BOOKS & ARTS

The many faces of carbon

An enticing new book ties together the vital roles this element has in life, the Universe and climate change, explains **John Meurig Thomas**.

The Carbon Age: How Life's Core Element Has Become Civilization's Greatest Threat
by Eric Roston
Walker & Company: 2008. 304 pp. $25.99

Eric Roston is a journalist and science writer who covered the 9/11 attacks as a reporter for *Time* magazine. In his fascinating book *The Carbon Age*, Roston weaves together the story of the element carbon, mining his facts largely from electronic research databases, particularly Google Scholar. Providing for the layman the 'connective tissue' of a vast array of subdisciplines — encompassing anthropology, astrophysics, biotechnology, genetics, geology, mathematics, nuclear synthesis, nucleic acids, nanotechnology, palaeobotany, phylogeny and more — this US-centric monograph is a success, especially in dealing with climate change.

Roston's approach calls to mind the Christmas lectures given by Michael Faraday at the Royal Institution of Great Britain in 1848–49, and again in 1860–61, entitled "The Chemical History of a Candle". Faraday used the candle example as a door opening onto many other areas of science: "so wonderful are the varieties of outlet which it offers into the various departments of philosophy. There is not a law under which any part of this Universe is governed which does not come into play, and is touched upon in these phenomena."

Carbon, rather than a candle, takes centre stage in Roston's attentions: its creation by nuclear synthesis in the stars, its assimilation by our planet, the generation of carbon dioxide and myriad other phenomena. Through a better understanding of these processes, he argues, we may comprehend the nature of the Universe we inhabit and find clues to overcome the problems that humans have created that bring us to the brink of global crisis.

Roston's fluent writing can be pleasing, no more so than in the chapters entitled 'CO_2 and the Tree of Life' and 'The Potential of Biological Fuels', and in his prologue. He deals lyrically with the chemical systems of the ginkgo tree, the living symbol of survival through extremes of conditions and time. However, the book contains too many US slang terms, such as "gazillions", and the text is replete with anthropomorphisms, such as "the enmity between hydrogen molecules and helium atoms". There are some oversimplifications — it is surely better to describe isotopes in the conventional manner rather than to say misleadingly that "the sum of protons and neutrons are called isotopes".

Yet *The Carbon Age* makes a compelling case concerning solutions to the problems of climate change. "Industry needs to find a way to live inside the biosphere," Roston writes.

D. SEWELL/PANOS

"Scientists are only beginning to understand biochemistry enough to find possible answers to our energy and climate crises within it." He also summarizes well the beautiful work of Frances Arnold at the California Institute of Technology, Pasadena, on the directed Darwinian evolution of proteins and carbohydrates, in which she is finding ways to convert cellulose efficiently into the biofuel, butanol.

Roston has an eye for historical perspective, as when he quotes from the evocative 1995 novel *The Rings of Saturn*, in which German émigré author W. G. Sebald visits the United Kingdom and asks how its forests, particularly at Dunwich in Suffolk, have been ravaged owing to man's preoccupation with burning. "From the earliest

Burning down the house

Global Catastrophic Risks
Edited by Nick Bostrom and Milan Ćirković
Oxford University Press: 2008. 550 pp.
$50, £25

Eschatology, the study of how and when the world will end, has always grabbed attention, but perhaps never more so than now. Disaster movies play out our fear of our own extinction following a massive comet impact or cataclysmic volcanic super-eruption. The market for books on doom, gloom and disaster has never been so buoyant, nor so crowded — 148,000 titles on the online book shop Amazon contain the word "catastrophe".

A new addition to the genre is *Global Catastrophic Risks*, a weighty, academic tome edited by Nick Bostrom, aptly hailing from the University of Oxford's Future of Humanity Institute, and Milan Ćirković, a professor of cosmology at Serbia's University of Novi Sad. Eschewing a tight focus, Bostrom and Ćirković pull together 23 chapters covering the complete spectrum of events that could severely damage our world and civilization. They consider the philosophical, psychological and financial aspects of global catastrophic risks, and address the usual suspects of asteroid impacts, volcanic megablasts, plague and pandemic, and nuclear war. They also touch on more exotic potential terminations at the hands of over-enthusiastic nanobot replicators, by the anthropogenic creation of exotic matter such as black holes or strange particles, or through the rise of belligerent artificial intelligence.

As an eschatologist's almanac, the book works well, providing a mine of peer-reviewed information on the great risks that threaten our own and future generations. Yet the book is unbalanced, devoting just three chapters to natural catastrophes of global reach. Unlike technological catastrophes such as nuclear terrorism or rampant biowarfare, which may never happen, the long-term probability of occurrence of natural cataclysms such as comet impacts and volcanic super-eruptions is 100%.

More disturbing still is the downplaying of contemporary climate change, the greatest threat facing our planet, covered in a single chapter. In the editors' view, "global warming commandeers a disproportionate fraction of the attention given to global risks." Yet they also observe that "a wise person will not spend time installing a burglar alarm when the house is on fire". When your house is burning down, surely you use all the means at your disposal to put the fire out. The lack of immediate concern doesn't end there. In an otherwise insightful foreword, Martin Rees, president of the UK Royal Society,

Carbon dioxide concentrations must drop if natural disasters caused by climate change are to be prevented.

times, human civilisation has been no more than a strange luminescence growing more intense by the hours, of which no one can say when it will begin to wane and when it will fade away", Sebald ponders. "For the time being, our cities still shine through the night, and the fires still spread." These words prompt Roston to declare that "we as individuals and as a society, as nations and as species are deciding that our lifestyle is more important than its continuity".

Vivid and important passages pertaining to colourful or pioneering individuals, notably the astronomer Fred Hoyle, are well presented. In retrospect, it is clear that Hoyle should have shared the Nobel prize in physics with William A. Fowler for his contribution to the synthesis of elemental carbon from the fusion of three helium nuclei. As well as Faraday, Roston highlights lesser known, loner scientists, such as Guy S. Callender, who realized in 1938 what was later confirmed by and credited to Charles Keeling in 1955 — that man-made CO_2 contributes to global warming. Although Roston mentions the important work on greenhouse gases by Svante Arrhenius in 1896 and John Tyndall in 1860, he does not discuss Joseph Fourier's pioneering studies in 1827.

Roston states the oft-repeated but erroneous claim that the 1985 study of carbon-60, or buckminsterfullerene, became "a founding moment for the nanotechnology movement". Not so. The contributions of Richard Feynman in 1958, Norio Taniguchi in 1974, Eric Drexler in the 1980s, and the coming of cluster science and new microscopic techniques all lay greater and prior claim. In the petrochemical industry, for example, supported nanocatalysts consisting of just a few atoms of platinum were used industrially 15 years before the carbon-60 frenzy. Even the advocacy of nanotechnology by former US president Bill Clinton takes higher priority, in influence, than buckminsterfullerene in the pervasive talk of the nanoworld.

The Carbon Age contains some minor infelicities, yet its many fine attributes win out: it is teeming with unexpected information and is a grand tour of the Universe. ■

John Meurig Thomas is professor of solid-state chemistry at the Department of Materials Science and Metallurgy, University of Cambridge, Cambridge CB2 3QZ, UK. He is author of *Principles and Practice of Heterogeneous Catalysis*.
e-mail: jmt2@cam.ac.uk

deems that the main downsides of climate change lie "a century or more in the future", whereas the authors of a chapter on the threat from cosmic rays persist with the discredited idea that "current global warming may be driven by enhanced solar activity". Neither statement stands up to scientific scrutiny.

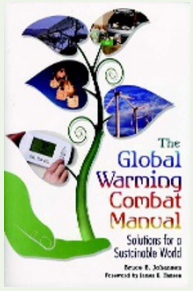
If we are to evaluate future global threats sensibly, we must distinguish between real and projected risks. We should consider separately events that are happening now, such as anthropogenic climate change and the imminent peak in the oil supply, other events that we know with certainty will occur in the longer term, notably asteroid and comet impacts and volcanic super-eruptions, and extrapolated risks, such as those associated with developments in artificial intelligence and nanotechnology, which are largely imagined.

Any ranking exercise of global threats must put contemporary climate change and peak oil firmly in the first two places. Yet the latter is not even mentioned in *Global Catastrophic Risks*. Crystal-ball gazing and horizon scanning are warranted to avoid unexpected future shocks, but these efforts should not come at the expense of ignoring the severe threats that are already staring us in the face. Closing our eyes to dangerous climate change and fast-dwindling fossil fuels will bring about a failing society that is not equipped to address any other major threats, natural or anthropogenic. To return to Bostrom and Ćirković's analogy: a mushroom cloud may hang over the distant horizon and nano-goo may be oozing in our direction, but we still need to douse the flames wrought by climate change and peak oil if we are to retain for ourselves a base from which to tackle such menaces, when and if required. ■

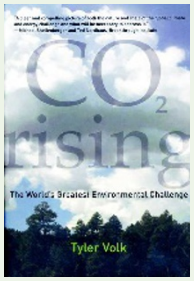
Bill McGuire is director of the Benfield UCL Hazard Research Centre, University College London, Gower Street, London WC1E 6BT, UK. He is author of *Seven Years to Save the Planet*.
e-mail: w.mcguire@ucl.ac.uk

CRISIS READING

Books on natural cataclysm, often climate-induced, are in vogue. Two books, Bruce Johansen's *The Global Warming Combat Manual* (Praeger, 2008) and Bill McGuire's *Seven Years to Save the Planet* (Weidenfeld & Nicolson, 2008), seek to make readers more environmentally aware.



McGuire explains how our homes can be made more energy efficient and our holidays greener. He recommends draconian measures to reduce China's greenhouse-gas emissions, and highlights the battle over crops for biofuels and for food production. *The Global Warming Combat Manual* discusses climate-driven changes in US environmental policy and practice. By describing recent switches — the increasing use of wind power in Texas, for example — and emerging technologies and trends, Johansen lays out a range of solutions for minimizing climate change.



CO_2 Rising by Tyler Volk (MIT Press, 2008) explains the carbon cycle in detail. Volk describes how evidence of past changes in carbon dioxide levels is obtained and interpreted, before discussing recent increases brought about by our use of fossil fuels.

Edited by Kurt Campbell, *Climatic Cataclysm* (Brookings Institution Press, 2008) looks beyond the findings of the Intergovernmental Panel on Climate Change (IPCC) to the consequences of expected, severe or even catastrophic climate change, and to what national and international organizations can do now to prevent future threats.

Dire Predictions by Michael Mann and Lee Kump (Dorling Kindersley, 2008) is an illustrated guide to the IPCC reports. Running through the scientific evidence, conclusions and key figures behind these influential reports, the book explains the latest thinking on climate science to a general reader.

Jenny Meyer