity to update the book and add or replace a few of the photographs.

To those who do not have a copy of the original volume, I cannot recommend the revised edition too highly. The core of the book is represented by 130 black-and-white photographs with self-contained captions, and a text accessible to the layperson. The majority of the photographs are taken from the air, and have been selected to demonstrate the awesome beauty of glaciers and their impact on the landscape. Most images are from the Western Cordillera of North America, especially Alaska, but the Himalaya, the European Alps, Chile, Greenland, the Canadian Arctic and Antarctica are all represented. Topics covered in individual chapters are: Glacier Formation and Mass Balance; Major Surface Features of Ice; Glacier Flow; Glacier Fluctuations; Moraines; Glacier Surges; Ogives; Meltwater on Glaciers; Surface Details; Calving Glaciers; Glaciers, Volcanoes and Jökulhlaups; Effects of Glaciers on the Landscape; and Temperate, Subpolar, and Polar Glaciers. The text is supported by a useful glossary and a selected bibliography containing reference to books, journals and web-sites; however, there is no index.

The weight given to North America in terms of photographic illustrations is perhaps unfortunate for readers elsewhere in the world, but reflects primarily the areas in which the authors have worked. One could quibble over the under-representation of other areas with substantial ice cover, notably Antarctica and Greenland, but that would be churlish. What we have here is a set of photographs that every mountain lover, and especially glaciologists, will drool over! You will rarely see better quality photographs of glaciers in terms of sharpness, contrast and composition. There can be no better introduction to glaciers, and I can wholeheartedly recommend it to professional earth scientists, to the layperson, and as a supporting text for undergraduate courses concerned with glaciers and their landscapes. The authors and publishers are to be congratulated on reproducing and updating this fine volume.

Michael J. Hambrey


This attractively designed pair of books aims to provide a complete grounding in the rapidly emerging field of remote sensing. As the authors state, most of us have had contact with some form of remotely sensed imagery – be it an aerial photograph of a city or a satellite image of Mars – at some point in our lives, though the principles governing the acquisition and display of such imagery are often poorly understood. These volumes seek to demystify the science and introduce the expanding portfolio of remote sensing applications, including climatology, geology, environmental monitoring, agriculture and urban planning. Despite functioning adequately as stand-alone texts, the set is designed as an integrated multimedia study/teaching package, featuring a linked Website and an accompanying CD-ROM that contains image processing software and satellite data.
Volume 1 (Principles and Concepts) introduces the science of remote sensing, covering the basic physical principles, the main imaging systems and some key applications. It begins with a short history of the field, from the days of wartime airborne surveillance, through the 1960s space race and the clandestine military reconnaissance satellites of the Cold War, to the meteorological and Earth Resources satellites of today. Chapter 2 tackles the fundamental characteristics and laws of electromagnetic radiation, its various interactions with the Earth's surface, and the nature of the intervening atmosphere. Important concepts such as digital imaging, image resolution and scale are discussed, and there are also short sections on image interpretation principles and the human visual system. Mathematics is kept to a minimum and worked examples are highlighted, whilst more advanced material (denoted by grey boxes) can be easily skipped by the cursory reader.

Chapter 3 covers remote sensing systems, including sections on aerial photography and thermal imaging, and an excellent introduction to the relatively new field of microwave imaging and radar systems. Much of the chapter is devoted to a fairly exhaustive listing of launch dates, orbits and sensor wavebands for past and current remote sensing missions. The final chapter synthesizes the preceding material in a summary of remote sensing applications, such as weather forecasting, natural hazard monitoring, vegetation mapping, petroleum exploration, sea ice mapping and wave height measurement, to name but a few.

The accompanying Website (www.remote-sensing.routledge.com) is an excellent idea as it displays the images in their natural medium – the computer screen. Included in the site is a batch of example images from around the globe illustrating the main applications of remote sensing, along with some image interpretation exercises, an interactive 'question and answer' session to test knowledge gleaned from the book, and links to online remote sensing resources. However, aside from a few inevitable glitches (e.g. broken links) the site is slightly let down by a somewhat restricted viewing window. Although individual images can be enlarged, it appears impossible to display two enlarged images side-by-side, making some of the 'compare and contrast' interpretation exercises difficult. It would also have been worthwhile to include links to the Websites of image processing software suppliers (whose postal addresses are given).

Having mastered the principles and concepts of remote sensing, the reader is directed to Volume 2 of the set (Digital Image Processing and Applications) to explore the nuts-and-bolts of image processing. The CD-ROM bundled with the book contains a limited edition of an MS-DOS image processing packaged called DRAGON, along with nine datasets for the user to play with (since this version of the software cannot import data). A software manual is included in the book, offering seven practical exercises demonstrating important processing routines such as contrast stretching and convolution filtering. The software allows the computer-equipped reader to gain immediate hands-on experience of basic image processing in a very user-friendly environment, without resorting to the more complex and expensive software packages currently on the market.

Volume 2 takes us through the typical image processing cycle in chronological order, beginning with pre-processing (chapter 2). The concept of the image histogram is introduced, and various procedures are described including geometric correction, atmospheric correction and adjustments for lost or damaged data. Techniques of image enhancement follow in chapter 3, from simple contrast stretching through to principal component analysis. Image classification is also discussed, and the chapter concludes with a useful review of the range of hardware and software currently employed by the remote sensing community. Chapter 4 enters the applied domain and looks at selected environmental monitoring applications of satellite data, such as cloud classification and vegetation mapping, incorporating descriptions of techniques and algorithms used by organizations such as the United Nations. The final chapter provides some 'real-world' examples of these environmental remote sensing techniques in five case studies, ranging from rainfall monitoring in West Africa to the detection of peat soils in northern England.

Both books contain a comprehensive glossary of acronyms – essential for anyone delving into the alphabet soup of remote sensing terminology, and each chapter concludes with a short summary, self-assessment test and bibliography. Excellent, clear diagrams are employed throughout although the reproduction of a few of the greyscale images is, perhaps inevitably, rather poor. The authors cover a lot of ground and there are few notable omissions, with the possible exception of planetary remote sensing.

Altogether, this two-volume set provides a comprehensive and interactive introduction to the principles, techniques and potential of remote sensing for budding environmental scientists. Although the combined price may exceed the budget of the average student, the books are well suited to their target audience (upper secondary school to undergraduate level) and the package should serve as a valuable resource for teachers of introductory courses in the subject. Its interactive, multimedia approach is particularly commendable and should set an example for future remote sensing textbooks to follow.

Simon A. Carn

Interest in the nature of the interaction between plants and animals has a history, based largely on anecdotal natural history, that can be traced back to Aristotle. However, it was not until George Cuvier (at the beginning of the 19th century), and his more generalized functional interpretation of vertebrate form, that comparative studies took on the implications of, for example, the evidence for feeding preference exhibited in the structure of teeth and jaws in vertebrates. Among those involved in herbivory among vertebrates, by far the most instructive research lines follow from the examination of living forms, their mechanical and behavioural adaptations as well as those linked to biochemistry and physiology; this can in turn be linked directly to equivalent studies in the botanical realm where the ‘pre’ adaptations can be examined and the two fields linked into a satisfyingly multi-disciplinary branch of co-evolution – applied natural history.

However, while the most detailed work can be done on living taxa, the Earth has a tangible history, and the fossil remains of vertebrate herbivores and their plant prey are known and, despite the Darwinian caveat about the imperfections of the fossil record, comparative functional morphology can reveal aspects relevant to the early evolution and diversification of plant eaters and their plant prey. This volume, edited by Hans Sues, attempts to provide a summary of recent work on the fossil perspective on the evolution of herbivory among vertebrates. As the editor admits, this is not a comprehensive review of the subject, but rather attempts to highlight some of the key issues and is aimed at postgraduates and postdoctoral level research workers, in the hope that it will stimulate further research in the future.

The book opens with an (unfortunately redundant) introductory chapter that outlines its overall content. In a book intended at this academic level this is unnecessary, and repetitious of the first true chapter (by Reisz & Sues) on the rise and diversification of the earliest terrestrial vertebrate herbivores. This latter represents a modest enlargement on earlier articles by the same authors on this general topic and is actually covered in considerably more detail by Gillian King in her book Reptiles and Herbivory published in 1966. What is notably lacking in this chapter is a detailed consideration of the evolution of synapsid (mammal-like reptile) herbivory in the Permian and Triassic. This is followed by a chapter by Barrett that addresses the question of prosauropod dinosaurs and serves as a timely reminder about the difficulties associated with applying basically Cuvierian approaches to tooth structure and their implications concerning diet too far. Supposedly exclusively herbivorous lizards, for example, have a penchant for meat as a dietary supplement even though their teeth might be classified using traditional (= assumption-based) schemes as typical of a herbivore. This more wary approach is also applied to previous assumptions concerning the diets of more derived dinosaur groups and leads logically into the chapter by Upchurch & Barrett on a detailed survey of the feeding adaptations exhibited by the more classically herbivorous sauropod dinosaurs of the Jurassic and Cretaceous. This is the first attempt to look in detail at the variety of herbivorous adaptations exhibited by these dinosaurs (rather than simply lumping them together as a somewhat amorphous bunch of herbivores), to look for functional/adaptational patterns and ‘map’ these onto cladograms to investigate the evolutionary implications of such adaptations in a broader sense. The authors also, in the spirit of the book, outline ways in which research could be carried forward into the future.

The last two contributions are balanced by a revision (Worshampl & Jianu) of evolution and ornithischian herbivory; this provides a critical analysis of earlier papers that have attempted to model co-evolutionary patterns between plants and ornithischian herbivores during the Mesozoic. This approach uses cladograms and the implied ghost lineage durations derived from the cladograms to estimate diversity changes through time, rather than simple counts of relative abundances of taxa during stratigraphic intervals. The results indicate that raw metrics on species abundance appear to over-emphasize the relationship between plant diversification and their potential predators over time. Research should now concentrate on richer and ‘finer-grained’ assemblages of herbivores if co-evolutionary patterns are ever to be recognized in the fossil record.

The last three chapters (Rensburger, Janis and MacFadden respectively) explore aspects of the Tertiary (post-dinosaurian) evolution of herbivorous mammals from markedly different perspectives. Rensburger provides an interesting insight into how mammals (evolving as they did from insectivorous forebears) adapted the morphology of their teeth and the microstructure of the enamel with which...
they were coated, to the demands of a more specialized herbivorous diet. Janis reviews large herbivore diversity during the Palaeogene (Palaeocene, Eocene, Oligocene) and looks at the changes in diversity of differing 'guilds' of herbivore. She attributes changes in representation in each 'guild' through time to some measure of environmental control (even if it is not evident from other environmental proxies); the absence of a cladistic framework for this analysis, or indeed any phylogenetic backdrop within which to frame such an analysis, is surprising. Finally MacFadden looks at the fossil record of the most specialized of Neogene (Miocene, Pliocene, Pleistocene) herbivorous mammals (the grazers) and the relative timing of the appearance of grazing mammals using isotopic analysis of their teeth (the C3/C4 shift). In recent years this has become a hot and oft-discussed topic, as revealed by his bibliographic section.

Edited volumes are pretty frequently affected by the diversity of approaches adopted by individual contributions; this book is no exception. The book derives from a meeting, held in 1996, and the gap between the meeting and the date of publication is very obvious in several of the contributions. It also seems clear that it would have been very useful if some of the authors had been encouraged to liaise over their contributions. In 1997 this book might have been timely; today it seems to represent a rather patchy, somewhat outdated, review of the subject. I would probably buy this book because a couple of the chapters interest me but, at best (given its awful price), this book is destined for just a few library shelves.

David Norman


This book is the fourth, and penultimate, volume of a set of mineral reference texts by this group of authors. The first volume of the series was published in 1990, the second in 1993 and the third in 1997 (the third volume was recently reviewed in Geological Magazine, volume 136, p. 703, 1999). The latest volume follows the same format as the previous volumes: species are arranged alphabetically by mineral name with one species per page. The essential data for each species is set out in a standard format under the following heading: Crystal Data, Physical Properties, Optical Properties, Cell Data, X-ray Powder Pattern, Chemistry, Polymorphism & Series, Occurrence, Association, Distribution, Name, Type Material, References. An account of the crystal structure of each species is not given, although reference to one, where it exists, is included. The locality data in the present volume, particularly for less common species, are very well researched and up to date and this reviewer found this aspect of the work particularly useful.

Overall the Handbook of Mineralogy's format is well suited for less common and rare species but less satisfactory for common or important species. There are several shortcomings to the format: specific reference to the data sources is not given nor is there any form of chemical index. Unless you know minerals by name and chemistry it is not possible to find, for example, all of the known forms of Cu5(PO4)2(OH)4, although once you find pseudomalachite, ludibiate or reichenbachite, the other two are listed as the polymorphs. For this reviewer organization by a chemical classification would be preferable. One great advantage this work has over other standard mineralogical works currently in print is its almost total freedom from errors. The volumes are well produced: printed in high quality, acid-free paper and well bound in a strong cloth binding. The Handbook of Mineralogy is a very fine reference work and should be in the reference section of all major Earth Science libraries.

Allan Pring


The offshore-shelf sand ridge (‘offshore bar’) facies model was developed during the 1970s to 1980s which interpreted isolated shallow marine sandstone bodies, especially those in the Cretaceous Western Interior Seaway of North America, as mid-shelf deposits. Then along came sequence stratigraphy: sea-level changed rapidly, erosion surfaces appeared and former ‘offshore bars’ disappeared. Most became lowstand shoreface deposits, resulting from ‘forced regression’, but for others they became trangressively-infilled incised valleys. For some workers, the new ‘lowstand shoreface model’ completely discredited the original ‘offshore bar’ facies model and consigned it to history. But the controversy had not disappeared, it was simply lying dormant. These dilemmas were faced head-on during a SEPM-sponsored research conference (in 1995), when many of the key players associated with the different models came face-to-face.

The book comprises six main sections, the first part (Introduction and Part 1) reviews and updates the range of models for both modern shelf sand ridges and ancient linear sandstone bodies (especially the Shannon Sandstone), discussing their implications in terms of processes, facies, stratigraphic architecture and their significance in relation to hydrocarbon exploration and production. Part 2 deals with modern environments, three papers addressing sand ridges on shelves bordering the USA (New Jersey, NE Gulf of Mexico and the West) and a fourth example (Adriatic), which seems somewhat out of place. The remainder (Parts 3–6) returns to the central theme of isolated shallow marine sandstones within the Cretaceous Western Interior Seaway. This covers aspects of shelf hydrodynamic modelling, biological and chemical aspects and, finally, sequence stratigraphic/facies analysis. The latter is where the controversy hinges, and this is further highlighted by companion papers on two contrasting models (prograding shoreface versus bay head delta) of the Viking Formation in Alberta.

The final paper (by J. R. Suter & H. E. Clifton) provides an exemplary contribution in its impartial and objective review of the lingering controversies surrounding the Shannon Sandstone. It is a model of sedimentological reasoning and synthesis, carefully weighing up the pros and cons of each element of the interpretation (e.g. facies, geometry, internal architecture, inferred process, modern analogues, etc.). It concludes that no interpretation proposed to date adequately explains all aspects of the Shannon.

Although this book focuses on one relatively limited topic, its significance is far wider and touches on many aspects of sedimentary geology. At the end the reader will realise that
none of the main protagonists have yielded an inch in their respective interpretations. My own feeling is that the ‘offshore bar’ is not quite as dead as it seemed, nor is the ‘low-stand shoreface model’ as universally compelling as has been suggested. Perhaps most surprising, in relation to the Shannon, is the variability of facies descriptions and their process interpretation among some very experienced sedimentologists. Less surprising, and beautifully illustrated, is how different stratigraphic models used to guide correlations and facies distributions result in such different geological models. A sobering and rarely published situation!

I would recommend all professional sedimentologists to acquire a copy of this book and, if nothing else, read the Suter & Clifton paper. Sedimentary geology teachers and students should also find this compelling reading as an example of a heated debate over different interpretations, particularly maintaining a healthy respect for alternative views. Finally, the book should be of interest to petroleum explorationists and development geologists as an example of the implications of different models on subsurface correlation, mapping and reservoir prediction.

Howard D. Johnson


The Catalogue of Meteorites was first published in its present form in 1923 and has since become the standard work of reference for the naming, description, and distribution of meteorites. Now in its fifth edition, this cumulative index is the main source of basic information on meteorites and their provenance for researchers, collectors, and libraries. The new Catalogue includes data on all authenticated meteorites (even if no material is now preserved) up to December 1999, a total of 22 507 entries.

As well as containing data on an order of magnitude more meteorites than the fourth edition, the addition of a CD-ROM version adds a new dimension to the Catalogue. The CD contains expanded literature references and analytical data for each meteorite, providing an important research tool. Meteorites are listed alphabetically according to their geographical names. Individual entries provide details of the fall or discovery of a meteorite, a modern classification and principal data for its description. The whereabouts of these proportions of each meteorite are listed, and there is special reference to samples in the collection of the Natural History Museum in London.

The indices of meteorites by classification and geographical location are particularly useful to those involved in statistical analysis of meteorites and their distribution. Synonyms (disused meteorite names) are retained and cross-referenced with currently accepted names. This feature is a boon to researchers delving into the history of meteorites and meteoritics.

Deviating from previous catalogues, full entries are not afforded to all meteorites. This is because of the enormous increase in the numbers of discoveries from Antarctica and the ‘hot’ deserts of the world. Common types of meteorites from deserts, and data pertaining to them, are tabulated according to areas. However, special entries are made in the main body of the Catalogue for those rare or unusual meteorites (lunar, Martian, carbonaceous, etc.) from deserts. Possible ‘pairs’ (meteorites thought to be part of the same fall) are also indicated for the Antarctic collection.

Missing from this edition is a compilation of the world’s impact structures, and the collection of tektites and other natural glasses at the Natural History Museum. Comprehensive databases of impact structures are available elsewhere, and impact research is a specialized study. However, entries are made in the main body of the Catalogue for those meteorites associated with impact craters.

There are some errors and omissions although it would be churlish of me to list them here. For the continuance of the Catalogue, researchers should communicate additions and corrections directly to the editor so they can be incorporated into subsequent editions. New Catalogues appear every ten to fifteen years (the third edition was published in 1966, an Appendix to the third edition in 1977, and the fourth edition in 1985). Inevitably, there is a long time between the fall or discovery of a meteorite and inclusion into a new Catalogue. The CD-ROM is searchable and there are plans to provide updates from a website. However, my only criticism concerns the production of the book/CD pair. I have never seen a catalogue that does not carry full references. I share the editors’ irritation that these were cropped from the printed version and are now only available on the accompanying CD-ROM. If the excuse is lack of space, then I ask: why print the book at all? Surely, the simple solution would have been to provide a printable reference list from the CD? Nowadays, whether we like it or not, we are being herded in the direction of electronic copy. I am certainly not a Luddite, but I sense an unhealthy restriction of choice.

The felony is compounded by the fact that only a PC version of the CD-ROM is supplied. To run the database requires a top-of-the-range PC that I doubt most small libraries will have available for visitors. Without a powerful computer the electronic Catalogue cannot be used successfully and, once again, Macintosh users are discriminated against. Running the CD on a Macintosh requires the use of Virtual PC and Windows 98 that uses an inordinate amount of memory, leading to system problems and sluggish response. The program works best on machines with 64 Mb RAM or more, and a large proportion of the memory dedicated to run the database. Ironically, Macintosh users have to use a program emulating the Mac system – and then there is the considerable additional expense of the software!

None of this criticism takes credit from the editor. With each edition the job gets harder. Compiling the Catalogue is an onerous task and the editor deserves our heartfelt congratulations for a job well done. Although it is a great shame about the printed version, no one remotely involved with meteoritics, nor any science library, can afford to be without a copy. I am left wondering whether I have written a review of a book, or an obituary for the printed word.

Alex Bevan


This volume is the fifteenth in the mostly excellent Geological Conservation Review Series, of which 42 volumes are planned. The overall aim of the series is to ‘review the current state of knowledge of key Earth science sites in Great Britain and provide a firm basis on which site conservation can be founded for years to come’. This particular,
long-awaited volume is essentially two books in one: ‘The Palaeogene’ (written by Brian Daley) and ‘The Neogene’ (by Peter Balson).

After a broad Introduction to the Tertiary, the Palaeogene section begins with a brave stab at that almost impossible task: briefly summarizing all the work on the British Palaeogene and then correlating the deposits, before going on to the main job, the description of 34 sites. The sites are grouped into the eastern and western parts of the London Basin, the Isle of Wight and other Hampshire Basin sites, and finally western outliers.

Each site is dealt with in a familiar format of Highlights, Introduction, Description, Interpretation and Conclusions, and most sites in this section are obviously well-to exhaustively researched. However, many of the Palaeogene site descriptions read more like academic reviews of published work than first-hand field studies, which of course by necessity must occasionally be the case in a study of this scale. Despite the aim of the series, there is little or no information about the current state of conservation of the individual sites; indeed in some cases one is left with the impression that the author has not actually visited the site within the last few years. This impression is reinforced by some of the more optimistic site photographs which were actually taken when a site was in its heyday (for example Roland Goldring’s 1979 photo of Pincent’s Kiln, and an English Nature photo of Harefield in 1974, sections both now reduced to mere shadows of their former glory). This is unfortunate, since the volume will undoubtedly be used by many as a guide for field-visits, and cautionary information about the poor (or otherwise) state of conservation of some of these Palaeogene sites would surely be useful both now and in the future.

Nearly all of the photographs in this first section appear to have been taken from some distance away, and one is therefore left with the impression that the Palaeogene consists largely of a series of indeterminate collapsing masses of sediment (Sheppey, Walton-on-the-Naze, Alum Bay, Whitecliff Bay). This appears to be in part due to poor reproduction of the photographs in this section, the responsibility for which may possibly be laid at the door of the publishers. However, other photographs have no such excuse. The Redend Sandstone at Redend Point, Studland Bay is one of the most extraordinarily ornamented and beautiful of the Palaeogene sediments, yet here it appears merely as a slab of grey stuff sandwiched between trees and sea, apparently captured on a day of thick fog.

The Neogene section of the book, which covers 24 sites, has a somewhat lighter style. Although it follows the same format, it is clearly written with great enthusiasm for the subject, and does, by contrast, include brief but useful conservation details in the site descriptions. Photographs in this latter section consist of a combination of excellent close-ups of sedimentary and palaeontological features (including some of the wonderful trace fossils found in these sediments), in combination with good quality distance shots which complement the text. In addition, good line drawings of a few of the more important fossils are included, and clear graphic sedimentological logs, drawn by the author, are included to good effect.

Overall, this book is a mine of useful data about the Palaeogene and Neogene and the extent of potential and actual SSSIs (Sites of Special Scientific Interest) in this country, and should certainly be in the library of all those universities which still maintain the luxury of a Geology Department, and indeed also in the libraries of all Conservation Departments. It will doubtless be frequently borrowed from said libraries on a regular basis by many geological society field-trip secretaries. However, at £60, it will probably only appear on the bookshelves of the most well-off, or most devoted, individual students of the Tertiary.

Jackie Skipper


Professor K. S. Valdiya has been one of the great stalwarts of Himalayan geology and has previously written several research volumes on the Kumaon Himalaya, spread over three decades of field work. This book is written for the non-specialist and is a simple and very readable account of the greatest mountain range on Earth. Despite some geo-poetical chapter headings, from Chapter 1 ‘Many Splendoured Mountain’ through Chapter 7 ‘Turbulent Times: Birth of the King of Mountains’ to Chapter 8 ‘Evolution of the Abode of Snows’, the content is a simple and well-presented account of the building of the Himalaya. It is aimed at high-school students and the interested layman who has a basic understanding of geology. The book is nicely printed with simple diagrams and 20 plates of colour photos. There is also a detailed Glossary at the back of the book, which will clearly be very useful for lay readers. The text is written in an easy style without use of complicated jargon. Occasional delightful Indianisms creep into the text; for example, ‘the seismic gaps are highly vulnerable to hazards due to rock ing or twitching of the mountains’.

This book takes us on a journey through time from the oldest Precambrian rocks of the Lesser Himalayan foothills right up to the present day uplift and erosion along the highest peaks of the Himalaya. Indian geology is particularly strong on stratigraphy, sedimentology and palaeontology and these aspects of the Himalaya come across most strongly. The structure, metamorphism and magmatism of the range are less thoroughly addressed. The Lesser Himalaya contains rocks from the Proterozoic and Palaeozoic which give us ideas about the earliest evolution of Gondwana. The great Tethyan passive sedimentary margin of India started during the Permian and continued throughout the Mesozoic right up to the timing of India–Asian collision about 65–50 million years ago. Valdiya describes the environment of formation of these sedimentary rocks, which are beautifully exposed along the mountains of Zanskar, Spiti and Kumaon in northern India. The famous ophiolites of the Tethyan ocean which once lay between India and Asia are also described from the Spontang region of Ladakh and the Kiggar region of south Tibet. Following the early Eocene collision, mountain building processes started with large amounts of crustal shortening, metamorphism and localized melting producing the classic Himalayan leucogranites along the High Himalayan range.

The Himalaya is a particularly fragile ecosystem with great monsoonal floods, over-population causing intense deforestation, erosion and landsliding. Valdiya describes the evolution of both the geological record preserved in the Himalayan rocks and the recent landscape with alacrity. Perhaps the greatest hazard facing the region is that of future earthquakes, particularly with respect to the known seismic gap in the central Himalaya.
This little book is an excellent, simple account of Himalayan geology and can be recommended for laymen and students who are fascinated in this most spectacular of mountain ranges.

Mike Searle


Here is a large quarto-sized read on ‘all-that-you-wanted-to-know’ about Palaeogene environments. Because the warmest period in Cenozoic history occurred at this time, this book fills a very important role, given current concerns over Global Warming. As such, it firmly places palaeontologists into a position of some significance in the modern environmental debates. In this volume, issues are covered that are not readily appreciated by neontologists, and it will provide a useful framework for them in which to view ongoing biotic changes.

This book covers a lot of ground, from magnetostratigraphy, nannoplankton evolution, oxygen and carbon isotopic analysis to taxonomic turnover in mammals and even sea turtles, to name a few. It is a handsome volume, well organized and well presented – it even features two blocks of colour plates; these are of graphs (there are no colour photographs). Because the editors have taken pains to include almost everyone who studies some aspect of this period in Earth history, there is a excellent holistic feel to the book. It is a volume that will be utterly invaluable for dipping into to check facts and figures. It has already proved useful to me during a prolonged episode of writing a book chapter on the life and environments of the Cenozoic Era! It is essentially a volume demonstrating the current state of our knowledge in this period of past time. The fly-slip trumpets that it ‘will be of great value as a reference source for a wide spectrum of scientists, from marine geologists, and oceanographers to palaeontologists, palaeoclimatologists and stratigraphers’. This is not an idle claim, and there can be few books of such a broad scope devoted to such a small – but crucial – period in the Earth’s past. This is distinctly a reference book and not a casual read. It should be a part of any really comprehensive university geology library, and staff should try to persuade their librarians to obtain a copy; I can’t think of many departments that would not require one. The illustration count is high, and these are very clear and well-integrated with the text; however, the illustrations are not particularly slick or impressive, being rather workmanlike. This is the only quibble and it probably meant that its price tag was not higher than £100.00.

Ian Jenkins


Numerical Experiments in Stratigraphy is a compilation of papers presented at a three-day workshop at the University of Kansas in 1996. The object of the workshop was to document, characterize, demonstrate and compare different computational algorithms and techniques used in simulating stratigraphic systems. Considering the variety of high-quality papers in the volume, the conference appears to have been successful in this aim.

Scientific philosophy receives less attention in the Earth sciences than perhaps it should, given that it largely determines our direction as scientists, and an understanding of model philosophy, advantages and drawbacks is crucial given the increasing use of numerical models in sedimentology and stratigraphy. This volume is an excellent source. Several papers discuss the philosophy behind how models, numerical and otherwise, are used. For anyone who has ever asked a modeller why they are involved in creating and utilizing models, and for modellers who do not know themselves, these papers are a must read. Particularly important is the idea that numerical models provide a method of experimentation, otherwise largely precluded in research on sedimentary systems because of the large spatial and time scales involved. This zeal for the usefulness of numerical models is tempered by various authors in the volume who point out that expecting precise predictions from models is unwise given the uncertainties, approximations and unknown initial conditions from which they suffer.

The volume is divided into three main sections, one containing two papers on areas of general modelling theory, a second on model testing sensitivity analysis and optimization, and the third on forward modelling. Anybody interested in modelling methods, for example how to use forward models rigorously as part of an inverse method, will learn a lot from papers in the section of the volume on model testing and model methods. In particular, Cross & Lessenger illustrate the method well with an example of a modelling exercise to reproduce stratigraph patterns from the San Juan basin of New Mexico. Bornholdt et al. use the same forward-inverse method, but use a different algorithm in their inverse model. Bagirov & Lerche provide a reasonably simple and fast procedure for determining relative importance of uncertainties in parameter values in a model of basin thermal and hydrocarbon evolution.

The forward modelling sections contains the greatest number of papers, reflecting the increasing use of forward models in sedimentology, stratigraphy and basin analysis. Papers in this section are separated into a group on general aspects of forward models, a group on using forward models to evaluate uncertainty, and a group concerning coupled models where output from one model is used as input into a second. The papers are diverse, covering topics from ocean circulation and associated sedimentation, fluid flow and diagenesis, response of stratal systems to relative sea level change, links between sedimentation and active fault movement and using forward models to constrain hydrocarbon reservoir geometries. Model scales range from whole oceans to single stretches of shoreline, to groups of a few current ripples. At the smallest scale, Zijlstra uses a cellular automata model in which adjacent model cells interact and evolve according to simple rules to reproduce basic patterns of current ripples and to illustrate how such organized systems reach an equilibrium state. At the largest scale, Haupt & Stattegger model ocean basin evolution during the Quaternary and use the model to suggest climatic forcing of ocean circulation patterns, in turn forcing sediment accumulation patterns.

This book is essential for anybody using or developing numerical models applicable to sedimentological and stratigraphical problems. It will also be very useful and interesting
for any non-modellers wanting to learn more about modelling philosophy, how models are applied, and what kinds of conclusions can be drawn from the results.

Peter Burgess


A book should not be judged by its cover, or indeed its title. I was expecting this book to be a general text for physical geographers and geologists on the processes of erosion and sedimentation. I imagined a mixture of descriptions of processes and products and some basic fluid dynamics for those wishing to take a more mathematical approach. The preface and the back cover make it clear that this is pitched at graduate level and that it is as much for engineers and hydrologists as sedimentologists. Erosion of road cuttings and bridge supports and sedimentation resulting from human activity such as mining and reservoir construction are as much the focus of this text as processes occurring without human intervention. It is well written and clearly set out, but there are almost as many equations to read as words, so only the more mathematically capable geologist is likely to find this book easy to use. It covers the physical properties of sediment and water, the mechanics of sediment-laden flows, particle motion (e.g. Navier–Stokes equations), and turbulent velocity profiles in the first few chapters. Geologists may be more familiar with the material covered in following chapters on incipient motion, bedforms and transport as bedload and suspended load. Descriptions of techniques and devices for field measurement of bedload and suspended loads are included in these sections. For students of fluid mechanics, there are several exercises and problems to solve at the end of each chapter, some of which could be carried out by hand, but others requiring short computer programs to be written. This is a useful book to have in the library for reference for anyone who finds that their sedimentological analysis requires a more numerical approach involving fluid dynamics, but perhaps not a text for every sedimentologist’s bookshelf.

Gary Nichols


This hardbound book is the third edition of a text that focuses on the petrology of potassic igneous rocks and the tectonic settings in which they occur, with particular reference to their associated economic mineralization. Originally published in the ‘Lecture Notes in Earth Sciences’ series, this updated and enlarged edition features, according to the outer cover, ‘several new sections, new geochemical data and additional references’.

The main purpose of the book is to provide a review of the geochemical and petrological characteristics of potassic igneous rock complexes, their classification, and the tectonic settings in which they occur. Since many porphyry, epithermal and other types of gold deposits have spatial associations with, or are hosted by, such rocks, the authors also attempt to elucidate the relationships between magmatism and mineralization and identify chemical differences between barren and mineralized intrusions. The petrology and mineralization aspects essentially divide the book into two halves.

The first half consists of four chapters, the first two providing a general introduction, a definition of potassic rocks and a summary of their nomenclature. This provides a useful summary for readers unfamiliar with this relatively unusual group of rocks. The third chapter summarizes the tectonic settings in which potassic rocks occur and a review of how such settings can be discriminated on the basis of major, minor and trace element data. This is a comprehensive review that provides a useful compilation of whole-rock geochemical data and some useful tools (discrimination diagrams) for the classification of potassic rocks and identifying likely geological environments of formation. The main tectonic environments considered are divided into continental arc, postcollisional arc, initial oceanic arc, late oceanic arc and within-plate. A slight concern is perhaps the lack of a detailed consideration (although mentioned in several places) of the effects of hydrothermal alteration on the discrimination schemes presented, particularly concerning ‘potassic’ calc-alkaline rocks which are often potassically altered. An example of the relevance of this is illustrated on p. 151, where geochemical discrimination (even using immobile elements) is not used to elucidate a tectonic setting for lamprophyres in a case study of the Goodall deposit, Australia, because of alteration.

The fourth chapter presents descriptions of the petrography and geochemistry of rocks from ‘selected’ type localities and, although containing relevant information, makes for a somewhat unexciting read. It is in chapters five through seven that the authors address the relationship between potassic igneous rocks and gold–copper mineralization and it is here that an important issue, central to the book, is first considered. The authors present evidence for a primary precious metal enrichment in potassic rocks and discuss ‘direct’ and ‘indirect’ associations between high-K rocks and mineralization.

With regard to primary enrichments, the case studies suggest that there is no universal elevation of precious metals in high-K magmas, implying that any genetic link between magma and mineralization is likely to be due to ore metal concentration by magmatic–hydrothermal processes. On the second point, whilst many gold–copper deposits are hosted by such rocks and, in some cases, have evidence for a direct magmatic input, the assumption of a genetic link between the igneous rocks and gold–copper mineralization seems to be made a priori by the authors, with little or no discussion in individual cases of the evidence on which this conclusion is based. This may be somewhat an academic point, but it did seem that the authors never quite got to the nub of this issue, although this may simply reflect the general lack of data on such links in the literature.

An example of the problem is a statement made on p. 125: ‘the [high-K] dioritic source rocks to gold mineralization at El Indio’ where direct magmatic derivation of metals from one particular group of intrusives is inferred with no supporting information. This problem resurfaces throughout these three chapters, with many statements referring to mineralization associated with or related to high-K rocks, with limited clarification of the nature of the association. In many
(mostly the indirect) cases it is purely spatial, with very little or no additional evidence (such as temporal or geochemical constraints) for a genetic link. This is particularly true for low sulphidation epithermal deposits where direct magmatic connections are rarely proved, and for structurally controlled deposits where magmas and hydrothermal fluids can independently exploit the same reactivated structures. Thus, although much circumstantial evidence is presented – the common co-occurrence of high-K rocks and Cu–Au mineralization being an obvious empirical relationship – the central tenet of the book is, in my view, never quite satisfactorily addressed.

Chapter eight presents a short summary of the halide content of micas in potassic rocks and the potential use of such data for discriminating barren and mineralized intrusions. Whilst this is interesting, it is a little brief and felt a bit out of place. Chapter nine provides a very cursory coverage of the potential implications for copper–gold mineral exploration of many of the features characteristic of potassic igneous rocks discussed in the previous chapters. I suggest this section falls between two stools in that the somewhat generalized comments probably would not provide enough information for a student interested in mineral exploration, nor would they be particularly insightful for an industry professional.

In contrast, chapter ten is a very useful tabulated compilation of key facts for each of the major ore deposits associated with high-K rocks discussed in the book. Each deposit has a single page entry with information such as reserves, host rocks, ore minerals, alteration, etc. This provides a very useful information resource, in one place, of the main characteristics of an important group of deposits and will be useful for students, academics and industry alike.

Overall, the book is well written and error-free (with the exception of the transplantation of a paragraph on Bingham into the El Indio section, p. 125), with numerous high-quality line illustrations and plots of a consistent style. There are also many (68) useful data tabulations. It would have been beneficial to have a preface to the third edition to indicate how and where the text had been expanded from the earlier editions.

Despite the criticisms outlined earlier, the authors have provided a good coverage of the subject matter and the book is well laid out. It will be beneficial to any advanced level undergraduate or Masters student wishing to find out about copper–gold ores hosted by high-K alkaline igneous rocks. It will also provide a useful text for academics interested in high-K rocks that are unfamiliar with their significance with respect to mineralization, or for economic geologists who do not have experience of these systems. Finally, the book represents a useful data and information resource that will be of wide use for academics and explorationists alike. At US$79.95 it is not unreasonably priced and will find a place on many university and company bookshelves.

Jamie Wilkinson


*Principles of Seismology*, by Agustin Udías, is an excellent introductory seismology text for advanced undergraduate and graduate students. Because he is writing for readers with no prior seismological knowledge, the author emphasizes basic developments of seismology. The most fundamental concepts are developed in complete mathematical detail so that students can follow these with little difficulty from the basic underlying physical principles to their application to the study of the Earth. Many of the topics are first introduced with simple analogue models to present the physical ideas before proceeding to a discussion of more relevant seismological models. For example, normal mode theory for the Earth is introduced in terms of a one-dimensional problem of vibrating strings and rods before introducing the Sturm–Liouville equation and finally the free oscillations of an elastic sphere and the Earth. Some of the more complex seismological subjects such as anisotropy are described in the text but are not fully developed, and in these cases adequate references are given to more advanced seismological texts where the readers can pursue these topics in more detail if they so desire. In presenting this material, the author assumes a familiarity with calculus and ordinary and partial differential equations, but the basic concepts of vectors and tensors, cylindrical and spherical coordinates, Bessel and Legendre functions, and Fourier analysis are given in appendices.

The book contains discussions of all of the seismological topics necessary for a comprehensive introductory course. Following an introductory chapter giving a brief history of seismology, there are three chapters dealing with elastic wave propagation: the fundamentals of elastic theory, the elastic wave equation and a discussion of solutions of the elastic wave equation in terms of both ray theory and normal modes. This is followed by a group of five chapters covering the propagation of body-waves, including the reflection and refraction and energy partition at a boundary, ray propagation in flat and spherical elastic models, and travel times and the structure of the Earth. Next, four chapters are devoted to surface waves and free oscillations of the Earth. The fourteenth chapter gives an introduction to anelasticity and anisotropy, a subject not often treated in introductory texts. This is followed by a comprehensive discussion of the seismic source, including a discussion of earthquake location and source parameters such as magnitude, seismic moment and stress drop, equivalent forces, point sources and the seismic moment tensor. Also included is an extensive discussion of dynamic fault models and a survey of methods for determining earthquake source mechanisms. The book concludes with a discussion of seismotectonics, seismic risk, and seismic instrumentation. One of the appendices contains extensive problems and exercises. Although the book is primarily devoted to seismological theory there are discussions on determining Earth structure and earthquake mechanisms so that students can gain an appreciation of the application of the theory.

*Principles of Seismology* provides a coherent and comprehensive introduction to the fundamental concepts and principles of theoretical seismology and covers the complete spectrum of seismological topics.

Keith Priestley


*Fossil Crinoids* is a profusely illustrated and informative book divided into an introductory section of five chapters followed by a further 24 on specific crinoid assemblages. The chapters on specific faunas are arranged stratigraphically
and range from the Middle Ordovician to the Recent. Coverage is inevitably uneven being largely controlled by suitably fossiliferous sites, but one can question the choices. In particular, I wondered why the Wenlock Limestone fauna of Dudley was omitted. However, this is my only serious criticism of the book.

The introduction is illustrated with the only colour photographs in the book, but includes a summary of fossil diversity which might have been better placed in the chapter on fossil occurrence. The following 'general' chapters cover: crinoid form and function; systematics, phylogeny and evolutionary history; fossil occurrence; taphonomy; ecology and ecological interactions. These are particularly informative and provide a detailed introduction to the crinoids as living functioning animals. The last chapter is largely concerned with interactions with platyceratid gastropods and other parasites and the crinoids' response to them.

The crinoid assemblages are covered in a large number of short chapters, illustrated with examples of key genera and including at the end of each chapter locations of important collections. The illustrations include some spectacular examples of articulated crinoids. Worth special mention are the Scyphocrinites from Morocco (Chapter 11), interpreted as the only truly pelagic crinoids with slabs including the floats, stems and crowns; and the x-radiograph of Parisangulocrinus from the Hunsrück Schiefer (Chapter 13). Inevitably the Palaeozoic is particularly well represented (15 chapters), with the Mesozoic next (7 chapters, 5 from Jurassic horizons), whereas the Tertiary and Recent have one short chapter each. Some chapters include discussions of the discovery and exploitation of the fossil horizons, as for example the Lower Mississippian faunas from Crawfordsville, Indiana (Chapter 18), the locality which also prompted the concept of tiering among stalked faunas from Morocco (Chapter 11), interpreted as the only truly pelagic crinoids with slabs including the floats, stems and crowns; and the x-radiograph of Parisangulocrinus from the Hunsrück Schiefer (Chapter 13). Inevitably the Palaeozoic is particularly well represented (15 chapters), with the Mesozoic next (7 chapters, 5 from Jurassic horizons), whereas the Tertiary and Recent have one short chapter each. Some chapters include discussions of the discovery and exploitation of the fossil horizons, as for example the Lower Mississippian faunas from Crawfordsville, Indiana (Chapter 18), the locality which also prompted the concept of tiering among stalked crinoids. Jurassic localities include the Posidonienschiefer with Sintocrinus preserved attached to floating logs, and the Solnhofen Plattenkalk with Sintocrinus preserved attached to floating logs, and the Solnhofen Plattenkalk in which the supposedly pelagic crinoid Saccocoma is by far the commonest fossil. The alternative hypothesis that Saccocoma lived on the sea floor is dismissed, but to my mind the illustration of the comatulid Pterocoma, with all its arms trailing on one side of the cup shows how I would expect a dying pelagic crinoid to hit the sea floor, whereas Saccocoma is always preserved with the arms spread around the cup. The book ends with a table of fossil horizons, a glossary of terms and a very extensive arms spread around the cup. The book ends with a table of fossil horizons, a glossary of terms and a very extensive arms spread around the cup.

In her introduction Adrienne Mayor takes palaeontologists and historians of palaeontology to task. At best there has been a complete and easy to use. It gives simple, short and accurate translations of 37,000 terms and forms a good reference source for palaeoentologists who have to deal with written forms of French or American English. This is also why this dictionary might shock the purists: the authors have chosen to ignore the raging debate over hyphenation or non-hyphenation by welding composite words together (e.g. 'Sealevel'). If however one takes into account the fact that very few native English-speakers do master hyphenation this might not be so sacrilegious!

To summarize, this book stands head and shoulders above the pile of existing dictionaries as a modern, comprehensive, simple and certainly the most up-to-date French–English Earth Sciences dictionary. I definitely recommend it to both French and English speaking geoscientists; I use it!

A few criticisms can be made of this book, and I illustrate each with an example:

(1) The authors have chosen to include only American English terms in the dictionary: it is somewhat a pity that no room at all has been made for the British English vocabulary.

17. Behavior (American English) and ‘behaviour’ (English) are both acceptable words, and it would be useful for the French-speaking scientific community to have the two forms listed.

(2) If the explanations accompanying the English translations are generally concise and well written, the explanations accompanying the French translations are less satisfactory. Some could be better phrased. ‘Nektom: Nektom m, tous les organismes capables de se déplacer à volonté dans l’eau’. As this refers to the ‘will’ of animals, I think it would be better to refer to the Nektom as: ‘Nektom m, un organisme aquatique et qui nage pour se déplacer’.

Moreover, there is no harm in admitting that there is no better word than the English word or the French word to describe something: English speaking structural geologists use the French term ‘décollement’; why use convoluted ways of talking about the ‘beachrock’? ‘Beachrock: Dépôt de plage; […], sable ou gravier de composition carbonatée ou siliceuse lithifiée dans la zone de balancement des marées,…’

French geoscientists use literally the word ‘beachrock’; the term ‘dépôt de plage’ is too vague: it includes un lithifié and lithified beach deposits. Moreover the French explanation is not correct, it suggests that the composition of the rock and not the rock is lithified! It may be better to say instead ‘sables ou graviers lithifiés, de composition carbonatée ou siliceuse et formés dans la zone de balancement des marées,…’

(3) Some of the stratigraphic entry words and explanations given in the dictionary are not entirely satisfactory. (a) ‘Calpionella’ (English and French) is a genus of the Calpionellidae family. The word ‘calpionelle’ is the correct French word to be used. (b) ‘Chord’ (English and French) is a genus of the Charophyte family. The word ‘Charophyte’ is the correct French and English word to be used. (c) ‘Neocomian: Neocomien […] m, étage européen du Crétacé inférieur…’ This is a mistake: the term ‘Neocomien’ was used as a Cretaceous stage only in the 19th century. Nowadays, stratigraphers use this term as an informal stratigraphic unit and definitely not as a stage.

Suggestions for the next edition: some stratigraphic and systematic terms and some French explanations used in the dictionary need to be revised. The dictionary would benefit from adding British English spelling (mainly to show other acceptable ways of writing), appropriate usage of the words (usage in Britain, …) and a short pronunciation guide of the entry terms.

Eric J.-P. Blanc

This French–English dictionary is well presented, modern, complete and easy to use. It gives simple, short and accurate translations of 37,000 terms and forms a good reference source for palaeoentologists who have to deal with written forms of French or American English. This is also why this dictionary might shock the purists: the authors have chosen to ignore the raging debate over hyphenation or non-hyphenation by welding composite words together (e.g. ‘Sealevel’).

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C. R. C. Paul


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In her introduction Adrienne Mayor takes palaeontologists and historians of palaeontology to task. At best there has
been accidental ignorance and at worst wilful avoidance and misrepresentation of how much the Greeks and Romans knew about fossils. Mayor asks how did modern science and history come to lose the significant paleontological discoveries, thoughts, and activities of classical antiquity? In *The First Fossil Hunters: Paleontology in Greek and Roman Times* she puts the record straight and places the ancients where they belong, well and truly back in the history of palaeontology.

She claims that ‘four errors about ancient experiences with fossils recur in paleontological histories’. For instance, although the early Greeks understood the meaning of marine fossil shells, they ‘somehow … never noticed the huge fossil remains of dinosaurs, mammoths, and other extinct vertebrate species’. The explanation normally provided is that they ‘were essentially too big to be noticed … or to be taken seriously as bone of animals’ (Sertjeant in Currie & Padian, 1997).

The strangest of her four ‘errors’ is the Empedocles myth in which the Greek philosopher is supposed to have studied fossil elephant skulls from the caves of Sicily. For instance, Novacek (1996) perpetuates the story that ‘Empedocles, writing in 400 B.C., noted that fossil elephant skulls common in the Mediterranean region could be associated with the Homeric legend of the Cyclops’. The story is sometimes embellished with the claim that Boccaccio was the first to publicize Empedocles’ finds. Mayor traces the whole myth back to the Austrian palaeontologist Othenio Abel who, in 1914, speculated that the single large nasal opening in elephant skulls might have been mistaken for the eye-socket of a large one-eyed giant and declared that ‘Empedocles reported such finds in Sicilian caves and believed these to be unassailable proof of the existence of an extinct race of giants’. It is perhaps the body of the Tanagra relic already was very fragile and unrecognizable.

With the academic naming and shaming over, Mayor proceeds to make her case with detailed ‘chapter and verse’ from the ancients. It is indeed impressive and generally very convincing. She is very well aware of some of the pitfalls, especially those associated with the very ancient tradition of fraud and fakery. She cites the case of the Tritons as a good example. Around 2000 years ago, a Greek civil servant, Demostratus, was sent to investigate a pickled Triton kept at Tanagra (Boeotia). The specimen resembled the typical half-man, half-sea creature which had been portrayed as a Triton with highly fragmentary material. Skeletons were excavated quickly, often in terrible weather conditions, in order to get this remarkable collection back to an ever-demanding Yale University, who was quick to realize the potential of the site. Marsh’s talented and dedicated field assistants (the great man hardly ever went into the field himself) managed to secure many of the most productive quarries in the Como area, beating Marsh’s great rival Edward Drinker Cope to one of the most important pieces of palaeontological real estate that had been discovered up until that time.

In July 1877, two railwaymen stumbled upon one of the world’s greatest palaeontological treasure troves. A series of terse telegrams from Wyoming announced the discovery of many fossil bones in the region around Como Bluff, a prominent ridge located close to the Union Pacific Railroad. The telegrams were dispatched to no less a personage than Othniel C. Marsh, Professor of Vertebrate Palaeontology at Yale University, who was quick to realize the potential of the site. Marsh’s talented and dedicated field assistants (the great man hardly ever went into the field himself) managed to secure many of the most productive quarries in the Como area, beating Marsh’s great rival Edward Drinker Cope to one of the most important pieces of palaeontological real estate that had been discovered up until that time.

The Upper Jurassic sandstones and mudstones of Como Bluff (which pertain to the famous Morrison Formation) quite literally yielded dinosaur bones by the tonne. Many of the specimens recovered represented ‘new’ animals and the quality of the material, and the presence of many articulated skeletons, provided a vast amount of information for a branch of science that, until that point, often had to contend with highly fragmentary material. Skeletons were excavated quickly, often in terrible weather conditions, in order to get this remarkable collection back to an ever-demanding Yale University, who was quick to realize the potential of the site. Marsh’s talented and dedicated field assistants (the great man hardly ever went into the field himself) managed to secure many of the most productive quarries in the Como area, beating Marsh’s great rival Edward Drinker Cope to one of the most important pieces of palaeontological real estate that had been discovered up until that time.

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**Marsh’s Dinosaurs** provides a detailed account of the discovery of the site and the subsequent history of the Marsh sponsored excavation. Drawing on the archives of the Peabody Museum of Natural History at Yale University (this
...tive sea-level fall are represented by non-deposition, particularly in the shallow marine realm. Recent work suggests that shallow marine deposition is common at such times, and is characterized by unusually rapid regression that is driven (‘forced’) by relative sea-level fall rather than sediment flux alone. This work has raised further questions: what criteria allow us to recognize the products of this ‘forced regression’ in the sedimentary record, and what impact does ‘forced regression’ have on the evolution of depositional systems? This book arose from a meeting held at the Geological Society in 1995 to address these questions. The book is arranged in three sections, the first discussing general concepts and models, and the second and third presenting a series of case studies from Palaeozoic-Mesozoic and Cenozoic strata.

The concepts and models presented in the two papers comprising the first part of the book (Plint & Nummedal; Posamentier & Morris) are essential reading for those wishing to understand the expression of relative sea-level fall in the sedimentary record. These two papers synthesize and develop previous work to provide the conceptual skeleton that is fleshed out in the later case studies. In particular, Posamentier & Morris emphasize the variability of ‘forced regressive’ deposits, which results from the interplay between sea-floor bathymetry, the rates and magnitudes of relative sea-level fall, sediment supply and active depositional processes.

The case studies themselves are uniformly well-illustrated and utilize a large range of data types (outcrop, subsurface core, wireline-log and high-resolution seismic data) to examine a variety of shallow marine depositional systems. The nature of the key facies relationships and stratigraphic surfaces developed during ‘forced regression’ are documented in two outcrop studies from the U.S. Western Interior Basin (Fitzsimmons & Johnson; Mellere & Steel), while similar relationships are presented from subsurface cores and wireline logs (Hamberg & Nielsen; Olsen & Steel). High-resolution seismic data from Pleistocene and Quaternary strata provide exquisite examples of the stratal geometries developed during falling relative sea-level (Trincardi & Correggiari; Chiocci; Kolla et al.; Hernández-Molina et al.).

In addition to the case studies of siliciclastic strata described above, carbonate and mixed carbonate-siliciclastic depositional systems are documented in three outcrop studies (Ineson & Surlyk; Haywick; Tropeano & Sabato). Two case studies from active extensional and compressional basins settings examining the more complex stratal architectures and geomorphologies developed in such basins (Gawthorpe et al.; McMurray & Gawthorpe). Perhaps the most intriguing of these case studies presents a simulation of ‘forced regressive’ stratigraphy produced by a computer forward model (Ainsworth et al.). While the rigour of the modelling approach is open to some criticism, it presents a thoughtful alternative to more conventional forward models of stratigraphy, which commonly use a different set of ‘rules’ and assumptions — and Ainsworth et al.’s ‘thought experiment’ does replicate the stratigraphic relationships documented in many of the case studies presented in this book.

In summary, this book provides an excellent introduction to the sedimentary record of falling relative sea-level. The editors and authors are to be congratulated on the broad range of papers presented here and on the clarity of presentation. The book is required reading for postgraduate researchers interrogating the stratigraphic record of shallow marine sedimentation using facies models and sequence stratigraphic methods. I have only one criticism: this book...
has taken a long time to come to print, which has diminished
the impact of some of the papers within it.

Gary Hampson

York, London, Paris, Tokyo, Hong Kong: Springer-
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This is the third edition of Structure of Crystals, originally
written by three distinguished Moscow crystallographers.
The previous edition was published five years ago, but since
that time the first two authors have died, and this may
explain why the latest edition contains only very minor
changes: a slightly expanded bibliography and some subtle
corrections to the text. This is not so much a new edition, as
a reprinting with minor amendments – which is probably no
bad thing. Here we have a very catholic approach to
structural crystallography, encompassing silicate minerals,
superconductors, liquid crystals, through to biological struc-
tures – and touching on aspects of crystal chemistry, lattice
dynamics, defects, and experimental techniques.

The first half of the book, comprising chapters written by
Professor Vainshtein, makes excellent reading. We begin
with an introduction to chemical bonding and atomic radii,
investigating ways of packing atoms in three dimensions,
building extended lattices. Crystal chemistry is explored in a
sequence of increasing complexity, from simple elemental
structures, ionic compounds and onto more complex coval-
ent structures. The culmination of this treatment is an expo-
sition of organic compounds including liquid crystals,
polymers, proteins and viruses; as a non-biologist, I found
this unusually approachable and informative!

The next two chapters, written by different authors, are
not quite as successful. A short chapter introducing the
Schrödinger equation leads on to band structures, Brillouin
Zones, and Fermi surfaces. This is followed by a lengthy
chapter on lattice dynamics and phase transitions. We are
presented with an introduction to simple lattice dynamics –
vibrations of a linear atomic chain, dispersion and phonons
– followed by a thermodynamic perspective. Finally, there
is a section on phase transitions, describing order–disorder
mechanisms, thermodynamics, and equations-of-state.
These chapters adopt a somewhat heavy-handed physics
approach which seems out of place here; surely such treat-
ment is more appropriate for the companion volume
Physical Properties of Crystals (Volume 4 in the Springer
‘Modern Crystallography’ series).

Chapter 5 describes imperfections in crystals: point
defects, dislocations, stacking faults, and the like. The tech-
niques for observing such phenomena are described. The
final chapter, ‘Advances in Structural Crystallography’, is
effectively an appendix to Chapter 2, providing case studies
and ‘tasters’ from recent research. Sections include crystallo-
graphic data bases, the structures of fullerene compounds,
crystal chemistry of silicates and superconductors (a
detailed section with a good overview of the main structural
types) followed by a discussion of molecular crystals. The
book is peppered with extensive references (unfortunately
many of these are to Russian-only journals) and ends with a
wide-ranging bibliography.

From a purely geological perspective this book may prove
disappointing. The approach to minerals is less than rigor-
ous (e.g. ‘quartz’ used in place of ‘silica’) and I would have
preferred a more systematic treatment of inorganic struc-
tures, rather than relying on occasional model compounds.
However, in the authors’ defence it is probably fair to say
that their emphasis on biological crystallography reflects the
interests of the majority of the world’s crystallographers.

As a broad overview of crystal structures in the context of
interdisciplinary modern crystallography, this book remains
highly impressive. The major part of the book – that which is
truly devoted to crystal structures, and which avoids too
much overlap with other volumes in the series – should prove
a useful introduction to crystal chemistry and structure for a
general audience.

David C. Palmer