

two volumes are nothing less than a blueprint for how to shove *Homo sapiens* off centre-stage in evolution's endless play. □

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Affecting climate in a second-best world

Human Choice and Climate Change, vols 1–4

edited by Steve Rayner and Elizabeth L. Malone

Battelle: 1998. 1,714 pp. \$250, £150 (hbk); \$100, £60 (pbk)

Paul Ekins

If the importance of climate change is related to the quantity of words that have been written about it, these volumes would suggest it is easily the most significant of contemporary environmental issues. *Human Choice and Climate Change* runs to four volumes and 1,400 pages of text, with chapters that stretch up to 80 pages and have well over 100 references each.

This ambitious project aims to present an alternative view of climate change to that provided by the Intergovernmental Panel on Climate Change (IPCC) — which, of course, has also been responsible for some weighty tomes. The questions underlying the IPCC approach may be characterized as: Is anthropogenic climate change occurring and how might it develop? What might be the impacts on ecosystems and human societies? How should human societies, and the international community, respond?

Human Choice and Climate Change, in contrast, starts with such questions as: How do scientists choose to study climate change and form a scientific consensus? How do people attribute blame for climate change and choose solutions? How are climate-change policy instruments chosen? Why and how did the international community choose to address climate change?

These questions make it clear that *Human Choice and Climate Change* treats the issue of climate change more as a social construction than as a natural-science phenomenon. Its authors occupy a spectrum of acceptance of what the IPCC natural scientists say about climate change. At the most sceptical end, one chapter by Michael Thompson and Steve Rayner refers to climate change as part of the “hegemonic myth” of “global vulnerability and fragility”. It suggests that a “potentially implausible hypothesis that human activities will warm the entire planet” has been picked up by the public because of “the lay propensity to attribute changes in weather patterns to human activity” rather than because of any scientific evidence.

At the other end of the spectrum is a chapter by Donald J. Wuebbles and Norman J. Rosenberg presenting the natural science of climate change very much as the IPCC does. Similarly positioned, another chapter assesses the possible impacts of climate change on land and water use, coastal zones and oceans, and on people, and discusses possible response strategies. Another explores how the world's energy systems have developed to their current state, how they might evolve, and the costs involved, as a result both of climate change and of attempts to mitigate it. Another discusses the possibilities, challenges and limitations of integrated assessment modelling. None of these chapters would be out of place in an IPCC report; they all make a useful contribution to knowledge about the issues.

In the last volume the editors try to pull together all the insights and present them in a form that would be useful to people who make policy. The final chapter is even called ‘Ten suggestions for policy-makers’, the project's equivalent to the IPCC's policy-makers' summaries.

One of the main points in this volume is the distinction drawn between two styles of social science: the descriptive paradigm that “analyzes social systems in terms of natural science metaphors” and the interpretive approach that “refers to the analysis of the values, meaning and motivation of human agents”. *Human Choice and Climate Change* contains good examples of both.

Rayner and Malone would like to see more research that seeks to integrate these two approaches, and would clearly recommend this as the basis for the climate-change research programme. Yet, on the evidence of these books, integration of the approaches is too strong an aspiration. The tensions and contradictions between them would make any such union chaotic. The descriptive approach depends on an acceptance of an objective reality that it is trying to describe. The interpretive approach sees the world much more in terms of social construction.

Both may generate insights into the human condition. But each approach calls into question the other's fundamental axioms. The integration of such contrasting styles would be unlikely to be useful even if it were possible.

As for policy-makers, my hunch is that those few of them with the time to read these volumes will be more impressed by the descriptive than the interpretive chapters. The problem with the latter from a policy point of view is that they increase substantially the already formidable uncertainties connected with climate change.

The editors' ten recommendations do not advise policy-makers on how much to reduce emissions, or what policy instruments to use. Rather, they urge them to “view the issue holistically”, “recognise the limits of rational planning” and “employ the full range of analytic approaches and decision aids”. This might be good advice in a policy utopia, but the danger is that, in a second-best world, taking it too literally could bring policy-making to a complete halt. And if the IPCC has got its descriptive science right, that could be a most unfortunate result for the good intentions and high scholarship that have gone into this work. □

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Happy accidents?

The Pattern of Evolution by Niles Eldredge

W. H. Freeman: 1999. 250 pp. \$24.95, £17.95

Mark Pagel

The palaeobiologists who peered into the fossil records in the early part of this century were not prepared for what they saw. Pre-Darwinian palaeobiology had been dominated by the need for explanations consonant with the Creator's plan. The first hint of change came from the geologist Charles

Diversity in danger

Relish the sight of this anglehead lizard while you can. It is one of the 163 species of reptile and more than 510 species of land animals that exist only on the Philippine islands, and which are in grave danger from the

economic pressures on the Filipino people to plunder the precious forest. *Vanishing Treasures of the Philippine Rain Forest* by Lawrence R. Heaney and Jacinto C. Regalado Jr (University of Chicago Press, \$24, £19.25, pbk) describes the richness and vulnerability of this “hottest of all hotspots”.



Lyell, who dismayed sensible people of the 1830s by proclaiming that the natural world was neither static — as God left it — nor young. Later, Darwin proclaimed a wholly material explanation for species, based on the principle of descent with modification. Lyell had opened the door, and Darwin showed God out.

Palaeobiologists flocked to these scientific visions of a world in a constant state of flux and admixture. But instead of finding the slow, smooth and progressive changes Lyell and Darwin had expected, they saw in the fossil records rapid bursts of change, new species appearing seemingly out of nowhere and then remaining unchanged for millions of years — patterns hauntingly reminiscent of creation.

But there was no turning back, and biologists have for the past century fought over how best to explain the diversity of life. Does it arise from the gentle moulding of genes by natural selection, or are there powerful, invisible hands at work that visit revolutionary changes upon the biotic world? Niles Eldredge has for three decades been among the leading voices of dissent against what he regards as a simplistic “ultra-Darwinian” view of the world: that the struggle among genes for reproductive success provides a sufficient explanation for organismic diversity.

The Pattern of Evolution is his passionate account of how he came to that view. Eldredge outlines in a popular style a theory of ‘matter-in-motion’ to entrain biological evolution to the many climatic, geological and even tectonic forces that sculpt the Earth. Eldredge sees their power, inevitability and even occasional cyclicality behind many of the otherwise puzzling patterns that characterize the history of biotic evolution on this planet.

A favourite textbook example is the dinosaurs. Not until they became extinct did the primitive mammals of the time radiate into the diverse forms we know today, including ourselves. Dinosaur extinction may have been an accident — a meteor struck the Earth; ergo, it is argued, we are happy accidents as well. Does this ‘wonderful life’, to paraphrase Stephen Jay Gould, one of Eldredge’s collaborators over the years, derive more than is appreciated from contingency and luck?

Late in the twentieth century we should be asking if a synthesis will ever emerge from this old and decidedly Hegelian conflict of thesis and anti-thesis. Before it does, a ‘third way’ (but not a ‘*neue mitte*’) may demand an accounting. Whole genes can emerge *de novo* from the process of gene duplication. The major groups of animals — such as invertebrates versus vertebrates, or the fish versus the mammals — have different numbers of the important and fundamental Hox genes that determine their very divergent pheno-



George Lyell: contributed to the revelation that the Earth is in a constant state of flux.

types. It is as if the extra genes give rise to the way of life. No one knows how general this is. Perhaps another powerful, stochastic and relentless driving force of evolution resides right inside our genomes. □

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Species without frontiers

Life out of Bounds: Bioinvasion in a Borderless World

by Chris Bright

W. W. Norton/*Earthscan*: 1998. 287 pp.

\$13/£12.95 (pbk)

Harold A. Mooney

The threat of biological warfare has resulted in extraordinary measures by nations to detect and defend themselves against potential weapons of destruction. But inadvertent biological invasions have actually been occurring for centuries, decimating human populations and the crops and livestock upon which they depend. The fundamental driver of this has been the transport of people and their goods, along with biological stowaways, some of which have been benign, others extraordinarily destructive.

For some reason, insufficient attention has been paid to the scale of this interchange, its increasing tempo, and its enormous economic and ecological impact. International commerce has broken down the ancient bio-

geographic barriers that allowed the evolution of the rich biological diversity on which we based our civilizations. The breakdown of these barriers has resulted in a biological scramble of species competing for newly opened resources. This is now happening on a global scale, with serious consequences for the future course of evolution and the number of species that will populate the Earth.

This is pretty dramatic stuff — and yet the forces to counter this tidal wave have not yet been assembled. The first part of the job of resistance is to raise awareness of the problem and of the potential courses of action available to deal with it. Chris Bright has done an admirable job of marshalling the facts and writing about them in a clear and compelling manner.

This book developed from an excellent article he wrote in 1995 for *World Watch*, on the spread of exotic species. Since then, a landmark conference on alien species held in Norway in 1996 has provided new information as well as the beginnings of an international plan to address this complex and urgent issue. Much of this information appears in this well-documented book.

The book is in three sections. First, Bright surveys the geography of invasions and shows that none of the major biotic realms — fields, forests, waters and the special case of islands — is now free of the impact of invaders from other continents. He then describes how the change described by some as the new geological epoch of biological homogeneity, the Homocene, came about. Both intentionally and by accident, human activity has mixed up the biota of the Earth, incurring large economic and environmental costs in the process. Finally, a course of action to deal with this crisis is presented.

In the section on the geography of invasions, Bright provides case after well-documented case of invading species that have had a profound impact on human societies. He describes, for example, the dramatic story of Lake Victoria, which may now be in a state of ‘chronic emergency’ as a result of successive waves of invasive species. The first of these was the Nile perch, introduced in 1962, which drove a couple of hundred native fish species to extinction and indirectly altered the surrounding forested ecosystems as local firewood was used by fishermen to dry the very large Nile perch. These major alterations apparently led to the successful establishment of water hyacinth in 1990. This invader is in turn making the shoreline anoxic, clogging pumping stations and severely affecting fishing activity. It is also apparently increasing the incidence of snail- and mosquito-borne diseases. This chain of events has affected millions of people.

The ‘villain’ species in such cases are either purposeful or accidental introduc-