

response to the need to measure land areas and keep track of financial transactions, incomes and taxation. A rigid caste and class hierarchy reserved the mystery of numbers for elite Brahmins. To maintain personal power, mathematical knowledge was jealously guarded. Its communication was deliberately made difficult, such as in the perplexing rhythmic chant of mathematician Aryabhata in the fifth century AD: “*makhi-bhakhi-phakhi-dhaki-nakhi-nakhi-nakhi-hasjha-skaki-kisgasghaki-kighva-ghaki...*” This recital of values of sine differences in arc minutes would be memorized by aspiring mathematicians in much the same way as verses of the sacred text Bhagavadgita.

The book details the impressive achievements of Indian mathematicians, from Aryabhata through Brahmagupta, Mahavira, Bhaskara and Madhava, until the Sanskrit tradition became irrelevant with the invasion of modern mathematics from Europe in the nineteenth century. Major discoveries include finding the solution to indeterminate equations and the development of infinite series for trigonometric quantities. Discovered in the fourteenth century by the Kerala school founded by Madhava, these series built on the work of Bhaskara II and grew from the ingenious computation of a circle's circumference. By breaking up the circle into polygons, Madhava was able to calculate the value of pi correct to 11 decimal places. Some developments preceded those in Europe. For example, Reuben Burrow — a British mathematician posted to Bengal as an instructor in the engineers corps — was intrigued by rules he discovered in an unnamed Sanskrit text, and wrote a paper in 1790 entitled ‘A Proof that the Hindoos had the Binomial Theorem’.

But how peculiarly Indian was early Indian mathematics? Did it evolve in isolation or did it absorb ideas and knowledge from elsewhere? Cultural pride in their recently reinvigorated country causes some Indians to claim that all worthwhile mathematics originated in ancient India. But this book will not please them. Plofker is not ready to certify that the concept of zero was an Indian invention; it could well have been conveyed by Chinese Buddhist pilgrims. Nor is she willing to believe that differential and integral calculus were anticipated in India ahead of the work of Gottfried Leibniz and Isaac Newton.

The chapter entitled ‘Exchanges with the Islamic World’ is of particular significance. The Muslim conquest of India brought with it the Islamic mathematical tradition, which was founded on Greek mathematics. Muslims made important advances in maths between the ninth and thirteenth centuries. Greco-Islamic and Indian mathematics were structured

quite differently, with the former emphasizing proof and the latter, result. Probably because of Islamic influence, Indian ideas on the nature of mathematical proof moved in the direction of greater rigour.

The book carefully separates fact from hyperbole, copiously quoting formulae. This makes for heavy reading in places, and one wishes that it had been interspersed with vignettes and light anecdotes. It is more of a research monograph than a popular book. But that is the price that scholarship exacts.

Mathematics in India explains how the early development of Indian maths was influenced

by religion, by the need to build temples of specific proportions and to meet astrological imperatives. Similarly, it could be argued that Islamic mathematics was religiously motivated — for example, by the need to know the precise times of daily prayers, and to determine the direction of the holy *Kaaba* (the *Qibla*). But a quadratic equation solved by whoever, by whatever means and for whatever purpose must give exactly the same solutions. Ultimately, mathematics is mathematics. ■

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Averting environmental crisis

One of the most important questions of our age is when will humankind take action to offset the impact of climate change? Will we do something before the inexorable rise in sea level or wait until the effect is cataclysmic? Can the history of previous environmental crises help us to predict the course of this one?

Two books address these challenges. In the first, *Becoming Good Ancestors*, David Ehrenfeld, a zoologist and the founding editor of the journal *Conservation Biology*, examines the destructive tendencies of humankind. He asks if we can “move ourselves and our society toward a more stable, less frantic, more responsible, and far more satisfying life”. The book is an expanded and revised collection of some three dozen essays that Ehrenfeld published first in *Orion* magazine and then in *Swimming Lessons: Keeping Afloat in the Age of Technology* (Oxford University Press, 2002). The result is a very good read.

Ehrenfeld believes that we must jettison our arrogant assumption of being able to fix anything through technology, that we forget at our peril what worked well in the past and that economics is a cloudy lens through which to view human behaviour. He says that we must and can reconnect with a nature that is resilient and that, despite globalization, local communities will never completely disappear. The essays retain the qualities that made them appealing when they were first published — brevity, passion and accessibility. However, as satisfying as they are as self-contained meditations, they do not hang together well, either as a sequence or as a complete analysis.

Nature and Power is a very different work, written by an environmental historian who refuses to follow convention unless he finds compelling reason to do so. Joachim Radkau's vision in this broad-reaching history of the state of the environment — in particular, its soils, forests and waters — is from three perspectives, namely German, continental European and global. His unrelenting focus on detail may frustrate the reader who seeks straightforward narrative. Many writers can be said to miss

the forest for the trees, but Radkau is extreme, at times abandoning the tree for the twig, bud, leaf or abscission scar.

Radkau's guiding lights are demographer Thomas Malthus, sociologist Max Weber and the nineteenth-century agricultural chemist Justus von Liebig. Radkau draws on von Liebig in his discussions on the chemistry,

well-being and degradation of soils; on Weber in his acknowledgement of the crucial role of culture and power in the course of environmental history; and on Malthus for his case that population pressure on resources is the enemy of sustainability. Radkau doesn't just apply these and many other ideas, but tests, refines and refutes them in chapters that range through time and across the globe. The book often startles. Insights come thick and fast with Radkau's ironic and unexpected turns of phrase.

True to form, he refuses to take the easy route. He comes close to declaring that environmental history is mostly about decline, and that human population control is the key to reducing resource pressure, yet he pulls back from whatever precipice he is nearing

Becoming Good Ancestors: How We Balance Nature, Community, and Technology

by David Ehrenfeld

Oxford University Press: 2008.

320 pp. \$19.95, £10.99

Nature and Power: A Global History of the Environment

by Joachim Radkau

Cambridge University Press: 2008.

448 pp. \$24.99, £14.99

and complicates his narrative with stories that either offset or flatly contradict his thesis. Rather than close a case with some glib conclusion, he reminds the reader that the course of environmental history is intertwined with human power and inertia, that it is a mix of decline, ascension and stability and that crisis is often contrived. Radkau keeps the reader off balance: "All simple pictures of environmental history are open to challenge."

Rarely, it seems, have we acted to prevent environmental crises. An exception was the 1987 Montreal Protocol to cease production of chlorofluorocarbons and other compounds that deplete the ozone layer. Will concern over climate change — a greater, more complex and more diffuse issue than destruction of ozone — also produce a pact for change? Given the cost of ramping up such efforts, this seems unlikely before climate change becomes a

worldwide cataclysm. Whereas Ehrenfeld may give you cause to hope, Radkau is likely to leave you gloomy. He might even be said to turn philosopher George Santayana's observation on its head: even those who remember the past seem condemned to repeat it. ■

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Q&A: Acting the part

Actor and playwright **Anna Deavere Smith** has pioneered documentary theatre through her one-woman plays constructed from interviews. As she prepares to portray biologists Edward O. Wilson and James Watson at the World Science Festival in New York next week, Smith talks about life, death and the influence of science on her work.

Watching Wilson and Watson

Skirball Center for the Performing Arts, New York City
11 June 2009. Part of the World Science Festival, 10–14 June.

When did you start writing plays based on interviews with real people?

Nearly 30 years ago, I created a project called *On The Road: A Search for American Character*. The idea was to travel the country with a tape recorder, talk to people and invite them to see themselves performed. Originally it was going to be with a company of actors, but I thought I'd do all the parts until I figured out how to raise money to pay them. As a kid I was a mimic. I find my expression through others.

How do you get people to open up to you?

In the early days I wanted people to talk to me in individual, peculiar ways. A linguist gave me three questions to ask to ensure that would happen: have you ever come close to death? Have you ever been accused of something you didn't do? And do you remember the circumstances of your birth?

When did you get interested in science?

As a child, I wanted to be a psychiatrist, or an inventor like Thomas Edison. I admire scientists' sense of experimentation, their tolerance for not knowing. While teaching drama at Stanford University, California, in the 1990s, I became infatuated with a geneticist there, Marcus Feldman, who studies evolution using twins. He told me he'd spent ten years of his career trying to shoot down the views of William Shockley



Playing solo: Anna Deavere Smith.

and Arthur Jensen, who argued that intelligence varies by race. Feldman became a muse for me.

Why did you decide to impersonate Edward O. Wilson and James Watson?

Watson is one of the forces behind the celebration of Wilson's 80th birthday at the World Science Festival this year. He invited me to do a 20-minute performance of each of them. When they were young scientists at Harvard University, there was a rift between them. Watson wouldn't speak to Wilson, and Wilson later wrote that he had thought Watson was "the most unpleasant human being [he] had ever met". They've reconciled over the years.

What is Wilson like?

He's fashioned himself as a southern gentleman: very friendly, patient, charming and with a ready smile. He was a boy scout,

and in some ways he's still a grown-up boy, in that he has that restlessness and excitement about learning something new. He developed a work ethic as a child when he had to get up at 3 a.m. for a paper route, and he now gets up very early with great purpose. Just look at all those big fat books he has written.

Why did you choose the topic of health care for your next play, which opens in New York City later this year?

Let Me Down Easy is about the beauty of life and the fact that it has an expiration date. In the late 1990s, Yale University School of Medicine asked me to interview doctors and patients and portray them at medical rounds. Since then, I haven't had the desire to make a play about anything else. The project has expanded in my mind from medicine to a long excursion into the human body, its resilience and vulnerability. The play ranges from portraying people who have physical prowess, such as cyclist Lance Armstrong and long-distance swimmer Lynne Cox, to people who are dying for no reason other than chance. And I too have had to come to grips with the fact that I'm going to die.

Has your work raised questions for you?

It has left me with unanswered questions about the relationship between speech and inner life. I don't understand exactly what happens when a word enters my imagination, or when I reiterate the word as it was said. There is probably a psychologist, neurologist or linguist who would offer a lot to my study. I should talk to some experts. I'm the machine but I don't know entirely how it works. ■

Interview by **Jascha Hoffman**, a writer based in New York.

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