an international reputation, becoming an honorary member of the Royal Astronomical Society, winning various awards, and earning a salary from King George III. An astronomer in her own right, she stands out among the inspirers, promulgators, assistants and institution-builders.

The implications of any collection are best revealed by the entries that are hardest to classify. Shelley and Herschel, from opposite extremes, indicate the risks of including women by fundamentally transforming the story. Fara urges us to stop telling heroic tales of individual brilliance and show the sciences in their true light, as cooperative projects. To be sure, geniuses have never been 'lone'. But we risk confirming the traditional view that women are capable of collaboration but not brilliance. Does Jane Dee, who oversaw her husband's household, belong in the same collection as Emilie du Châtelet, one of only a handful of people in her generation capable of understanding Newton's *Principia*?

In other words, does this collection implicitly confirm that modern science is fundamentally a masculine philosophy and rationalism the attribute of masculinity? Or is there a different interpretation? Perusing this rich, beautifully crafted book you realize that, assuming that the sciences require both individual insight and community, even when women were continually assigned the latter, they often contributed the former. ■

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Big-game theory

The Kruger Experience: Ecology and Management of Savanna Heterogeneity
edited by Johan T. du Toit, Kevin H. Rogers & Harry C. Biggs
Island Press: 2003. 492 pp. $75 (hbk), $40 (pbk)

Andrew Illius

The Kruger National Park, a strip of bush 60 km wide that stretches 350 km from the tropical northern end of South Africa bordering Zimbabwe and Mozambique to the temperate south, is one of the world's great wildlife reserves. *The Kruger Experience* is not about the experience of being there, which is breathtaking, but about the accumulated experience of the managers and scientists who have worked for a century to conserve and understand it in all its glory. The editors faced the challenge of bringing together more than a hundred researchers and getting them to put their work into a common theoretical framework. The chosen 'cross-cutting theme' is ecological heterogeneity in time and space, and their intention is to unravel the truism that heterogeneity underlies biodiversity and adaptive management. But there is also considerable value in the main body of the work, which is a fascinating compendium of observations on the ecology and management of the savanna biome.

A. BANNISTER/GALLO IMAGES/CORBIS

Burns unit: park rangers use fire to manage the ecology of South Africa's Kruger National Park.

Given South Africa's turbulent political past, the history of Kruger's management can be viewed against the backdrop of the changing socio-political context. Most of Africa's great national parks were established at a time when land use was allocated to suit the economic interests of colonial settlers. The new South Africa takes more seriously the land-rights conflicts that arise between conservation priorities and displaced or neighbouring farming communities. There are now many examples, as in other parts of Africa, of community-based approaches that allow local people some control over wildlife resources in a way that is more beneficial to conservation and sustainable use than strategies that dispossess local people and reduce their access to such resources.

At the outset, management interventions in Kruger were somewhat crude, such as the control of predators and fire, and the establishment of a network of water points, and were intended to increase the opportunities for viewing game. These have now given way to more subtle forms of adaptive management that attempt to recognize the complexities of natural processes within defined conservation objectives.

Fire policy provides a good illustration of the evolution of adaptive management. Fire was initially regarded as something to be avoided, but has since been seen as an integral part of natural savanna systems. Fire suppression then gave way to a policy of prescribed rotational burning in 1956. This command-and-control approach was abandoned in 1992, when it was realized that it had some negative effects and was a poor substitute for the processes by which natural fires drive and respond to vegetation heterogeneity. The next approach, which was intended to reproduce the patterns of frequency, season and intensity under which Kruger's biota evolved, allowed lightning fires to burn but suppressed anthropogenic fires. This led to the park's staff spending more time putting out fires than starting them. A mixed policy has now been adopted, in which all lightning fires are tolerated, and other fires are either started or tolerated only in areas that need to be burnt according to ecological criteria. A thorough-going state-dependent regime derived from the knowledge of how fires affect biodiversity was rejected as being too agricultural for a conservation area.

The ecological effects of establishing water points further illustrate the complexities of nature conservation and the law of unintended consequences. The provision of water was intended to allow game animals to spread into areas that were otherwise inaccessible to water-dependent species in the dry season, and to even out or homogenize vegetation use, but served to increase the number of wildebeest, zebra and their predators. Species that were less dependent on water, such as the roan antelope, now faced increased competition and heightened predation pressure from large carnivores attracted to the wildebeest and zebra. The roan antelope consequently suffered a precipitous decline in numbers, and is now endangered. In addition, the less dominant brown hyena has become extinct since the more dominant large carnivores became more common.

What, then, of heterogeneity? To those who reckon they have a common-sense understanding of heterogeneity, theoretical

treatments of it are something of an acquired taste, and the two fairly heavy-duty chapters here are no exception. Authors of subsequent chapters tend to focus on their specialism, and then say either how important it is for heterogeneity, or vice versa. A few chapters are on subjects sufficiently mature for the authors to really work the theme. For example, those on the ecology and population dynamics of the large herbivore community show how, over scales from biome down to local and from geological down to seasonal, habitat heterogeneity is a driving force in ungulate speciation and abundance, the size-scaling of ungulate assemblies, and the species richness of savannas. This and other examples show that understanding the effects of heterogeneity remains an important part of the research agenda for the future — a fitting tribute to the first century of research in Kruger. ■

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More on South African environments

South Africa's Environmental History: Cases & Comparisons
edited by Stephen Dovers, Ruth Edgecombe & Bill Guest
Ohio University Press/David Philip, $24.95

Social History & African Environments
edited by William Beinart & JoAnn McGregor
Ohio University Press/James Currey, $49.95 (hbk), $27.95 (pbk)

The Rise of Conservation in South Africa: Settlers, Livestock, and the Environment 1770-1950
by William Beinart
Oxford University Press, £65

Mind the gap

The Physiology of Truth: Neuroscience and Human Knowledge
by Jean-Pierre Changeux (transl. Malcolm DeBevoise)
Belknap Press: 2004. 288pp. $45, £29.95, €41.50

David Papineau

Can neurophysiology cast any light on the human condition? Books that set themselves this ambition, and there are plenty, are invariably disappointing. The problem is not that we lack information at the neuronal level — a great deal is known about cell receptors, neurotransmitters, re-entrant connections and so on. Rather, the difficulty lies in relating this microscopic knowledge to higher human faculties such as thought, emotion and consciousness.

To get round this, popular-science books by the likes of Francis Crick, Joseph LeDoux or Antonio Damasio typically have the following trajectory. We start with a few chapters on the neuronal nitty-gritty. But then the gears surreptitiously change, and we switch to speculation about the mind's higher powers. However, any serious theorizing at this level tends to be 'boxological', rather than physiological — we are given flowcharts connecting posited brain modules, but there is no bottom-up, cell-level account of how these modules might work.

Perhaps this is unsurprising, given the kind of evidence that is currently available about the large-scale operations of the mind. In recent years, functional-imaging data have been added to findings from studies of brain lesions. But even these new data are at too gross a scale: it is like trying to figure out how a computer works by noting when different bits get hot and what goes wrong when certain parts are broken. With luck, this might give us some idea of where certain operations are located, but it is not going to tell us about the mechanisms that make them possible.

Jean-Pierre Changeux's credentials as a neurophysiologist are outstanding. He has been director of the Unit for Molecular Biology at the Pasteur Institute in Paris for more than 30 years, where he has played a prominent role in understanding allosteric proteins and their relevance to neurotransmitter reception. Nor is Changeux any stranger to popular science writing — his *Neuronal Man* (1983) and subsequent book-length dialogues with other prominent French intellectuals have been great successes in his native country and elsewhere. Nevertheless, his new book, *The Physiology of Truth*, suffers from the typical flaws of the genre. Initial chapters concentrate on neurophysiological signalling and modulation, but by the end the topics are knowledge, culture and the history of science. Interesting points are made at both levels, yet the initial neuronal material seems to shed little light on the later large-scale issues.

Still, the book does have the virtue of suggesting a possible, deeper explanation of why the micro–macro gap may be so hard to bridge. Throughout the book Changeux emphasizes the plasticity of the brain. Significant neuronal variation can be found among even simple organisms such as water fleas, and the brains of monozygotic human twins often exhibit striking differences. Changeux sees this variability as a result of epigenetic selection — the genes provide a general 'envelope' for brain development, but the details depend largely on the selective favouring of some spontaneously formed synaptic connections over others during development.

If this neural darwinism is right, then perhaps it is inevitable that any attempt to identify the neurophysiological mechanisms

Exhibition

Inspired by insects

Observation is key to the work of both artists and scientists. Illustration has been an essential part of scientific research for centuries and the images have often been admired for their aesthetic as well as informative qualities. Not surprisingly, the beauty of biology has also captured the imagination of artists, some of whom borrow scientific techniques as an aid to observation.

Artist Mark Fairnington uses high-definition electron microscopes to photograph insect specimens before he begins to paint them. This enables him to capture on huge canvases minute details of the original, but with subtle manipulations.

Examples of his work, like the mantid depicted here, are on show in *Fabulous Beasts*, an exhibition at the Natural History Museum in London until September 2004. The exhibition also features the work of another artist, Giles Revell, who uses electron microscopy to reproduce majestic monochrome images of common insects. The works of both artists are juxtaposed with specimens from the museum's own vast entomological collection, and a rare glimpse of the first edition of Robert Hooke's *Micrographia*.