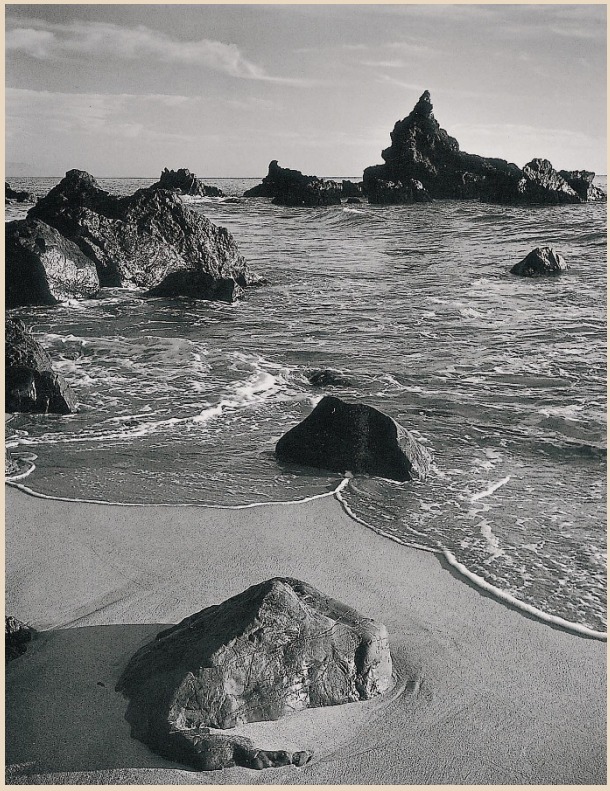
premiums, along with many more escape clauses. As a result, the vulnerable will decreasingly be protected by a commercial sector that cannot afford to be charitable. Crisis nongovernmental organizations will be left to pick up the pieces while governments wring their hands in passive culpability.

The inescapable conclusion is that climate-change politics are embedded in institutions whose survival is dependent on an economy and ideology that create climate change. Gelbspan reveals this tragic truth with candid clarity. Don't look to Kyoto for salvation. But do look to a more aggressive and politicized science that draws on the moral underpinnings of humanity for its message. □

Tim O'Riordan is at the School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK.

Celebration of light and landscape

Many rarely seen images by the renowned Californian photographer Ansel Adams are reproduced in a new book edited by Andrea G. Stillman. "One of the first things I noticed about California was the quality of the light," writes Stillman. "It was almost palpable, as if you could reach out and touch it. It was light that inspired Ansel to photograph, and it was his preternatural feeling for light that made his work approach the sublime. He worked almost exclusively at dawn or sunset; the rest of the time he found the light too flat, the forms of the landscape dull and uninteresting." The pictures in *Ansel Adams California* (Little, Brown, $50) are accompanied by writings about the state by classic and contemporary authors from Robert Louis Stevenson to Jack Kerouac.



From cats to computers

Quantum Technology
by Gerard Milburn
Unwin: 1997. Pp. 188. £7.99 (pbk)

An Introduction to Quantum Theory
by Keith Hannabuss
Oxford University Press: 1997. Pp. 380. £35, $65

Interpreting the Quantum World
by Jeffrey Bub
Cambridge University Press: 1997. Pp. 298. £35, $49.95

Alastair I. M. Rae

Gerard Milburn's *Quantum Technology* aims to explain and indeed celebrate the practical achievements that have emerged from our greater understanding of quantum physics in recent years. He manages to do this without employing a single mathematical expression, but instead uses a skilful combination of verbal arguments and diagrams.

The fundamental ideas of quantum mechanics are explained in a chapter on "Quantum Roulette" in which the quantum principle of combining probabilities is compared and contrasted with the laws of classical probability. After this follow five chapters, each on a different aspect of the new technology.

The use of Doppler cooling and magnetic traps to isolate and hold still single atoms is the subject of one of these. Initially, one is tempted to wonder what is particularly quantum about this example — certainly, it relies on the existence of atomic energy levels and radiation pressure and all these are quantum to some extent, but no more than many everyday phenomena (sodium street lamps, for example). But Milburn demonstrates how an ability to control atoms at this level can lead to the performance of atom interference experiments and the potential, at least, to use these to do lithography and construct devices at an atomic length scale.

The last and perhaps most exciting chapter is on the "Quantum Computer". Milburn provides a crystal-clear description of the "square root of NOT" which is an essential step along the way and explains how one such device might control the other, although at this point he talks about measurements that are apparently reversible — surely a quantum heresy!

I think I just about understand how a quantum computer could be used to perform operations that are impossible in principle in any conventional computer — which is an advance over anything else I have read in this area, including articles by David Deutsch who was responsible for the invention of the principle.

More detail about the type of technological barriers to the realization of a quantum computer would have been welcome and, although it would have been a departure from his technological theme, Milburn could also have indicated how the parallel calculations performed by a quantum computer can be interpreted as circumstantial evidence for the many-worlds view of quantum mechanics.

Keith Hannabuss's *An Introduction to Quantum Theory* is a textbook based on lectures given to second- and third-year mathematics students at the University of Oxford, England.

The first five chapters introduce wave mechanics and include the solution of the Schrödinger equation for the hydrogen atom and quantum-mechanical tunnelling. The more formal theory is then developed, assuming a prior knowledge of vector space theory; fairly standard treatments of topics such as angular momentum and many particles follow, and the book ends with a chapter on the Dirac equation.

Although the author claims that his treatment is less than rigorous, it is considerably more advanced than that taught to many undergraduates. The coverage is quite conventional on the whole and comparable with that in Dirac's own classic text, but Hannabuss brings his treatment up to date with sections on coherent states and squeezed light. An interesting, but rather difficult, chapter on symmetry in quantum theory covers material more commonly met in postgraduate courses.

Students who master the contents of this book as undergraduates would have considerable advantages over many of their contemporaries if they moved on to research in theoretical or mathematical physics.

As is common nowadays, Hannabuss's book contains a chapter on "Measurements and Paradoxes". This includes a treatment of Bell's theorem and the Schrödinger cat problem, but somehow I don't think the author's heart is really in it.

This is particularly true of the end of the chapter where his criticism of the decoher-

ence interpretation of quantum mechanics omits the central criticism that even if there are no correlations, the standard probability interpretation still has to be put in 'by hand'. He also fails to explain why it has led many people to take the Everett relative state theory more seriously, realizing that the central feature of this theory is not so much the splitting of the Universe as its potential for reunification in a future interference experiment.

No-one could accuse Jeffrey Bub of not taking the conceptual problems of quantum mechanics seriously. His authoritative book *Interpreting the Quantum World* makes no attempt to address a general audience, but consists of deep and detailed consideration of most, if not all, current thought in this area.

Many technical results are described and proved in detail. Bub clearly understands the Everett theory, but does not accept it. He explains David Albert's argument leading to apparent inconsistencies between different predictions of the answer an observer (Eve) would make to a questioner (Adam) about whether she has a definite belief about the result of the observation of the polarization state of a photon.

But I do not believe that Bub and Albert have properly taken on board the effects of decoherence, which explains why the classical states provide a preferred basis for this description. It seems to me that this inevitably makes it impossible in practice for Adam to address his question to the whole of Eve's mental state rather than to the branch of it in which he himself exists. I wonder whether similar considerations will not also form an insuperable barrier to the practical realization of a quantum computer.

It is probably no surprise to those who know about Bub's work that he ends up defending hidden-variable theories similar to those invented by David Bohm, with whom Bub started his research career. But I detect no trace of the "implicate order" beloved by the later Bohm, so I hope that Milburn would include this book in the subset of such texts that he describes as "quite excellent" in contrast to others that "invoke time-worn mysticism, both western and eastern". □

Alastair I.M. Rae is at the School of Physics and Astronomy, University of Birmingham, Birmingham B15 2TT, UK.

Related books

Mathematical Undecidability, Quantum Nonlocality and the Question of the Existence of God edited by Alfred Driessen and Antoine Suarez. Kluwer, $160, £95. Contains Paul Davies' acceptance lecture for the 1995 Templeton Prize.

The Message of the Atoms: Essays of Wolfgang Pauli and the Unspeakable by Kalervo V. Laurikainen. Springer, $42, £26. Philosophical basis and implications of the Copenhagen interpretation of quantum mechanics.

At a glance

Excellent ★★★★ Good ★★★ Fair ★★ Poor ★

Radioactive and Stable Isotope Geology

by H.-G. Attendorn and R. N. C. Bowen
Chapman and Hall: 1997. Pp. 522. £95, $174.95

Isotopic methods today crop up in every branch of modern Earth sciences and can elucidate countless processes that have shaped the Earth throughout its history, as well as making possible the dating of geological events. Here is a conscientious attempt to summarize the general principles of isotope geology as well as methods and techniques available for radioactive isotope dating, stable isotope abundance studies in the biosphere, and isotopic studies of terrestrial and planetary lithospheres.

The book is updated from an earlier version published in 1988. Because of the wide coverage, each section can provide only a basic introduction to principles and applications, and not all sections show the same critical insight. The reference list is not particularly exhaustive or up to date.

The descriptive density of the text and the overall paucity of illustrations may motivate prospective researchers to seek out more specialized textbooks and review articles.

The book is therefore recommended primarily for science libraries and laboratory reference shelves.

Stephen Moorbath *Department of Earth Sciences, University of Oxford, Parks Road, Oxford OX1 3PR, UK.*

Range	★★★★
Depth	★★
Accuracy	★★★
Up-to-dateness	★★
Accessibility	★★★
Style	★★★

Paleontological Events: Stratigraphic, Ecological, and Evolutionary Implications

edited by Carlton E. Brett and Gordon C. Baird
Columbia University Press: 1997. Pp. 604. $65, £52

Over the past 150 years, many groups of fossils have been used to establish a detailed biostratigraphy for Phanerozoic time. Biozonal schemes can achieve temporal subdivisions as short as 0.5–1.0 million years for strata as old as the Silurian period (417–443 million years ago) using the extinct graptolites. But is this the best that can be achieved, given the nature of the fossil record?

This multiauthored volume shows that renewed understanding of short-term 'catastrophic' episodes has recently opened the way to the possibility of such geologically 'instantaneous' events being recognized by fossil biomarkers.

Storms, earthquakes and volcanic eruptions all produce particular effects on land, different ones on the continental shelf and yet others in deeper marine basins.

The essays show how an understanding of the processes and effects of short-term events in different depositional environments are helping to pinpoint such events in Lower Palaeozoic rocks in North America.

Douglas Palmer *31 Mawson Road, Cambridge CB1 2DZ, UK.*

Range	★★
Depth	★★★
Accuracy	★★★
Up-to-dateness	★★
Accessibility	★★★
Style	★★★

The Colours of Life: Introduction to the Chemistry of Porphyrins and Related Compounds

by Lionel R. Milgrom
Oxford University Press: 1997. Pp. 249. £22.50, $95

"Porphyrins: molecules for all seasons" comes to mind as an alternative title for this book. The thesis that porphyrins permeate nature is sustained by seven chapters ranging from the origin of the Solar System and abiotic synthesis of porphyrins to their use in cancer therapy and possible application in molecular electronics. What other book would cover subjects as diverse as Kant–Laplace theory, anti-aromaticity and the Peierls transition?

The porphyrin–oxygen duet is the book's centrepiece. First we learn that the high oxidation potential available in PSII chlorophyll made possible the evolution of oxygen (a terrific pollutant which must have brought an end to much of early life).

Then we see how oxygen handling by haemoproteins made the full energy of reduced carbon compounds available so that aerobes could evolve. And, finally, we discover that the photophysics of singlet oxygen sensitization by porphyrins which nature struggled to suppress in photosynthesis is used, ironically, to our advantage in photomedicine.

The chemistry along the way is elaborate, engaging and presented with unusual insight.

What is the price for exploring porphyrin chemistry on geological to photophysical timescales in 249 pages? Not too high: certain details about photosynthesis are confused and the latest information in the final chapter on "Porphyrins for the future" is about four years old.

Thomas A. Moore *Department of Chemistry and Biochemistry, Arizona State University, Tempe, Arizona 85287-1604, USA.*

Range	★★★★
Depth	★★★★
Accuracy	★★★★
Up-to-dateness	★★★★
Accessibility	★★★★
Style	★★★★

ence interpretation of quantum mechanics omits the central criticism that even if there are no correlations, the standard probability interpretation still has to be put in 'by hand'. He also fails to explain why it has led many people to take the Everett relative state theory more seriously, realizing that the central feature of this theory is not so much the splitting of the Universe as its potential for reunification in a future interference experiment.

No-one could accuse Jeffrey Bub of not taking the conceptual problems of quantum mechanics seriously. His authoritative book *Interpreting the Quantum World* makes no attempt to address a general audience, but consists of deep and detailed consideration of most, if not all, current thought in this area.

Many technical results are described and proved in detail. Bub clearly understands the Everett theory, but does not accept it. He explains David Albert's argument leading to apparent inconsistencies between different predictions of the answer an observer (Eve) would make to a questioner (Adam) about whether she has a definite belief about the result of the observation of the polarization state of a photon.

But I do not believe that Bub and Albert have properly taken on board the effects of decoherence, which explains why the classical states provide a preferred basis for this description. It seems to me that this inevitably makes it impossible in practice for Adam to address his question to the whole of Eve's mental state rather than to the branch of it in which he himself exists. I wonder whether similar considerations will not also form an insuperable barrier to the practical realization of a quantum computer.

It is probably no surprise to those who know about Bub's work that he ends up defending hidden-variable theories similar to those invented by David Bohm, with whom Bub started his research career. But I detect no trace of the "implicate order" beloved by the later Bohm, so I hope that Milburn would include this book in the subset of such texts that he describes as "quite excellent" in contrast to others that "invoke time-worn mysticism, both western and eastern". □

Alastair I.M. Rae is at the School of Physics and Astronomy, University of Birmingham, Birmingham B15 2TT, UK.

Related books

Mathematical Undecidability, Quantum Nonlocality and the Question of the Existence of God edited by Alfred Driessen and Antoine Suarez. Kluwer, $160, £95. Contains Paul Davies' acceptance lecture for the 1995 Templeton Prize.

The Message of the Atoms: Essays of Wolfgang Pauli and the Unspeakable by Kalervo V. Laurikainen. Springer, $42, £26. Philosophical basis and implications of the Copenhagen interpretation of quantum mechanics.

At a glance

Excellent ★★★★ Good ★★★ Fair ★★ Poor ★

Radioactive and Stable Isotope Geology

by H.-G. Attendorn and R. N. C. Bowen
Chapman and Hall: 1997. Pp. 522. £95, $174.95

Isotopic methods today crop up in every branch of modern Earth sciences and can elucidate countless processes that have shaped the Earth throughout its history, as well as making possible the dating of geological events. Here is a conscientious attempt to summarize the general principles of isotope geology as well as methods and techniques available for radioactive isotope dating, stable isotope abundance studies in the biosphere, and isotopic studies of terrestrial and planetary lithospheres.

The book is updated from an earlier version published in 1988. Because of the wide coverage, each section can provide only a basic introduction to principles and applications, and not all sections show the same critical insight. The reference list is not particularly exhaustive or up to date.

The descriptive density of the text and the overall paucity of illustrations may motivate prospective researchers to seek out more specialized textbooks and review articles.

The book is therefore recommended primarily for science libraries and laboratory reference shelves.

Stephen Moorbath *Department of Earth Sciences, University of Oxford, Parks Road, Oxford OX1 3PR, UK.*

Range	★★★★
Depth	★★
Accuracy	★★★
Up-to-dateness	★★
Accessibility	★★★
Style	★★★

Paleontological Events: Stratigraphic, Ecological, and Evolutionary Implications

edited by Carlton E. Brett and Gordon C. Baird
Columbia University Press: 1997. Pp. 604. $65, £52

Over the past 150 years, many groups of fossils have been used to establish a detailed biostratigraphy for Phanerozoic time. Biozonal schemes can achieve temporal subdivisions as short as 0.5–1.0 million years for strata as old as the Silurian period (417–443 million years ago) using the extinct graptolites. But is this the best that can be achieved, given the nature of the fossil record?

This multiauthored volume shows that renewed understanding of short-term 'catastrophic' episodes has recently opened the way to the possibility of such geologically 'instantaneous' events being recognized by fossil biomarkers.

Storms, earthquakes and volcanic eruptions all produce particular effects on land, different ones on the continental shelf and yet others in deeper marine basins.

The essays show how an understanding of the processes and effects of short-term events in different depositional environments are helping to pinpoint such events in Lower Palaeozoic rocks in North America.

Douglas Palmer *31 Mawson Road, Cambridge CB1 2DZ, UK.*

Range	★★
Depth	★★★
Accuracy	★★★
Up-to-dateness	★★
Accessibility	★★★
Style	★★★

The Colours of Life: Introduction to the Chemistry of Porphyrins and Related Compounds

by Lionel R. Milgrom
Oxford University Press: 1997. Pp. 249. £22.50, $95

"Porphyrins: molecules for all seasons" comes to mind as an alternative title for this book. The thesis that porphyrins permeate nature is sustained by seven chapters ranging from the origin of the Solar System and abiotic synthesis of porphyrins to their use in cancer therapy and possible application in molecular electronics. What other book would cover subjects as diverse as Kant–Laplace theory, anti-aromaticity and the Peierls transition?

The porphyrin–oxygen duet is the book's centrepiece. First we learn that the high oxidation potential available in PSII chlorophyll made possible the evolution of oxygen (a terrific pollutant which must have brought an end to much of early life).

Then we see how oxygen handling by haemoproteins made the full energy of reduced carbon compounds available so that aerobes could evolve. And, finally, we discover that the photophysics of singlet oxygen sensitization by porphyrins which nature struggled to suppress in photosynthesis is used, ironically, to our advantage in photomedicine.

The chemistry along the way is elaborate, engaging and presented with unusual insight.

What is the price for exploring porphyrin chemistry on geological to photophysical timescales in 249 pages? Not too high: certain details about photosynthesis are confused and the latest information in the final chapter on "Porphyrins for the future" is about four years old.

Thomas A. Moore *Department of Chemistry and Biochemistry, Arizona State University, Tempe, Arizona 85287-1604, USA.*

Range	★★★★
Depth	★★★★
Accuracy	★★★★
Up-to-dateness	★★★★
Accessibility	★★★★
Style	★★★★