

This strategy aims to overcome dispersal barriers, so that species can survive climate change by altering their geographic distributions. Assisted migration is not a panacea, and it has serious risks, but it is an example of a new kind of thinking that we desperately need. We must devise other adaptation strategies to reduce the harmful effects of climate change where they occur.

*Heatstroke* concludes with ideas about how to slow the climate crisis, such as reducing energy consumption. But Barnosky stops short of offering suggestions that match the scale of the biodiversity crisis he has outlined. He could have suggested alternative strategies, and I hope that *Heatstroke* will inspire others to design potential solutions. We should also stop confusing assisted migration with 'Pleis-

tocene rewilding', an idea that Barnosky raises after assisted migration. Rewilding would return ecosystems to their state before historical climatic change by transporting large animals and predators across continents. But rewilding has different goals and potentially greater consequences than assisted migration, and it has muddied the waters for productive debates about such strategies.

After reading *Heatstroke*, I felt the urge to go outside and experience nature at first hand, to develop a deeper appreciation for

the life that climate change threatens. If the public at large could be similarly inspired, there might be hope for positive change. Read this book, and reflect on your own views about humanity's place in nature. Then plant a tree, walk to work, and go and call your political representative. ■

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## Tales of top models

### **Pavlov's Dogs and Schrödinger's Cat: Scenes From the Living Laboratory**

by Rom Harré

Oxford University Press: 2009. 288 pp.  
£16.99, \$34.95

This charming book is entertaining, thought-provoking and frustrating. It is worth reading for all three of those reactions.

Written by the distinguished philosopher Rom Harré, *Pavlov's Dogs and Schrödinger's Cat* is based on the premise that just as scientists interrogate the real world with inanimate equipment such as flasks, telescopes and DNA sequencers, we also do so with animate organisms or their parts. Thus, dogs were the apparatus Ivan Pavlov used to study conditioned responses, Galapagos finches the devices used by Peter and Rosemary Grant to study natural selection, and peas and flies the tools used by

Gregor Mendel and Theodosius Dobzhansky, respectively, to elucidate genetics. The use of organic equipment extends beyond the biological sciences: for a time, frogs' legs and canaries were more sensitive detectors of electricity and carbon monoxide than any machine, and we still explore Earth's climatic history using long-departed organisms. Harré romps through five centuries of vignettes, asking who used these organic tools, why and to what end.

And it is an entertaining romp, partly because it is so well written, and partly because the animals and plants involved generate great stories. Some stories are lovely, such as William Buckland's conclusion from cave bones that the UK county of Yorkshire was tropical before Noah's flood. Some are sad, such as the experiments on filial love and maternal separation in monkeys by Harry Harlow, studies that caused great distress to the animals involved, and that have not stood the test of time. And

some are horror stories — including one of the most gripping and succinct summaries of the Lysenko fiasco in Soviet genetics I have read. The scientific questions that lie behind Harré's stories are often startling; for instance, what are the psychological underpinnings of those who commit genocide? The experimental ingenuity of scientists is sometimes breathtaking, such as Stephen Hales' determination of blood pressure using wax, brass pipes, glass tubes and expiring horses. Despite the brevity of each case study, the scientists emerge as real people, with varying degrees of brilliance and interpersonal skills. As a lucid illustration of the messy, chaotic and glorious professional world we scientists have always inhabited, this book is great.

Yet the book is more thought-provoking than a simple storytelling exercise. It is organized not as a history, nor by scientific subject, but by the principles of the philosophy of science. Chapters are devoted to organisms as detecting and measuring devices, and as tools for exploration, for testing hypotheses and for modelling reality. This organization generates



### **Deadly Companions: How Microbes Shaped Our History**

by Dorothy H. Crawford  
(Oxford Univ. Press, £8.99)

From the origin of the first microorganisms on Earth, Dorothy Crawford describes how microbes have evolved alongside humanity. Showing how they have altered human history, such as through plague or famine, she explains how humanity has affected microbes in return — and why this will never change.



### **Elizabeth Blackburn and the Story of Telomeres: Deciphering the Ends of DNA**

by Catherine Brady  
(MIT Press, \$15.95)

This compelling tale describes the science and politics behind molecular biologist Elizabeth Blackburn's great discoveries. She "emerges as a valuable role model in the sometimes unsettling treatment of women in the world of science", wrote Maria A. Blasco (*Nature* **450**, 613-614; 2007).



an easily digested introduction to many of the key concepts of the philosophy of science. It demonstrates vividly that there is no single way of doing science; philosophers of science are hard pressed to describe what is going on, let alone prescribe what we ought to be doing.

There is another layer too. Harré is obviously troubled by the ethical dilemmas associated with the use of live organisms in science. He argues, quite rightly, that it makes no sense to hold strong views on animal experimentation without having a sound understanding of how science works, of how and why animals have been used, and the unpredictable gains that can result. The book does a terrific job of generating that understanding. Even the inclusion of examples that, at first glance, have little to do with animal experimentation — plants, worms on mounds of methane ice, and virtual animals such as the titular cat and Richard Dawkins' biomorphs — bring into sharp focus issues that are central to the political debate. Harré discusses the merits of inanimate and non-sentient alternatives, and the unpredictable value of generalizing from model organisms.

This book should be compulsory reading for activists who man the barricades, throw the bombs or step up to the microphone. As Harré says, "Only when we have a clear idea of what has been done by whom and for what purpose can we take up the pressing moral questions that must arise."

But then comes frustration. Having provided that "clear idea", Harré doesn't take up the pressing moral questions. He concludes that there are three dimensions to argue about: the extent to which gaining scientific knowledge is an absolute good, the extent to which other living things have inalienable rights, and the extent to which we ascribe mental lives to other things. But then he dodges the bullet, saying "I leave the working out of moral arguments to others more qualified than I am to reach just

and ethically sound conclusions". How much more qualified than Harré can you get?

It is easy to feel that Harré has interesting views that he has not shared. He mentions early on that he has "serious reservations about many projects in which animals have been involved". He hints in two places that experimenting with plants has implications for the animal-experimentation debate. He even says there may be moral issues about working with

virtual organisms. But on none of these does he expand.

Could it be that with animal experimentation, things are so muddy, so difficult, that even a professional philosopher, immersed in the topic and its context, is unable to come to a logically justifiable position? Are the moral issues raised by the scientific use of animals different from those raised by, say, slavery, abortion, euthanasia or the death penalty? They could well be. For the most part, we cannot tell in

advance which areas of scientific knowledge are worth knowing. Nor, for the interesting cases, can we tell whether our instrumentation — animate or inanimate — is up to the game. I think the debate on animal experiments is with us for eternity. ■

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## A billionaire's vision for India

### Imagining India: The Idea of a Renewed Nation

by Nandan Nilekani

Penguin: 2009. 528 pp. \$29.95

Nandan Nilekani's book is a product of the new India. The author, a first-generation, wealthy software entrepreneur, belongs to the iconic trinity of that nation — along with the film star and the cricketer, his words command attention.

On graduating in electrical engineering from the Indian Institute of Technology in Bombay in 1978, Nilekani, unlike many of his classmates, did not emigrate to the United States. In 1981, he and six others pooled US\$250 to start Infosys Technologies, an information-technology (IT) consulting

and service company; its revenue eventually surpassed \$4 billion. Today this company, listed on the US stock exchange and with more than 103,000 employees, has a global footprint.

As Infosys soared, so did the stature of Nilekani. He emerged as one of a new breed of businessmen, blessed by both Lakshmi and Saraswati, the rival Hindu goddesses of wealth and wisdom. He is a role model for young, ambitious Indians. Such is his profile in India that simply emblazoning his face on the cover of the book guaranteed a best-seller.

The various Indian Institutes of Technology, the seedbeds for the technical prowess of Nilekani and his peers, were founded as part of Jawaharlal Nehru's vision. Nehru, India's first prime minister, believed that these state-run institutes, offering quality technical



### Flower Hunters

by Mary Gribbin and John Gribbin (Oxford Univ. Press, \$19.95)

This engaging collection tells the stories of 11 remarkable 'flower hunters' who travelled the globe to discover new plants. It describes the impacts they had on both gardening and science, highlighting the difficulties they experienced on their travels and when trying to propagate the plants they brought back with them.



### Starved for Science: How Biotechnology Is Being Kept Out of Africa

by Robert Paarlberg (Harvard Univ. Press, \$16.95)

In this controversial book, Robert Paarlberg argues that opposition to agricultural science in prosperous countries is reaching Africa, denying poor farmers access to technologies that might improve their yields — especially transgenic crops with insect- or drought-resistance.