BOOKS & ARTS

Selling Darwin

Does it matter whether evolution has any commercial applications?

The Evolving World: Evolution in Everyday Life
by David P. Mindell
Harvard University Press: 2006. 270 pp.
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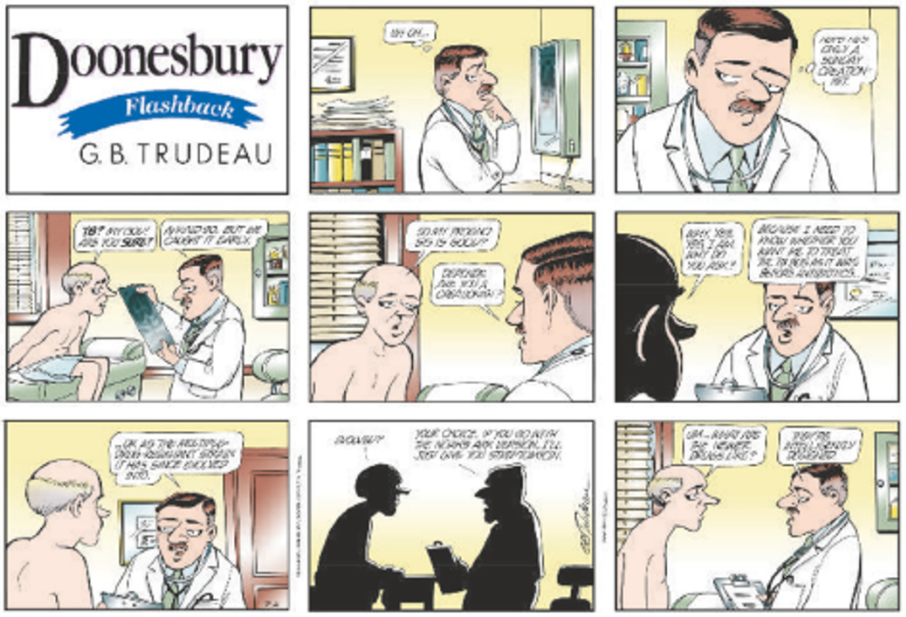

After lecturing this spring to the Alaska Bar Association on the debate over intelligent design and evolution, I was approached at the podium by a young lawyer. The tight-lipped smile, close-cropped hair and maniacal gleam in his eyes told me that he was probably a creationist out for blood. I was not wrong. "Professor Coyne," he said, voice quivering with anxiety, "I don't agree with what you said about evolution, but even if it were true, how does it cash out?" "Excuse me?" I answered. "Cash out!" he said. "Does it have any practical value? What good is it?" By 'good', of course, he meant money. After a moment's thought, I muttered something about drug resistance in bacteria, adding that not all research could — or should — be about money.

The idea that the main virtue of science lies in its practical applications, especially in fighting disease or creating wealth, is a by-product of the American notion that everything comes down to the dollar. After all, in a country where Martin Luther King dreamed that people should be judged by the content of their character, they are still judged by the cost of their car. It is a peculiarly American objection to evolution that it can't cure cancer or make you rich. And some US biologists, steeped in a culture both mercenary and resistant to evolution, believe that to sell darwinism to people we must show them how darwinism helps people to sell.

This is the motivation for David Mindell's engaging book *The Evolving World*. As he notes: "When a concept and its resulting applications become useful, people tend to embrace the applications and, eventually, the underlying concepts. It is difficult to argue with success." Indeed. Other fascinating aspects of science may lack practical application (work on black holes, for instance), but these apparently don't need justification because they don't strike at the core of human values as evolution seems to do.

After reminding us that acceptance of evolution has been no slower than that of the heliocentric theory of the Solar System, or the germ theory of disease, Mindell gets down to what he sees as the practical uses of evolutionary biology. These include plant and animal breeding, understanding the evolution of drug resistance in microbes and pesticide resistance in insects, darwinian medicine, and evolutionary conservation biology. Many of the examples of artificial breeding, although familiar, should inspire the lay reader. If we had the skeletons of only chihuahuas and St Bernards as fossils, these breeds of dog would be considered not only different species (which they may well be, given the difficulty of cross-copulation), but also members of different genera. Darwin used artificial selection in *The Origin of Species* to persuade the public of the power of natural selection, and our vastly increased knowledge of the history of human selection on animals and crops has confirmed his argument many times over.

Mindell likewise gives a readable account of evolutionary theory in medicine. Phylogenetic analysis has helped us trace the animal origins of human pathogens such as anthrax, tuberculosis, AIDS and influenza, as well as more specific routes of infection; for example, the testimony of a systematist helped convict a Louisiana doctor of injecting his mistress with HIV-infected blood. And darwinian medicine gives insight into why virulence and transmission are evolutionarily connected: malaria, reliant on the mosquito vector, leaves its victims prostrate and susceptible to bites, whereas the common cold, spread through the air, leaves its victims free to move around. But an evolutionary viewpoint has not led to cures, so its contribution to medicine has been more heuristic than practical.

In the field of conservation, Mindell highlights the use of phylogenies to recognize and catalogue the biodiversity that can yield valuable drugs. Conservation genetics — the use of genetics to save endangered species — is given short shrift, but that seems fair given its alarmingly low rate of success so far.

Mindell's defence of evolution ends with two odd chapters: one on 'evolutionary metaphor in human culture', the other on 'the role of evolution in court and classroom'. There are broad parallels between biological evolution and the evolution of languages and religions, but little more. And his legal examples, notably forensic DNA and forensic entomology, have little to do with evolution, while speculation about the evolutionary basis of ethics is a notorious intellectual quagmire.

As a brief for the practical value of evolution, *The Evolving World* gets a mixed verdict. It is embellished with good examples, and anybody who has not been exposed to the role of evolution in human affairs will undoubtedly derive some benefit. But there are problems too. In his desire to show how useful evolution is, Mindell strives desperately to herd every stray

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
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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

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