area of biology, even those barely related to evolution, into the darwinian fold. The "fruits of biodiversity" could yield useful compounds whether they were evolved or created. If our "evolved capacity for learning and planning" helps us solve conservation problems, it also produces art and psychotherapy. Perhaps our public-health practices "are dictated by the principles of evolutionary population genetics", but the Romans built their aqueducts for supplying fresh water without the benefit of reading R. A. Fisher, J. B. S. Haldane and Sewall Wright.

To some extent these excesses are not Mindell's fault, for, if truth be told, evolution hasn't yielded many practical or commercial benefits. Yes, bacteria evolve drug resistance, and yes, we must take countermeasures, but beyond that there is not much to say. Evolution cannot help us predict what new vaccines to manufacture because microbes evolve unpredictably. But hasn't evolution helped guide animal and plant breeding? Not very much. Most improvement in crop plants and animals occurred long before we knew anything about evolution, and came about by people following the genetic principle of 'like begets like'. Even now, as its practitioners admit, the field of quantitative genetics has been of little value in helping improve varieties. Future advances will almost certainly come from transgenics, which is not based on evolution at all.

As far as I know, there have been only two genuine commercial applications of evolutionary theory. One is the use of 'directed evolution' to produce commercial products (such as enzymes to protect crop plants from herbicides). The other is the clever use of insecticide-free 'pest refuges' to stop herbivorous insects evolving resistance to herbicides containing *Bacillus thuringiensis* (*Bt*) toxins, a strategy derived from principles of population genetics. There will certainly be more of these to come. And evolutionary algorithms are used in designing computer programs, and may have uses in engineering and economics.

One reason why Mindell might fail to sell Darwin to the critics is that his examples all involve microevolution, which most modern creationists (including advocates of intelligent design) accept. It is macroevolution — the evolutionary transitions between very different kinds of organism — that creationists claim does not occur. But in any case, few people actually oppose evolution because of its lack of practical use. As with my Alaskan interlocutor, they oppose it because they see it as undercutting moral values.

All the same, Mindell's analogy between biological evolution and the evolution of languages can be used to refute the tiresome creationist claim that we haven't seen one species change into another. We haven't seen one language change into another either, but any reasonable creationist (an oxymoron?) must accept the clear historical evidence for linguistic evolution. And we have far more fossil species than we have fossil languages.

In the end, the true value of evolutionary biology is not practical but explanatory. It answers, in the most exquisitely simple and parsimonious way, the age-old question: "How did we get here?" It gives us our family history writ large, connecting us with every other species, living or extinct, on Earth. It shows how everything from frogs to fleas got here via a few easily grasped biological processes. And that, after all, is quite an accomplishment. ■

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Triumph and dismal failure

Technology Matters: Questions to Live With
by David Nye
MIT Press: 2006. 282 pp. $27.95

Don Ihde

Humans and our ancestors have been using technologies since they made the first stone tools 1.3 million years ago, David Nye points out in his book *Technology Matters*. Yet the term 'technology' has been in widespread use for less than 100 years. A survey of prominent US periodicals published between 1860 and 1870 yields only 149 references to 'technology', compared with 24,957 mentions of 'inventions'. Nye credits the Norwegian sociologist and economist Thorstein Veblen with giving 'technology' its more contemporary sense, and concludes that the word only gained common currency after the First World War.

Nye is a historian of technology and his book focuses on the difficult problem of showing how technologies matter. To do that requires some insight not only into the history of technologies, but into their predictability. The historian Thomas Carlyle described economics as the "dismal" science, but it would seem our history of predicting changes in technology is even worse. Nye cites the work of George Wise, a historian associated with General Electric, whose doctoral thesis revealed that of the 1,500 published predictions from scientists, inventors and sociologists he surveyed, only a third were fulfilled. Towards the end of the book Nye claims that historians are more likely than most to get their predictions right. I found little proof of this claim in the book.

One could use this predictability problem as evidence of the indeterminacy of technologies; that is, they have multiple, but indefinite, effects. And, indirectly, Nye does this. He is clearly against the now outmoded notion of technological determination. One of the positive features of his book is the vast array of examples and mini-histories that are developed. Nye recognizes the tendency of inventors to hype each invention and make grand claims about how it will bring about a utopian future. Yet a more sober historical account shows both that the outcome may be very different to that predicted, and that much effort has to be put into getting the technology accepted. For example, it took a long time to create demand even for the technologies that shaped much of the modern world, such as the telegraph, the telephone and even the personal computer. Samuel Morse, Nye points out, spent five years "lecturing, lobbying, and negotiating" before getting the US Congress to pay for the first telegraph line.

A second theme for Nye is the claim that technologies are "socially constructed", which

R. MORSE/TIME & LIFE/GETTY

When IBM launched its early home personal computers, it had to create a demand for them.

he means in a broad sense. He argues that any emergent technology requires many players, not just an inventor with a great idea. There is a field of players involved in negotiations and development, and only some of the resulting technologies are ultimately successful. This plays back into the problem of predictability.

What's missing from Nye's account — and this is a complaint that can be levelled at 'social constructionists' — is a sensitivity to the 'materiality' of technologies. Part of the struggle is not just that of markets, social structure and the like, but also the resistance and accommodation of the material used. For example, consider human powered flight. Most of Leonardo da Vinci's machines would have failed to fly because of their sheer weight and lack of strength. But when the Gossamer Albatross was constructed in 1979 using modern materials, kevlar and mylar, it was moderately successful. One exception for Leonardo, according to a recent account (see *Nature* **421,** 792; 2003), was a glider, but this was modified by subtracting heavy control mechanisms and adding hang-glider strengtheners.

Nye's book addresses many of the issues and debates surrounding our highly textured technological society, and these are reflected in the questions he asks. Does technology control us? Does it lead to cultural uniformity or diversity? To sustainable abundance or to ecological crisis? To more security or escalating danger? The book is rich in examples, is easily readable and is short enough to be recommended for a day's read. ■

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On fertile ground

Soils and Societies: Perspectives from Environmental History
edited by J. R. McNeill & Verena Winiwater
White Horse Press. 2006. 369 pp. £50

Camilla Toulmin

Soil is often viewed as just 'dirt', but *Soils and Societies*, edited by J. R. McNeill and Verena Winiwater, shows why soil provides the foundation on which our societies are based. Soil enters ordinary speech in many and various ways. We talk of seed falling on fertile ground, and the transformation wrought by rain falling on parched soils. Long-time urban dwellers wait for years for their name to top the list for a small allotment to grow fruit and vegetables. In Marcel Pagnol's novel *Jean de Florette*, the central characters taste the soil of a field they hope to acquire to get an indication of its quality — a practice dating back, so *Soils and Societies* tells us, to Roman times and before.

Western society today is particularly disconnected from farming life, leading to contradictory demands on what we want the food and agricultural system to do for us. So this book is a valuable reminder of the former close understanding of the soil that human societies needed to harvest higher returns and maintain soil structure and quality. A delight for the soil aficionado, this book teases out multiple threads from different societies and weaves them together to show how the fabric of daily life is closely connected to the soils from which their bread has been harvested.

Eleven chapters range from a discussion of early Indian poetry about the natural world and a history of the soils of Mesoamerica to a discussion of nutrient flows in pre-modern European agriculture. The chapter on the dynamics of soil, landscape and culture on Easter Island provides welcome clarity on how and why this extraordinary culture, known for its massive stone sculptures of heads, came to an end.

In the introductory chapter, the editors provide a valuable framing of the main issues. Ultimately we all depend on the continued health of certain fundamental ecosystem elements and processes. As the Millennium Ecosystem Assessment reported last year, the health of our soils, in wetlands, forest areas and dry savannas, is declining. Soils have their own histories, natural and human, which intertwine, leading either to declining productivity or, if they are well managed, to sustaining the heart of the farming system.

Soils change in different ways, depending on the time scale. Gully erosion can open up a hillside in a few hours after an exceptional storm. Over decades, the barely noticeable losses each year from sheet erosion cumulatively bring about a scarred landscape, like skin drawn too tight over a bony visage. The sediment found in lake beds forms a rich archive of information about former patterns of vegetation, land use and climatic changes.

Given my own background in west Africa and work on the interaction between crops and livestock, I particularly enjoyed the chapter on African soils. It presents well the different assumptions brought to sub-Saharan Africa by colonial administrators, and their ever-ready desire to transplant foreign agricultural knowledge into local farming systems. And despite occasional massive failures with such enterprises, such as the groundnut scheme in Tanganyika in the 1940s and 50s, the power of the narrative linking African peasant farmers to poor soil management has enabled confidence among the soil experts to be sustained even today. As the book points out, "theory moulds perceptions of environmental change", made worse by the lack of detailed data on which to make firm judgements. Yet soil scientists are slowly starting to break free from conventional approaches to soil and water conservation and turn to more participatory methods that recognize local knowledge and expertise. These are now bearing a harvest of their own, even in areas with low rainfall such as the West African Sahel, with the spread of simple methods for catching rainfall and concentrating both water and organic matter along with the seed in small planting pots.

Thankfully, the past five years have seen a massive growth in demand for organic food, bringing a return to the kind of knowledge and understanding among farmers about what works best for the diverse contexts and constraints faced in different parts of the farm landscape. With luck, the rising cost of oil and energy will also help shift farm production away from high-intensity inputs and mechanization towards the greater use of agro-ecological processes. It's good to know that in this book and its detailed reference list there lies a sound body of historical material on soils that has been laid down over time. ■

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V. WENTZEL/HULTON ARCHIVE/GETTY

Laying the groundwork: growing crops in areas with low rainfall requires good soil management.