data to tell us about human history and contemporary human problems?

As the title suggests, the book is largely about the endless movements of human populations over millennia and the genetic traces left behind. But at another level, Cavalli-Sforza shows plainly the futility of trying to interpret genes without knowing so much more — about selection and drift, about processes of cultural transmission, about history and geography, about fossils, about anthropology, about statistics. It is an excellent introduction to the complexities of human genetic diversity, and should also be read by genome-dippers and those who talk confidently about race. As this book shows, human biological history is far too dynamic for monolithic racial categories to survive.

This is a gentle and modest book, lacking the hyperbole and over-wrought metaphors of much modern science writing. Its simplicity, though, is deceptive, for Cavalli-Sforza brings insight and subtlety to human evolutionary genetics. Besides, his last book was more than a thousand pages long and cost more than $150, so this one is a bargain. □

*Robert Foley is in the Department of Biological Anthropology, University of Cambridge, Downing Street, Cambridge CB2 3DZ, UK.*

# Universal Darwinism

*David L. Hull*

**Without Miracles: Universal Selection Theory and the Second Darwinian Revolution.** By Gary Cziko. *MIT Press: 1995. Pp. 385. $30, £25.50.*

RICHARD Dawkins strikes again. He has inspired yet another investigator to take up his Darwinian cause, in this case to extend explanations in terms of variation and selection to all cases of adapted and adaptive complexity. Cziko has taken on a tall order, because such complexity manifests itself in everything from the vertebrate eye, the mammalian immune system and the central nervous system to mating behaviour in prairie chickens, religious rituals among Melanesians and scientific theories.

Cziko begins by explaining how standard Darwinian theory accounts for organic adaptations and rapidly proceeds to the more controversial cases, in particular human knowledge. For each area, Cziko shows how providential and instructional explanations always seem to precede and to appear more attractive than selectionist explanations. For example, one of the earliest explanations of organic adaptations was literally God's divine plan. When biologists finally abandoned this extremely satisfying explanation, they tended to prefer such instructionist mechanisms as the inheritance of acquired characteristics to Darwin's explanation in terms of blind variation and natural selection.

For the immune system in mammals, the providential explanation is that each organism is born with all possible antibodies already formed. An instructional explanation is that antigens induce the body to produce the appropriate antibodies. As it turns out, the mammalian immune system behaves in a classical Darwinian fashion. Organisms produce massive numbers of diverse antibodies, only a few of which are ever used to attack invading foreign bodies. Similar explanations have also been suggested for the development of the central nervous system, but in this case no selectionist consensus has yet to emerge.

Once Cziko has established the credentials for selectionist explanations in biology, he proceeds to his main concern — learning, behaviour and cultural transmission. Here the opportunities for obfuscation lie in wait at every turn. Everyone seems to think that they know what they mean when they say that cultural evolution is 'Lamarckian', but Cziko presents some of the problems with this notion. For example, if a female dog teaching her young to hunt is a form of Lamarckian inheritance, then so is the transmission of fleas from the mother to her offspring. The trouble with treating cultural transmission as Lamarckian is that the distinction between Lamarckian and Darwinian inheritance turns on the genotype–phenotype distinction, a distinction that is far from apparent in cultural evolution.

The appropriate adjective to modify the term 'variation' is equally problematic. Darwin referred to variations "in all directions", that is, with no bias toward the variations that an organism might need. Such variations are certainly not 'chance' or 'random' if these terms imply lack of causation. Cziko opts for 'blind', but he is well aware that this adjective also begs to be misunderstood. In the context of perception, he asks whether it can make any sense to refer to vision as blind.

Scientists may be many things, but very few of them are blind. All Cziko intends in claiming that science is one more instance of blind variation and selective retention is that scientists are not prescient or clairvoyant, but this interpretation is too weak. As far as I know, no one has claimed that scientists, let alone genes and fruitflies, are clairvoyant. The issue is the effect that previous knowledge has on the process of discovery. Cziko acknowledges that it serves as a constraint. Is English really so impoverished that no word can accurately characterize the sort of variation that occurs in selection processes?

Although Cziko is aware of the dangers of the terminology he has chosen, on occasion it gets him into trouble. For example, as an educational psychologist, he objects to providential education, but he also feels obliged to denigrate instruction. We all know the benefits of providing an environment in which students can make discoveries on their own, but this process just takes too long. Selection processes are wasteful and inefficient. Cziko agrees that the most successful teachers are those who find an optimal mix of instruction and freedom to innovate, but, in this discussion, technical and everyday uses of 'instruction' are, I'm afraid, being run together.

Early in his book, Cziko decries the sorry state of biological education in the United States, where 47 per cent of people polled in 1991 still believed in creationism. Later, in the context of cultural evolution, he asks if the traditional Balinese farmer is "in any way irrational and illogical in his adoption of centuries-old methods of rice cultivation?" The answer is no. Even though scientists think that the religious beliefs that inform rice farming in Bali are mistaken, the beliefs have stood these farmers in good stead over the centuries. Are first-world creationists any more irrational or illogical in continuing to believe in the miraculous creation of Earth 10,000 years ago? From the perspective of selectionist epistemology, the answer has to be no. Like it or not, false beliefs can be more highly adaptive than true ones.

Cziko outlines universal Darwinism as clearly and comprehensively as is possible in a book designed for a popular audience. Some readers will find his views as misleading as they are seductive. Others will find them highly suggestive, possibly worth pursuing in their own right. I find myself in this second group. But one problem remains for all sides. The evolutionary process of variation in all directions and selective perpetuation has produced an organism that finds it very difficult to understand this process. If understanding really *is* produced by something like a Darwinian process of variation and selective retention, then why are the general features of this process itself so difficult to understand? Evolutionary theory seems so easy that almost anyone can misunderstand it. □

*David L. Hull is in the Department of Philosophy, Northwestern University, Evanston, Illinois 60208-1315, USA.*

■ *Darwin's Dangerous Idea: Evolution and the Meanings of Life* by Daniel C. Dennett has just been published by Allen Lane in the United Kingdom at £25. For a review by Mark Ridley of the US edition, see *Nature* **375**, 457 (1995).