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BOOK REVIEWS

GUBBINS, D. 2004. *Time Series Analysis and Inverse Theory for Geophysicists*. xv + 255 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £70.00 (hard covers), £27.95 (paperback). ISBN 0 521 81965 2; 0 521 52569 1 (pb).
doi:10.1017/S0016756805210786

Time series analysis and inverse methods form an integral part of any geophysics degree programme, yet there are very few textbooks that either focus on these topics or are written with the geophysics student specifically in mind. Consequently, this excellent textbook fills a much neglected gap. The topics are often found difficult by students partly because a reasonable standard of maths (all too often lacking in today's students) is required before the material can be grasped. While in no way can this book be described as avoiding the mathematics it does at least focus on what is necessary and ancillary explanations and proofs are included in an extensive series of appendices. The approach taken is a pragmatic one in which many years of teaching and understanding of the capabilities of students have obviously been employed in refining the contents. Personally, I welcome this approach, which is justified in the book, although it may not be for the purist. For instance, time series analysis is explained from the premise that all that is strictly necessary is a knowledge of the discrete Fourier transform, because this form of the transform applies to the most common type of data handled by geophysicists which are discretely sampled.

The book is divided into three sections (four if you include appendices). The first deals with time series analysis and is very clearly written and well illustrated. There are clear examples of filtering and convolution methods so that the reader is left in no doubt as to the application of the theory. Each chapter ends with a series of paper and computer exercises (purchasers of the book can access the computer-based material online on various websites, but some programs require a unix or linux based system and a FORTRAN compiler, and so will not be of much use to PC users).

The second section deals with the basics of inverse theory. I found the problem-based approach very helpful in understanding the concepts and it kept the purpose of substantial amounts of matrix-based maths clear. Most of the chapters in this section, where appropriate, conclude with a box summarizing a 'recipe' for solving, for example, linear and non-linear inverse problems. Again, there is a set of exercises for the student to attempt.

After the theory sections the final part of the book contains three chapters which demonstrate how the methods are used in examples of time series analysis (optimum filter design); seismic tomography, and earthquake location; and determination of the geomagnetic field over the surface of the core from historical and recent measurements. These concentrate on inverse methods and were well chosen to illustrate some of the problems which arose when applying techniques to real data and demonstrate their solutions.

The appendices cover all mathematical details of the Fourier series and integral transform, sampling theory, linear (matrix) algebra and vector spaces, which would have otherwise made the main text rather unwieldy and heavy going. In addition there is a short but useful reference list and an index.

I can envisage this book being used by anyone at a research level, employing inverse methods to solve problems, or requiring a background in time series analysis, while I expect that the group that will benefit most from its guidance will be future generations of geophysics students – provided they have mastered some mathematics.

Richard England

WEBBY, B. D., PARIS, F., DROSER, M. L. & PERCIVAL, I. G. 2004. *The Great Ordovician Biodiversification Event.* xi + 484 pp. New York: Columbia University Press. Price US $99.50, £69.00 (hard covers). ISBN 0 231 12678 6.
doi:10.1017/S0016756805220782

The starting point of this great compilation is Sepkoski's fertile idea that most life-forms can be assigned to one of three 'evolutionary faunas', the Cambrian, the Palaeozoic and the Modern faunas. The Palaeozoic Evolutionary Fauna largely originated in the Ordovician Period and was much depleted by the end-Permian mass extinction, after which the Modern Fauna dominated. In order to get a better understanding of the Palaeozoic faunal origination, a project on the Ordovician Biodiversification Event (supported by the International Geological Correlation Programme) was initiated around 1998 and a group of a hundred specialists, representing expertise on practically all the faunal and floral groups of fossils, was invited to compile information on the development of the Ordovician biota. Considering the size and complexity of the project, and the completeness of the end result, the editors and authors have done well to get the present volume to press in good time. As the present book makes abundantly clear, the Ordovician was a hugely important period; marine life everywhere underwent a great diversification and gave rise to many forms of life whose descendants are with us today, but, just before the advent of the Silurian Period, suffered a rapid and calamitous decline, accompanied by an extinction event.

The book is divided into an Introduction (Chapter 1) followed by four Parts. The Introduction is the longest chapter. It gives the origin of the project, sets out its aims and groundwork, and goes on to discuss some of the problems and constraints in assessing biodiversity. It includes important information, but is not sufficiently concise. Nearly half the chapter consists of summaries of all the subsequent chapters; these seem out of place here and would have been more useful if given as abstracts at the head of the relevant chapters.

Part I (Chapters 2–4) sets the standards that contributors were to use in recording the changes in diversity of the various fossil groups, and is vital for the consistency of the results. Chapters 2 and 3 identify the succession of time-slices employed, their duration and their correlation. Chapter 4 discusses how diversity can be measured or estimated; the author (Roger Cooper) recommends the use of 'normalized diversity', and most contributors favoured this suggestion. All these chapters are short and to the point.

Part II (Chapters 5–10) summarises the Ordovician world: the movement of plates, changes in sea-level, isotopic signatures and climate, etc., and summarises the glaciation at the end of the period. These chapters are mostly well illustrated and quite short.

Part III (Chapters 11–33) makes up the bulk of the book. Each chapter reviews the diversification of a group of organisms. Some, such as those on brachiopods, trilobites and chitinozoa, record information pooled by many specialists; others are the work of one or a few workers. Each of the chapters begins with a brief comment on the nature of the group under discussion, the problems of identifying clades within the group, a justification of the taxonomic levels at which the compilations were made, and also comments on the completeness of the records that could be drawn upon. Some, for example Chapter 16 (Bryozoa), add helpful comments on the ecology and modes of life of the taxa under consideration. However, there is understandable variation in the approach adopted by the authors. Groups with a patchy record (e.g. Radiolaria) and others whose taxonomy is not well established (e.g. Polyplacophora) are treated only generally, while other groups with a good record (e.g. Brachiopoda, Trilobita) are the subject of longer and more detailed accounts. The graptolites, having widely distributed species and well reported record, are analysed to test the effects of palaeogeography and of palaeolatitude on distribution; the analysis uses data from Australasia, Baltica and Avalonia only, but is rigorous. The analysis of conodont records is likewise based on an impressive dataset, though confined to the early and middle Ordovician faunas. Perhaps the most remarkable compilation is that for chitinozoa, based on species recorded from all over the world, by a large team led by Florentin Paris.

Part IV (Chapters 34 and 35): Chapter 34 concerns the ichnological record and illustrates the importance of trace fossils as a record of the way animals extended their activities to new environments such as deep water settings. Chapter 35, entitled 'The Ordovician Radiation: Toward a New Global Synthesis', by Arnold Miller, is a thoughtful summing up of the problems to be overcome in assessing biodiversity and rates of evolution; they are complex and, with many factors to be taken into account, the opportunities for comparing and contrasting data on diversification seem endless. There are many unanswered questions, and Miller's essay is an eloquent plea for more complete and more rigorous study.

The book ends with a huge list of about 2000 references and an index that commendably includes most of those abbreviations (e.g. EF for 'evolutionary fauna') that can exasperate the uninformed reader. I saw few mistakes, though the principal editor seems to have adopted a new group of organisms, the bryoniids (p. 31) that is duly indexed (clearly byroniids was intended).

Although there is no overview of Ordovician biodiversification based on the present contributions, it seems that there must be a story to be extracted from them. Many contributors noted that their groups show a slow diversification during the Tremadocian, a peak in or around the Darriwilian, a steep decline in the Hirnantian, while there are those that strikingly buck some of these trends. All these could be compared and collated (bearing Miller's caveats in mind), and interesting conclusions might emerge.

The book is well produced and will provide a valuable source for anyone studying the development of Ordovician faunas – as it should, considering the expertise of the contributors. It should be on the shelves of all geological libraries.

Adrian Rushton

HOLMAN, J. A. 2004. *Fossil Frogs and Toads of North America.* xv + 246 pp. Bloomington: Indiana University Press. Price US $79.95 (hard covers). ISBN 1 800 842 6796.
doi:10.1017/S0016756805230789

Alan Holman is one of the doyens in the field of palaeoherpetology (the study of fossil amphibians and reptiles), with particularly strong interests in amphibians, lizards and snakes. This is Professor Holman's second book in the 'Life of the Past' series published by IUP, following a book on the fossil snakes of North America (2000). The subject matter of this book is relatively narrow and clearly circumscribed, but it is covered in quasi-monographic form. The book is divided, rather unequally, into three principal chapters: 'Introduction', 'Systematic Accounts' and 'Chronological Accounts', with some valuable supplementaries in the form of a short epilogue, references and indexes.

In short this is an excellent and comprehensive account of the state of our knowledge of this important, and often neglected, group of tetrapods. As a group, their characteristics (notably their preference for a proximity to fresh water, and the use of their skin as a respiratory surface and as a water-absorbing agent) renders them very susceptible to environmental change and pollution. As a consequence changes in their relative abundance and diversity can be used as one of many proxies for some of the human-influenced changes to our world today. In many ways the apparently innocuous frog or toad should not be overlooked – would it be fanciful to suggest that we overlook them at our peril? Yet we do! How many of my generation routinely butchered frogs as part of our biology education at school – cheap, easy to get hold of, expendable! And how tragic: frogs (and toads) are a genuine miracle of biological engineering, so complex, so specialized, so highly tuned to their own particular way of exploiting the precarious interface between water and land; how much we youngsters could have learned, if only our teachers had understood and used such knowledge to inspire us.

Professor Holman is just one of those teachers. The 'Introduction' basically takes the reader through the 'points of the frog' much as a veterinarian might lead his enthusiastic, but woefully ignorant, first-year students through the 'points of the horse'. Setting out the anatomy (I only spotted one obvious error!) with some clarity is valuable, because it is an essential preamble to the meat of the book: the systematic section that follows. However, he also prepares the way by outlining some key aspects of anuran (frog and toad) history and summarizes the geological timescale within which their history is being assessed.

The 'Systematic Accounts' is an authoritative review of all known discoveries of fossil anurans from North America. Structured around a generally accepted (albeit provisional) classificatory hierarchy, this section is long and very detailed, and incorporates a considerable amount of Professor Holman's accumulated wisdom on the subject. This chapter is supplemented by a good quality photographic colour montage of the living anurans of North America; while the latter might seem a little indulgent, it does effectively link with the otherwise 'dry' classification quite well because modern anuran species have been identified well back into the Pliocene indicating some quite substantial longevity.

The 'Chronological Accounts' chapter more or less completes his review, but puts the systematic account into a manageable chronological order (dictated by the geological timescale). This clearly illuminates some of the major

problems encountered with this group (small size means fragility and rarity as fossil finds go, so the fossil record is decidedly patchy and accordingly frustrating). The strong implication from this is that if a fraction of the effort and money expended on discovering and documenting dinosaurs (for example) were directed toward the 'insignificant' fossil anurans or herptiles more generally then the rewards would be considerable. A short 'epilogue' allows Professor Holman to illuminate some of the difficulties encountered when studying a group such as the fossil anurans, ending with the equivalent of a defiant "c'mon you lot!"

As must be obvious, I liked this book. It is unified in tone (it has after all only one voice), it is authoritative, and it offers generous and wise counsel. What more could one want I wonder? It deserves to sell in far greater numbers than it undoubtedly will.

David Norman

JACKSON, I. (ed.) 2004. *Britain Beneath Our Feet. An Atlas of Digital Information on Britain's Land Quality, Underground Hazards, Resources and Geology.* vi + 114 pp. Keyworth: British Geological Survey. Price £5.00 (paperback). ISBN 085272479 9.
doi:10.1017/S0016756805240785

Britain Beneath Our Feet is an index atlas to the vast amount of digital information now available on Britain's land quality, underground hazards, resources and solid geology. However, the data base does also extend offshore so the 'beneath the feet' is interpreted in a much more useful wider sense to cover most of the UK Exclusive Economic Zone of more than 850 000 square kilometres.

The base data range from bedrock and surface geology to structure and geophysical information. Many aspects of hydrogeology from groundwater levels to contamination are becoming increasingly important in these small crowded isles. Several are intimately linked to growing hazards as pressure for new housing encroaches upon floodplains and old water meadows. Recent and future climate change is making hazard assessment increasingly important for insurers as well as the insured. And recent building on flood prone land is not far from a national scandal. How was permission granted when the flood assessment information has been available? I suppose that we should at least be grateful that earthquake hazards are low in the UK but, as the maps here show, they are by no means absent.

The resource section covers the traditional industrial materials, from coal and metallic minerals to sand and gravel as well as oil and gas. The website details (www.bgs.ac.uk/georeports) are pretty technical but the atlas provides very useful general maps and introductions for students.

Douglas Palmer

FLEET, M. E. 2004. *Rock-Forming Minerals. Volume 3A: Sheet Silicates: Micas*, 2nd ed. (eds DEER, HOWIE & ZUSSMAN). xxi + 758 pp. London, Bath: Geological Society of London. Price £125.00, US $209.00; members' price £62.50, US $104.00; AAPG members' price £75.00, US $125.00; hard covers. ISBN 1 86239 142 4.
doi:10.1017/S0016756805250781

The first edition of Deer, Howie & Zussman's *Rock-Forming Minerals* was published in 1962 to provide a 'reference useful to advanced students and research workers in the geological sciences'. That understated expectation has been fully realized in the intervening years. Professor Fleet's wonderfully comprehensive, revised and updated Volume 3A of the second edition of *Rock-Forming Minerals*, dealing with the true and brittle micas, was published by the Geological Society of London in 2003. Volume 3B, concerned with the interlayer-deficient micas, is to be published separately. That the second edition of Volume 3 (*Sheet Silicates*) is split into two parts clearly reflects the expansion of research in the earth sciences during the intervening years. However, the major sub-section headings used in the first edition for the treatment of each mineral or mineral group have been retained in Volume 3A, and also in those volumes of the second edition already published.

Cation ordering is common in the sheet silicates and modern spectroscopic studies, now so well summarized under the sub-sections 'Optical and Physical Properties', have critically complemented the X-ray and neutron diffraction results discussed in the 'Structure' sub-sections. For example, ^{29}Si NMR studies on Si–Al^{iv} ordering in muscovite reveal that ordering is present in local domains. Diffraction, however, depends upon the coherence associated with long-range order and so does not indicate that the $[AlSi_3O_{10}]$ structure has a major Si_2Al next nearest-neighbour component. It is regretable that ^{29}Si and ^{27}Al MAS–NMR spectroscopy has not been possible for natural kinoshitalites (Ba–Mg trioctahedral brittle micas) because of their solid solution with phlogopite and the presence of paramagnetic cations. For kinoshitalites, X-ray studies surprisingly have revealed that Si and Al^{iv} are disordered, apparently in violation of Loewenstein's avoidance principle. However, ordering within individual tetrahedral sheets, in combination with disorder caused by random stacking faults perpendicular to (001), seems to explain the diffraction data.

Modern single crystal X-ray diffractometers reliably collect large amonts of information for comparative structural studies. However, unless careful preliminary investigations are made, weak reflections, perhaps indicative of cation ordering as in rose muscovite and ephesite, may be missed.

Volume 3A covers both new and older work on mica polytypes and appropriately points out that the origin of polytypism 'remains controversial'. The lack of high resolution crystal structures, due to the unsuitability of complex mica polytypes for single crystal studies, has 'frustrated' the confirmation of polytype theories.

The first edition of *Rock-Forming Minerals* has long been a valuable source of chemical analyses and the structural formulae of minerals. The tables of chemical data in the new edition are impressively comprehensive and this will ensure that 'Deer, Howie & Zussman' will continue to be a key reference for mica chemistry.

Professor Fleet's '*Micas*' represents such an impressive achievement that to remark upon its non-standard usage of 'sheet' and 'layer' seems mean. However the accepted practice is to refer to 'tetrahedral' and 'octahedral sheets' and to an assemblage of sheets as a 'layer'.

In his Preface to the Second Edition, Professor Fleet comments that micas are actively researched in chemistry, physics, engineering sciences and agricultural sciences. His comprehensive work will support and provide stimulation to all with an interest in micas.

P. G. Slade

SELLEY, R. C. 2004. *The Winelands of Britain : Past, Present & Prospective.* x + 109 pp. Dorking: Petravin. Price £10.00 (paperback). ISBN 0 9547419 0 0.
doi:10.1017/S0016756805260788

As the author notes, 'geologists have studied the relationship between geology and viticulture for many years, with all the collateral conviviality that such demanding research entails'. It is surprising, then, that this is the first book to look at the vineyards of Britain from the perspective of an Earth scientist. And it is two gently delivered scientific threads that run through the volume: the twin influences of geologically controlled landscape and of changing climate on the location of British vineyards.

The first part of *Winelands of Britain* is an historical review of viticulture in Britain, from its pre-Roman origins and its Roman revival, through its acme during the Medieval Warm Period and its decline into the Little Ice Age. In part two, Selley outlines the geological controls on the location of British vineyards, and reviews their rapidly expanding footprint on the map of England and Wales. Part three reviews the causes and progress of global climate change and how any future warming might allow further northward expansion of the British winelands. This material is well-researched, lucidly described and adequately illustrated, so that the geological reader will feel better informed about growing grapes, and the wine enthusiast will have absorbed a smattering of geology and climatology.

A climatologist might point out that, before global warming permits vineyards on the shores of Loch Ness, it is perhaps more likely that a weakening in the Gulf Stream will put an abrupt halt to all of future British viticulture. This person will have missed the point of the book. Dick Selley has written as much to entertain and provoke as he has to educate. By editing and publishing the book himself he has been able to retain a trickle of asides and witticisms that should have kept even our sceptical climatologist amused. A Health and Safety analysis of English wine, the yields of medieval vineyards measured in Bm/pa (Benedictine monks satisfied per annum), the information that a Saxon's wine container of choice was a goat's scrotum: these and other jests allow us to share the author's enthusiasm for geology and wine on the cordial level that he intended. This modestly priced book is a diverting read for a winter evening, and the perfect accompaniment for a bottle of English or Welsh wine. Cheers!

Nigel Woodcock

KARATO, S. 2003. *The Dynamic Structure of the Deep Earth. An Interdisciplinary Approach.* xi + 241 pp. Princeton, Chichester: Princeton University Press. Price £24.95 (hard covers). ISBN 0 691 09511 6.
doi:10.1017/S0016756805270784

This book is concerned with the recent progress made in understanding the Earth's deep interior through observation, theory and experiment. Karato is an acknowledged expert in the field and in writing this book he has made this diverse and complex subject accessible to anyone. When I agreed to review this book, I had anticipated dipping into it in places, assessing the overall layout, and generally just making sure it had an appropriate amount of relevant science as indicated by its title. I started reading it and was, at first, somewhat taken aback by its lack of international breadth – familiar European deep Earth 'icons' failed to appear in either the index or bibliography, which is dominated by those from the United States and Japan. Furthermore, I was disturbed by what appeared to be lack of proof reading, which led to some irritation and confusion. However, these shortcomings were soon forgotten: this book turned out to be a veritable 'page turner' and I found myself having to read it all, every page. The book unfolds as a story – albeit a story according to Karato, as unashamedly indicated in the preface – but a story none the less which is relatively easy to follow and as exciting as any I have read on the deep Earth. Sections are introduced with an historical setting so that the reader can follow how we have come to understand our deep Earth, and we are then gently taken by the hand into the realms of speculation about many complex unanswered questions such as the fate of subducted slabs and the origin of deep earthquakes. This book should, therefore, be a first port of call for anybody wanting more than just an introduction to the Earth's deep interior; Karato conveys his enthusiasm and evident understanding through every page.

It is the nature of the subject that some aspects of the book are more understandable than others; this difficulty is addressed by clearly set out chapters with more detailed boxes, giving the reader the choice as to the level of depth in which to go without necessarily getting bogged down in detail. The book discusses how seismology, mineral physics and geodynamic modelling are the fundamental tools with which to understand the Earth. The structure essentially follows that of the Earth 'top down', from the mechanics of the crust through to the dynamics of the inner core in six chapters. The first chapter introduces the structure of the Earth in terms of seismology, composition, temperature and rheology. The second chapter discusses the lithosphere and asthenosphere and the important role water plays in defining the brittle and ductile behaviour of the rocks in these regions. The third chapter deals with seismic tomography and the hot and cold regions of the Earth through slow and fast seismic wave velocities and how these may be related to composition. The fourth chapter looks at mantle convection and the fate of subducting slabs, and the fifth at the origin and mechanisms of deep earthquakes. The final chapter introduces the core, explaining how the magnetic field may be generated and discussing the importance of the inner core. This inspirational book, therefore, should be read by any scientist with an interest in our current state of understanding of the deep Earth.

Lidunka Vocadlo

SECKBACH, J. (ed.) 2004. *Origins. Genesis, Evolution and Diversity of Life.* Cellular Origin and Life in Extreme Habitats and Astrobiology Series. xxxi + 707 pp. Dordrecht, Boston, London: Kluwer. Price Euros 255, US $281, £176 (hard covers). ISBN 1 4020 1813 4.
doi:10.1017/S0016756805280780

'Are we alone?' This is the question that may come to predominate the science of our new century, as is evident from the vigour of the nascent discipline of astrobiology (or, if you prefer, bioastronomy, or even xenobiology). A cynical definition of this area is 'the study of things that do not

exist', but even if the question of extra-terrestrial life, and especially intelligence, is never satisfactorily answered, the theme of astrobiology has the immediate benefit of drawing upon strands of science as diverse as infra-red astronomy, microbial ecology and molecular biology, not to mention planetary missions and palaeontology.

As the field of astrobiology burgeons, so necessarily does the literature. This hefty volume is an important marker of present progress, and is the sixth in a series dealing in cellular origin and life in extreme habitats and astrobiology. With 40 chapters, it has all the advantages and disadvantages of such compilations. Thus it covers an enormous range of topics, and in a few cases the inclusion of the chapter seems almost arbitrary. So too the tenor encompasses everything from hard, pragmatic science to somewhat philosophical contributions which in places verge on the woolly. The advantages, however, include a topicality and a constant reminder of the many exciting frontiers under active investigation.

In this volume the emphasis is very much on the questions of the origin of life and bacterial evolution, especially the remarkable extremophiles. These are organisms, mostly prokaryotic, which bask in temperatures above that of boiling water (the present confirmed record is an astonishing 113 °C, and higher temperatures are claimed), flourish under extreme pressure, and enjoy conditions of extreme acidity and high alkalinity. These extremophiles have not only caught the imagination of biologists because of their mind-boggling tolerances, and often using mechanisms that are imperfectly understood, but also because if the earliest history of the Earth was very hot, subject to massive bombardment and dotted with acidic hot springs or alkali pools, then the extremophiles may well give us some glimpses as to the nature of early life. It is not surprising, therefore, that a key area of discussion is the temperature of the early Earth and the extent to which the most primitive life was adapted to such conditions. High surface temperatures and the first life being thermophilic is, at the moment, very much the orthodoxy, and here it receives support in an interesting analysis by Lineweaver & Schwartzman who propose a 'phylogenetic thermometer', that is a direct correlation between temperature tolerance and phylogenetic depth. Yet, the evidence of a hot, early Earth is by no means universally accepted. In their chapter Vincent and co-workers take the radically opposite view of a cool, even Snowball, Earth, where life was not located in seething hydrothermal systems but in the interstices of ice.

This divergence of opinions also has a central bearing on the origin of life. The attractions of the hydrothermal systems are well known, and much energy has been expended in recent years in studying the early evolution of metabolic cycles and formation of protocells in this environment. In this volume the story continues, with for example Matsuno's study of the behaviour of fatty acids and amino acids in a hydrothermal setting, with the potential key steps of the synthesis of peptides (and ultimately proteins) and lipid vesicles. Yet, problems remain. One of the most influential thinkers, Deamer, stresses how the formation of amphiphilic vesicles, plausible prototypes for the cell, is greatly constrained by temperature, as well as ionic concentrations. Interestingly, the latter constraint places a major question mark over a marine setting for the origin of life. In fact, forming stable membranes suitable for a proto-cell is hedged in by many specific requirements, and it is important to note Deamer's view that hyperthermophily must be a secondary adaptation rather than being primitive.

Students of the origin of life have long been aware of the immense difficulties in making progress. A key difficulty is the stability of many key molecules. Thus not only is it difficult to envisage lipid vesicles forming in hydrothermal environments, but key molecules involved in the construction of DNA are highly unstable at elevated temperatures. The attraction of any icy beginning is obvious, even if heterodox. But the difficulties do not stop there. In the context of the origin of life, one cannot help being struck by the number of scenarios presented, each implicitly so plausible. Yet equally striking is their sheer incompatibility and the ready employment of escape clauses when the argument begins to falter. Navarro-González & Segura, for example, conjure up the neglected possibilities of a volcanic environment with respect to the properties of the ash and energy from eruption-generated lightning. Yet, in the following chapter Tervahattu and colleagues explore the radically different possibility of aerosols (and bubbles) as the starting point of life. So, volcanoes or the surface of the oceans, if not clouds? Perhaps neither, as Negron-Mendoza & Ramos-Bernal return to the ever-popular possibilities of clay minerals, an area made famous by such luminaries as Bernal and Cairns-Smith. But as ever, there are snags. In the case of clays it is the awkward fact that the absorption of bio-organic compounds drops to effectively nothing in mildly alkali conditions. Unfortunately, that was probably the pH of the primitive ocean. Negron-Mendoza & Ramos-Bernal promptly appeal to 'natural microenvironments that attain higher acidities' (p. 187). Quite so, but all the relevant chapters on the origin of life show how the entire area is dogged by incomplete arguments and special pleading.

Apart from serving as a series of dispatches from the front line this book has two particular advantages. First, it contains a number of excellent reviews, including those by Seckback & Oren (on extremophiles), Campins *et al.* (on cometary water and the implications for supply to the early Earth), and Castenholz (on ultra-violet radiation and bacteria). So too there are more specialist contributions on both bacteria, notably alkalithermophiles (Kevbrin *et al.*), permafrost microbes (Soina & Vorobyova), and chemolithotrophs (Amils *et al.*) as well as metabolic systems (e.g. iron reduction mechanisms, by Lovley) and membrane structures (König *et al.*) in bacteria. The thorny problem of bacterial phylogeny is addressed by Gupta, where it appears that the distribution of so-called indels (i.e. a characteristic insertion or deletion in the DNA) offers dramatically improved resolution.

In conclusion, this book is a must for all students of astrobiology, but its size is matched by its cost, and regrettably even libraries will be hard-pushed to purchase this volume.

Simon Conway Morris

OPPENHEIMER, C., PYLE, D. M. & BARCLAY, J. (eds) 2003. *Volcanic Degassing.* Geological Society Special Publication no. 213. vi + 420 pp. London, Bath: Geological Society of London. Price £100.00, US $167.00; members' price £50.00, US $84.00; AAPG members' price £60.00, US $100.00 (hard covers). ISBN 1 86239 136 X.
doi:10.1017/S0016756805290787

The past decade has led to considerable advances in our understanding of the origin and behaviour of volatiles in magmas and the processes involved in magma degassing.

New techniques to measure the composition and flux of volcanic gas emissions have been developed and a much improved understanding of their environmental impact has been gained through studies of active degassing volcanoes and past volcanic eruptions.

Geological Society Special Publication no. 213 provides a useful and comprehensive collection of 23 papers devoted to many of the key areas and recent discoveries concerning the origin of magmatic volatiles, degassing processes, the measurement of volcanic gas emissions and the characterization of the impact of these emissions on the environment. The publication had its origin in a two-day 'Flagship Meeting' of the Geological Society in October 2001 on 'Origins, emissions and impacts of volcanic gases' held in memory of Peter Francis, one of the pioneers of volcanic gas remote sensing. The book is divided into four parts arranged by the editors into a well-ordered and logical sequence. This traces volcanic gas from its magmatic source to release into the atmosphere and the environmental impact when deposited at the Earth's surface.

Part I (Magma degassing: models and experiments) contains five papers. It opens with a review of the dynamics of magma degassing and its effect on magma transport and eruption dynamics (Sparks). The following four papers present petrological experiments on volatile abundances in arc magmas and their implications for degassing processes during volcanic eruptions (Scaillet & Pichavant), water diffusion experiments on potassic magmas (Freda *et al.*), measurements of volatile abundances in volcanic clasts from Plinian and dome-building eruptions (Villemant *et al.*) and a thermodynamic model for volatile saturation in silicate melts (Moretti *et al.*).

In Part II (Characterizing volcanic emissions), the emphasis shifts to the techniques to measure and characterize the composition, mass and flux of volatile emissions. The six papers encompass the classic petrological approach using volatile abundances in melt inclusions trapped in volcanic phenocrysts to estimate volatile release during flood lava eruptions in Iceland (Thordarson *et al.*), direct sampling and analysis of particles from volcanic plumes (Obenholzner *et al.*), ground-based and satellite remote sensing techniques to measure volcanic gas and ash emissions (McGonicle & Oppenheimer; Gerlach; Carn *et al.*) and rainwater and ash leachate analysis as proxies for volcanic plume chemistry (Edmonds *et al.*).

The five papers of Part III (Field investigations of degassing volcanoes) present case studies of degassing volcanoes such as Soufrière Hills, Montserrat (Young *et al.*), Mount Erebus, Antarctica (Wardell *et al.*), Póas, Costa Rica (Vaselli *et al.*), Popocatépetl and Colima, Mexico (Varley & Taran) and Etna, Italy (Burton *et al.*). These aim to characterize degassing processes and the composition and flux of volcanic gases, fumaroles and hot springs at actively and passively degassing volcanoes representing a broad spectrum of volcanic behaviour and eruption style.

The last section, Part IV (Atmospheric, climatic and environmental impacts of volcanic emissions), contains seven papers. These give detailed discussions of the climatic and environmental impact of tropospheric and stratospheric volcanic gas emissions at local, regional and global scales (Stevenson *et al.*; Textor *et al.*; Grainger & Highwood; Horrocks *et al.*; Blake; Delmelle). In the final paper (Grattan *et al.*), an evaluation is made of the human health effects in Europe following the 1783–84 Laki eruption in Iceland.

On the whole, *Volcanic Degassing* is well presented and illustrated, editorially well organized and of the highest scientific standard. Its contents are remarkably diverse and the list of authors who contributed to this book is impressive compared with many other multi-authored symposium-type volumes, in which the selection of authors, the diversity and the substance of papers are often uneven. In this respect, this publication is a very welcome exception, providing a balanced compilation of specialized and more 'general' papers, each written and peer-reviewed by recognized authorities in the various fields and covering many of the major issues in the observation and modelling of volcanic degassing and its atmospheric and environmental consequences. The editors and contributing authors have brought together a timely summary of recent discoveries and developments in the study of volcanic degassing and an outlook on future research opportunities and directions. The book is a valuable resource that should appeal to professional volcanologists, experimental petrologists, atmospheric scientists, advanced students and anybody working in the field of volcanic degassing. Published within the Geological Society's prestigious Special Publication series, this book will be a widely cited addition to the literature on volcanic degassing.

Ralf Gertisser

SÁNCHEZ-VILLAGRA, M. R. & CLACK, J. A. (eds) 2004. *Fossils of the Miocene Castillo Formation, Venezuela: Contributions in Neotropical Palaeontology.* Special Papers in Palaeontology no. 71. 112 pp. London: The Palaeontological Association. Price £48.00 (paperback). ISBN 0 901702 82 X.
doi:10.1017/S0016756805300781

This is a relatively short volume (112 pages) comprising eight articles on various members of the Miocene 'fauna' of Venezuela. The material includes decapod crustaceans, a variety of bony fish, a gavialoid crocodile, turtles, an astrapothere, some xenarthran remains and fragments of a toothed whale. This is a valuable set of accounts that draws attention to a less-well-studied part of the world; however these contents are relatively narrow and specialist, and would attract a correspondingly narrow readership. As with all Palaeontological Association publications the quality is of a generally very high standard.

David Norman

KRONK, G. W. 2003. *Cometography. A Catalog of Comets. Volume 2: 1800–1899.* xiii + 837 pp. Cambridge, New York, Melbourne: Cambridge University Press. Price £120.00, US $185.00 (hard covers). ISBN 0 521 58505 8.
doi:10.1017/S0016756805310788

I have a soft spot for catalogues. Perhaps it is because I have been involved in the production of several comprehensive listings myself. I suspect, however, that there is more than a little of the 'nerd' in all of us. Nevertheless, there is something immensely satisfying about plucking a book from the shelf, knowing that it contains the information you are seeking urgently, in an easy-to-find format.

This is the second of an anticipated four-volume series documenting the discoveries of comets down the ages. It is an

ambitious attempt to catalogue all recorded comets through history. Volume 1 was published in 1999, and documented comets from ancient times (the oldest recorded was 674 BC) up until 1799 (nearly two and a half thousand years). It is a greatly expanded version developed out of an earlier work by the same author entitled *Comets: A Descriptive Catalog* that was published in 1984. Volume 2 (1800–1899) is 274 pages longer than Volume 1, yet covers a period of only a hundred years. This leaves the size of subsequent volumes (3 and 4) a matter of considerable speculation. In the last ten years, with the birth of sophisticated comet detecting and documenting technology, one wonders whether the project is actually achievable.

To the uninitiated the title of the book could be slightly misleading. The title derives from Alexander Pingré's classic compilation of comets, *Cometographie*, published in two volumes in 1783 and 1784, respectively – essentially, a kind of 'biography' of comets and their discoverers. Even though photographic techniques have been used to document comets since 1892, seven years within the scope of *Cometography Volume 2*, the book lacks photographs. A small observation, but one that might disappoint purchasers who bought the book sight unseen on the assumption that it did.

Following a brief introduction to the history of comet discovery, entries in the main body of the work, the Catalog of Comets, are arranged chronologically in order of comet discovery. No separation is made between long- and short-period comets. Each entry contains the comet identification, the date of discovery, the last time it was seen, when it was closest to Earth, and its calculated path. A section on the history and observation of each comet is followed by orbital elements, absolute magnitude, and references. Three appendices cover uncertain objects and mistaken identities, periodical abbreviations, and source abbreviations used in the catalogue. Finally there are excellent person and comet designation indexes.

For people like me, who are involved in Planetary Science, but who are not astronomers, this book is a boon. Comet nomenclature is neither friendly, nor memorable. The only question that hangs over any catalogue concerns the veracity of the information it contains. No doubt there are omissions and inaccuracies, and the 'cometocracy' will nitpick, but on my part the sheer volume of information contained in this book far outweighs any pedantry.

The old comet catalogues are now either no longer available, or may be bought only at astronomical expense from antiquarian bookshops. *Cometography Volume 2* contains a wealth of historical facts. Irrespective of whether you are a professional or amateur astronomer, historian, or planetary scientist, *Cometography* is a very useful work of reference.

Alex Bevan

MARTIN, M. 2004. *Deserts of the Earth. Extraordinary Images of Extreme Environments.* 371 pp. London: Thames & Hudson. Price £35.00 (hard covers). ISBN 0 500 51194 2.
doi:10.1017/S0016756805320784

This large format picture book qualifies I guess as a coffee-table book. It certainly is a kind of 'ooh look at that' book full of stunning pictures by the German photographer Michael Martin, ranging from smiling Bedouin children to scowling Mongolian ones along with lots of shots of sand dunes and the odd volcano. I imagine that most of the pictures are destined for photo libraries and will be seen many times again in picture books.

There is a good coverage of many of the world's deserts, mostly the hot ones, although some of the high and cold Asian and South American ones do get a look in. As with so many such illustrated books, scientifically it is extremely frustrating. There are pictures for which one would love to have more information, such as a shot of high dunes just inland from the Mauritanian coast. The photo caption just says 'far inland the dunes are covered with shells' and it is clear from the picture that they are marine glycimerids (p. 257).

If only this amount of time, effort and money to produce a beautiful book could also have a scientifically informative or even interesting text. Martin is apparently a geographer by training and has enlisted the help of some academics to help 'beef up' the latter part of the text with essays on desert life, landscapes and exploration. No doubt the publishers would argue that if it had a more scientific 'bent' then it would not sell in big enough numbers to cover the outlay let alone make money. Inevitably the book is trying to appeal to everyone, *National Geographic* style, and that controls the tone and content. At the price it is a bargain if you like photographs of people and landscapes.

Douglas Palmer

SELDEN, P. & NUDDS, J. 2004. *Evolution of Fossil Ecosystems*. 160 pp. London: Manson Publishing. Price £39.95 (hard covers), £19.95 (paperback). ISBN 1 84076 040 0; 1 84076 041 9 (pb).
doi:10.1017/S0016756805330780

This is primarily a book about fossil lagerstätten, those sites of exceptional preservation where, for one reason or another, the usually savage processes of decay and destruction have been slowed and allowed soft-bodied and poorly mineralized, or otherwise delicate, organisms to enter the fossil record. In 'normal' conditions these organisms are guzzled by scavengers and bacteria, and physically destroyed by abrasion. It is well known, therefore, that the fossils found in the vast majority of sedimentary rocks are but a small selection of the organisms that lived in the area at the time of deposition and that this record is massively biased, for example towards those organisms with robust shells, to smaller organisms which are more easily buried, to faunas which inhabited marine rather than terrestrial settings. There is also the realization that many sedimentary units present us with a time-averaged and transported assemblage of organisms which never lived together either in time or space. It is a gloomy outlook for those of us who are interested in palaeoecology. Lagerstätten present us with precious opportunities to see a more complete census of the organisms living at a given time and place.

Selden & Nudds have produced a book that introduces the reader to fourteen major lagerstätten from around the world. They are arranged in stratigraphic order. We start logically enough at the celebrated sandstone deposits of the Ediacaran Hills which revealed to the world the remains of large, multicellular organisms which resemble jellyfish, worms and putative echinoderms and arthropods (although other interpretations are possible) from the Late Precambrian of Australia, before moving on into the iconic Burgess Shale of British Columbia together with its fascinating

fauna where the normal Cambrian fauna of trilobites and brachiopods is joined by a plethora of weird worms and more delicate arthropods. Further along still we meet the magnificent icthyosaurs of the Jurassic Holzmaden Shale from Germany, and later into another German classic, the Solnhofen Limestone (also Jurassic in age) that gave up *Archaeopteryx*. And so we move on up through the geological column culminating with a chapter on the insects and spiders trapped in Baltic amber and finally to the wide variety of animals that stumbled into the tar pits of Racho La Brea in what is now Los Angeles during the Upper Pleistocene. Each chapter has the same layout. After a brief introduction that spells out the significance of the fauna in question, there is a brief history of the discovery, and a discussion of the stratigraphic setting (including very useful locality maps) and taphonomy of the sites, before entering a description and illustration of many of the most important and fascinating members of the biota. There is some description of the likely palaeoecology and then, very usefully, a comparison with some other coeval, and often less well known, exceptionally preserved biotas. Finally each chapter provides a useful list of up to date publications.

Many of the particularly well known lagerstätten, for example the Ediacaran Hills, the Burgess Shale and the Solnhofen Limestone, have been studied extensively and a number of whole books have been written discussing them and their significance. Of course a book such as this can only scratch their surfaces. It does, however, provide a good introduction to the issues from where the student can start their further researches, helped on their way by the up to date reference list. Other sites have received far less 'public' attention, and similar coverage and explanation of the Soom Shale with its giant conodont animal and Grès à Voltzia with its fantastic spiders and horseshoe crabs and the introductions to these will be particularly welcome. It is a shame, however, that other extremely important lagerstätten get little or no mention. A case in point is the Chengjiang lagerstätten of southern China. This Lower Cambrian site has yielded a procession of tantalizing arthropods and deuterostomes. Yet there is relatively little on this deposit written for the general geological audience and so it is disappointing that the coverage here is restricted to three paragraphs and no illustrations of the fauna.

In general the chapters are well written although there are odd points which appear sloppy. I do not think that the authors meant quite what they wrote in the Introduction when they stated that 'only' 15% of organisms are preserved; I think they mean 15% of taxa. Similarly I am not sure that it is helpful to refer to cyanobacteria as blue–green algae. Each chapter is plentifully illustrated by a range of line drawings and photos of actual fossils. The multi-colour location maps are particularly welcome. Most of the specimen photographs are truly excellent, but some of those in the Mazon Creek chapter are distinctly substandard. There is a very helpful Appendix which deals with the sites one by one giving lists of museums where it would be possible to see examples of fossils from each (although it does not say whether they are on public display or deep within dusty vaults) and further details about the actual localities. There is responsible advice about the need for permission to visit or collect at many of the localities and pointing out that it is illegal to buy and export fossils from Brazil without appropriate authorization.

So far so good, but I have to confess that I am puzzled about the title of this book, *Evolution of Ecosystems*. Nowhere in this book is the term ecosystem defined and there is no real discussion of how ecosystems may have evolved at all. My understanding of the term ecosystem is the consideration of how members of biological communities interact with one another and with their physical environment. Lagerstätten by their very nature sample something rather different. The vast majority of the cases illustrated in this book involve individual organisms being transported into some hostile environment where their preservation potential was enhanced by the lack or at least reduced level of biotic activity. The Burgess Shale animals appear to have been transported and buried in a low oxygen environment, whilst storms washed both marine and terrestrial creatures into the hypersaline lagoon at Solnhofen. More often than not, the organisms are not preserved in their own physical environment and, however excellent the preservation may be, the sampling is never complete; we know that there are no very small organisms preserved in the Burgess Shale and there are few pelagic taxa there. Even if we were to assume that these deposits did give us an insight into real ecosystems (and at least they do provide a detailed look at the kinds of animals that might have lived together) there still is no real commentary on how these systems may have actually evolved.

In summary, this book provides a generally well illustrated, up to date account of most of the key lagerstätten, giving interested students and enthusiasts a good entry to the vast literature on exceptional preservation which has emerged in the last two decades. It does not, however, tell us much detail about ecosystems.

Liz Harper

HOU XIAN-GUANG, ALDRIDGE, R. J., BERGSTRÖM, J., SIVETER, DAVID J., SIVETER, DEREK J. & FENG XIANG-HONG. 2004. *The Cambrian Fossils of Chengjiang, China. The Flowering of Early Animal Life.* xii + 233 pp. Oxford, Malden, Carlton: Blackwell Publishing. Price £60.00 (hard covers). ISBN 1 4051 0673 5.
doi:10.1017/S0016756805340787

There can be few livelier, and sometimes acrimonious, areas in palaeontology than the Cambrian 'explosion', and the debates that accompany the evidence for a sudden irruption of animal life about 550 million years ago. Oddly enough, to some investigators this event is little more than a figment of our imagination, at least in terms of evolution. From this perspective there is an 'explosion', but it is one of fossils and simply the result of the sudden removal of taphonomic barriers otherwise unconducive to fossilization. The view of what is effectively the opposite camp is that to the first approximation what we see is what actually happened. Nobody is pretending from this latter perspective that the fossil record is perfect, but it is argued it is good enough to derive a history. The arguments surrounding the Cambrian 'explosion', moreover, extend far beyond palaeontology, and it is a sign of its scientific importance that it attracts also the close attention of molecular and developmental biologists.

Scientific progress depends on new data, and for the palaeontologist there can be no more important source of information than the superb soft-part preservation seen in the Burgess Shale-type faunas. The cynosure of these, the Burgess Shale itself, from the Canadian Rockies of British Columbia, has long been a focus of interest, but its pre-eminence is now rivalled, if not exceeded, by the extraordinary new discoveries from around Chengjiang in

Yunnan, South China. With its palaeontological riches the Chengjiang biota provides an apt counterpart to the Burgess Shale. In some respects the biotas are similar, but the differences are even more important. First, Chengjiang is geologically somewhat older. Second, it was located on the South China craton, separate and probably far removed from the Laurentian craton where the Burgess Shale and a number of other comparable lagerstätten were located. Third, the overall environment of deposition in Chengjiang is somewhat different, certainly shallower water and perhaps influenced by proximity to rivers and fresh water. Fourth, and finally, the discoveries from Chengjiang have thrown open even wider our metaphorical 'window' onto the Cambrian marine world. Perhaps the most famous instance was the announcement in 1999 of the earliest known fish, a group that hitherto had been thought to have appeared much later, in the Ordovician.

In this welcome overview Xian-Guang Hou and colleagues introduce some of the wonders of the soft-part preservation of Chengjiang. For the great majority of readers of *Geological Magazine*, this will likely be their first real opportunity, because the previous monographs have all been in Chinese. In format, the book consists of effectively two parts, a set of general introductions and the main body of the text which is a survey of many of the principal players in the Chengjiang biota. To the disinterested reader it will provide much to enjoy, as well as ponder. As in the Burgess Shale arthropods predominate, but also important are such groups as the priapulids (or near relatives) and sponges. So too groups with skeletons are well represented, and in this respect the spectacular soft-part preservation of the brachiopods is particularly impressive. Of all the groups, however, it is the deuterostomes which at present seem to be attracting the greatest attention. Not only are there primitive fish, but arguably more archaic groups such as the vetulicolians and yunnanozoans, both of which continue to excite controversy.

Whilst this book is a welcome addition to the palaeontological literature, it is important to stress that it suffers some drawbacks. The colour illustrations are generally spectacular, but in some cases the quality is disappointing with crucial details difficult to elucidate. The style of descriptions is also variable; some are almost telegraphic whereas others are reasonably extended. For the most part areas of current debate are at least touched upon, although in several cases the stance adopted is dismissive to alternative hypotheses, but without the benefit of sufficient justification. The real problems with this book are two-fold. First, it is over-priced. Second, and more importantly, from the point of view of understanding early metazoan evolution and the central questions surrounding the Cambrian 'explosion' the book hovers in a kind of limbo. Take the arthropods. Here, on the basis of finds in various Cambrian lagerstätten and also continuing breakthroughs in molecular biology, we have seen some sensational developments in the last few years. The arthropods of Chengjiang are clearly going to be central to driving this story forward, and here was a good opportunity to review the current synthesis. Instead, we have a fragmented narrative which lacks either cohesion or an overview.

In conclusion, this is a timely production and one of value to non-Chinese readers. This book can only reinforce our sense of astonishment as to the amazing fossils of Chengjiang, but it is to be regretted that the authors have skirted the hard scientific problems of the Cambrian 'explosion' and the light this Chinese locality will certainly throw on one of the central questions in evolution.

Simon Conway Morris

GASPARIK, T. 2003. *Phase Diagrams for Geoscientists. An Atlas of the Earth's Interior.* xi + 462 pp. Berlin, Heidelberg, New York: Springer-Verlag. Price Euros 149.95 (plus VAT at local rate), SFr 242.50, £105.00, US $ 169.00 (hard covers). ISBN 3 540 00248 0. doi:10.1017/S0016756805350783

Tibor Gasparik has devoted his career to determining the high-pressure, high-temperature phase relations of the geologically important Sodium–Calcium–Magnesium–Aluminium–Silicon (NCMAS) oxide system. This book is his *opus magnum*, summarizing more than 1700 experiments in over 120 figures. Gasparik follows the well-established route of presenting results for the major binary system MgO–SiO_2 before moving on to more complex ternary, quaternary and higher-order systems. There is a section briefly describing piston-cylinder and multi-anvil experimental techniques and the final chapter synthesizes the experimental results into a mineralogical Earth model. In addition, sections describing the thermodynamic basis of the mixing and phase equilibria models are well presented and clearly associated with their respective phase diagrams. This is not, however, an undergraduate text: the thermodynamics sections assume a high level of prior knowledge and some of the latter figures have sacrificed clarity in favor of brevity.

High-pressure experiments are by no means trivial and *Phase Diagrams for Geoscientists* represents a considerable achievement. In particular, sluggish reaction kinetics in dry sub-solidus systems can present a significant problem: smaller grain size increases the likelihood of reaching equilibrium but makes it much harder to perform accurate chemical analysis. Gasparik overcomes this problem by using low melting temperature incompatible melts as a flux for grain growth (normally PbO or V_2O_5). Ideally, these fluxes are incompatible with the silicate phases and so do not alter the phase equilibria of interest. Where they do enter the solid phases they can significantly affect the properties of solid-solutions and hence partitioning behaviour. I therefore find it frustrating that the author has presented just the thermodynamic model fits to his experimental data in most figures, with the experimental data tabulated at the end of chapters, making it cumbersome to assess the accuracy of the models. Similarly, studies by other authors are referenced, but not generally plotted. Results from other, flux-free, studies could provide a reliable test of the effect of contamination by the flux. Iron, the fourth most abundant element in the Earth's mantle, is conspicuous by its absence. Likewise, despite its significance in altering phase relations within the mantle, water receives only two pages in the last chapter. These omissions limit the utility of the book since so much of our modern understanding of the deep Earth stands or falls by partition coefficients or the position of phase boundaries.

Given the above caveats I have found *Phase Diagrams for Geoscientists* to be a useful first port-of-call for finding the *P–T* stability fields of the major silicate phases up to 27 GPa, and I can recommend the book as a reference for geoscientists requiring an overview of the stable phase assemblages in the top 700 km of the Earth.

David Dobson

TUCKER, M. E. 2003. *Sedimentary Rocks in the Field*, 3rd ed. The Geological Field Guide Series. ix + 234 pp. Chichester: Wiley. Price £15.99 (paperback). ISBN 0 470 85123 6.
doi:10.1017/S001675680536078X

This is the third of the six volumes in the Geological Field Guide Series to reach a third or later edition, a testament to the enduring appeal of these compact and informative books. *Sedimentary Rocks in the Field* provides a practical guide to describing and interpreting sedimentary rocks. The level is appropriate to the needs of a second or third year undergraduate student, but the book is also a useful reference for postgraduate and professional geologists.

The text content of the third edition remains much the same as in the second. There are additional sections on GPS techniques and on logging of cores, but otherwise the apparent changes are few. More noticeable is the 25% increase in the number of figures, both photographs and line drawings. The switch from double to single column format has also allowed the reproduction of some figures at a more generous size. However, this attempt to increase the readability of the book is more than negated by the marked decrease in quality of the photographs compared with the second edition. The loss of contrast and brightness looks more like publishing carelessness than misfortune, because a similar quality loss afflicted the photographic figures in the recent new edition of *Basic Geological Mapping* (Barnes, J. W. & Lisle, R. J., 2004) in the same series. Clear photos are central to any guide to identifying rocks, and Wiley must address their technical problems urgently if these books are to continue to fulfil their niche in the market.

Whether by fortune or design, the line diagrams have survived with undiminished clarity in the new edition. The new additions are appropriate and well-designed, particularly those on sequence stratigraphy and sedimentary facies models.

The price of the field guides is increasing with their page count, but they are perhaps still just affordable by individual students embarking on field projects. If the price rises much more, however, the guides will only be available to consult in student libraries and the point of their concise, portable format will have been lost.

Nigel Woodcock

MERRITT, J. W., AUTON, C. A., CONNELL, E. R., HALL, A. M. & PEACOCK, J. D. 2003. *Cainozoic geology and landscape evolution of north-east Scotland. Memoir for the drift editions of 1:50 000 geological sheets 66E Banchory, 67 Stonehaven, 76E Inverurie, 77 Aberdeen, 86E Turriff, 87W Ellon, 87E Peterhead, 95 Elgin, 96W Portsoy, 96E Banff and 97 Fraserburgh (Scotland)*. Edinburgh: British Geological Survey. x + 178 pp. + CD-ROM. Price £40.00 (paperback). ISBN 0 85 272463 2.
doi:10.1017/S0016756805370786

What's in a title? Perhaps naively, I imagine that the title of a scientific work should capture the essence of the book, and this title piqued my interest. NE Scotland is a self-contained land cut off from the rest of Britain by mountains; it has separate cuisine (try skink), language ('fit and fa' for 'what and who') and saints (have you ever heard of Ternan?). Even to other Scots it has a curiously foreign air. Geologically, it is part of the Highlands, but topographically it is distinctly lowland, with deep weathering resulting from nearly 400 Ma of surface exposure. The rich rolling farmlands of Buchan are nearly as devoid of exposed rock as East Anglia, so my preconception of the geology of the area was simple: coastal Dalradian and a lot of soil. Given this background, I was eager to find out what I had missed in the Paleogene and Neogene. I even forgave the precise, but rather precious, spelling of Cenozoic in the title.

Alas, I was to be disappointed, for this is a Quaternary memoir in almost all but name. The warning bells start to ring inside the front cover, where there is an event chart that starts in the Pliocene – with an event in the North Atlantic. The first event on this chart that mentions NE Scotland dates from late in the early Quaternary and is: 'Scottish Highlands probably glaciated'. The first definite event recorded in NE Scotland dates from late in the Middle Quaternary. This event chart prefigures what is to come – in short, the title promises Cainozoic; the meat seems to be Quaternary (18 of 137 text pages cover Paleogene and Neogene: 13%).

However, once I had come to terms with my middle-aged grumpiness, I greatly enjoyed this memoir, which is handsomely produced and well illustrated. It is divided into eight chapters: a summary of the geological history of the area; a review of the applied geology, covering resource exploitation, engineering geology and environmental geology; a short chapter on landscape evolution; another short chapter reviewing Paleogene and Neogene weathering and soil development; two long chapters on Quaternary history and Quaternary deposits; a section on geomorpological features; and finally a chapter on Quaternary lithostratigraphy and correlation. There is a CD-ROM with three appendices and a complete, searchable, PDF version of the memoir in the rear pocket. The five authors and six 'contributors' have managed a remarkably even style, and the text is clearly written and very well illustrated. The references are exhaustive, with no major omissions that I could detect.

In my view the best chapters in the memoir are those covering the landscape evolution and the Paleogene and Neogene history. Both are masterly reviews, dealing clearly with one of the hardest problems in geology – the history of an area with little or no net deposition. The Quaternary chapters were interesting, and gave a very useful review of the development of ideas on the glaciation, although the large number of maps with subtly varying arrows started to resemble drafts of a plan for world conquest by a mad dictator. Some minor quibbles: I did not understand why the chapter on Quaternary stratigraphy was separated from that on Quaternary deposits, as you have to jump back and forth between the two to get the full picture. I would also suggest that there is no need these days to number plates separately from figures, especially since they are not on separate pages. The bibliographic information on the CD-ROM differs from that on the title page of the book.

The real joy of this memoir is in the appendices, which contain clearly written, well illustrated accounts of all the major localities, together with detailed information on the bulk resources and results of shallow geophysical surveys. The PDF version of the memoir is easily searched, and will be a valuable research resource. In summary: a valuable work, well written, well presented and well worth buying. Just don't be misled by the title.

David Macdonald