

successfully warns us that almost everywhere are human artefacts that will be with us for a long time — plastics, for example — making things ever more complex.

These and many other good leads are in *The World Without Us*, but their placing is incoherent. There is not going to be an Earth without us. So excluding us from some of it and reducing our impacts elsewhere is an important part

of a discussion that this book could do a lot to facilitate. Perhaps the broader vision — the missing introductory and final chapters it so clearly needs — could be added on a related website. ■

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Degrees of change

Six Degrees: Our Future on a Hotter Planet

by Mark Lynas

Fourth Estate: 2007, 384pp, £12.99

Stefan Rahmstorf

This book is not for the faint-hearted. British writer Mark Lynas ventures where few scientists would dare to tread. He sets out to answer the question that many of us climatologists ponder in private and often get asked by journalists, but usually shy away from answering: what will it really be like to live on a warmer planet? In Lynas's words: "Will we all, as some environmentalists suggest, be reduced to eking out a living from shattered remains of civilization in Arctic refuges, or will life go on much as before — if only a little warmer?"

Lynas sets out to answer this systematically on the basis of his extensive reading of the scientific literature. He has spent many months in Oxford University's Radcliffe Science Library trawling through thousands of papers. The result is arranged in six chapters, one for every degree Celsius of potential global warming. His statements are referenced throughout, and, as a palaeoclimatologist, I was familiar with fewer than half of the 500 or so papers he cites. That is the nature of scientific specialization: few researchers could afford the time for such a wide-ranging literature review.

One of the best aspects of *Six Degrees* is that it pulls together data from past climate changes in Earth's history to get an idea of what a warmer climate might look like. The often dramatic natural climate changes of the past are sometimes cited by those opposed to reducing greenhouse-gas emissions as evidence of why we need not worry about the ongoing warming. But the latest Intergovernmental Panel on Climate Change (IPCC) report (www.ipcc.ch), which contains a 65-page chapter reviewing the main palaeoclimatic findings, shows that the first lesson from the past is that Earth's climate system is very sensitive. It has always responded strongly to natural changes in Earth's energy budget — the balance between the absorbed incoming energy from the Sun and the outgoing long-wave (thermal) radiation from Earth. So we have every reason to believe that it will respond strongly again to the growing

perturbation to the radiation balance that humans are now causing. *Six Degrees* hammers home the second lesson to be drawn from the past: mega-droughts or sea-level changes of tens of metres accompanied past cooling and warming episodes of similar magnitude (albeit probably not as rapid) as that expected this century.

I have my quibbles with some of Lynas's interpretations and there is the odd error, but such complaints seem petty in view of the overall achievement and importance of this book. Lynas avoids the obvious pitfall of cherry-picking the most dramatic possibilities; *Six Degrees* is alarming but not alarmist. He tries to give a level-headed account of what we may expect, mentioning scientific controversies where they exist. For example, he gives balanced discussions about the future of the Sahel region of northern Africa, citing studies that conclude that global warming may end the ongoing drought there, and about the risk of a shut-down of the North Atlantic Current, to which the new IPCC report assigns a probability of up to 10% this century.

Six Degrees is essentially about risks, because much remains uncertain about the future. My major beef is that he often makes risks sound like truths. After a sensible discussion of amplifying feedbacks from the carbon cycle and methane release, in which he states how uncertain and hard to quantify these still are, he then claims that three degrees Celsius of warming "inexorably leads to four degrees, which leads inexorably to five". Even a small risk of this happening is bad enough, without making it sound so definite.

Lynas, who is not a natural scientist, must be highly commended for basing his book thoroughly on science — more so, in fact, than some popular books on climate change written by scientists. Gloomy as his story sounds, in some cases he may even be too optimistic. The possibility of violent conflict in regions struck by drought and food shortages is only mentioned in his three-degree-warming chapter. A recent report by the German Advisory Council on Global Change (www.wbgu.de/wbgu_jg2007_engl.html) sees this risk arising much sooner.

The book ends with a lucid description of the state of denial about climate change that humanity is still in (but hopefully now emerging from), and a good account of the policy options available to us to stop global warming. Lynas is interested in leaving the reader ready for action, rather than depressed.

Lynas is a gripping story-teller, making the book infinitely less tedious than the papers it is based on. A must-read for those who can stomach it. ■

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Climate change will bring water shortages to many regions, but it may end ongoing drought in others.