EDITORIAL

A New Perspective on Evolution

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Did Charles Darwin get it wrong? Is it the less fit organisms, not the fittest, that evolve? If so, the implications are momentous.

Some years ago, *Journal of Heredity* published my article entitled *Mendel's Opposition to Evolution and to Darwin* (1), in which I argued that Mendel, far from being an evolutionist, as is generally assumed, was a supporter of the doctrine of special creation, the prevailing belief at the time. I proposed his *Pisum* paper, which appeared in 1866, was specifically written in controversion of Darwin's iconoclastic book *On the Origin of Species by Means of Natural Selection*, published in 1859, and that Mendel's and Darwin's theories are completely antithetical. However, once the Mendelian myth has been discredited, it becomes necessary also to re-evaluate Darwin's contribution to evolutionary biology, for it was only the unification of Darwin's and Mendel's ideas in the 1930s and 1940s, in what is known as the modern synthesis or neo-Darwinism, that appeared to legitimize Darwin's externalist account of evolution.

But biology has moved on since those days when genes were not considered to be capable of exhibiting any behaviour other than a tendency to occasionally mutate. Then, perhaps, it was feasible to encapsulate evolution as the natural selection of alternative alleles, or, as it is usually put, a change in gene frequencies.

Now, however, it is known that the genome is extraordinarily fluid, with all sorts of internal dynamics of its own, which surely must affect evolutionary directionality. Thus, Darwin should be judged not in the context of the simplistic and fallacious "bean-bag genetics" that were claimed to have substantiated his theory but in relation to all the highly complex and incontrovertible molecular phenomena that have been elucidated since the formulation of the synthetic theory. William B Provine, historian of science, has described the persistence in textbooks and classrooms of the one-locus, two-allele theoretical models of RA Fisher, JBS Haldane and Sewall Wright, the founders of population genetics, as "amazing" and "an impediment to understanding evolutionary biology", and he queries: "*Do teachers think that students must first learn what they did as students, and later correct these beliefs?"* (2).

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Today, it is often asserted or implied that Charles Darwin was the first to suggest that evolution had occurred, but that is not so. He had several precursors, whom he acknowledged in the historical sketch that was added to the third edition of *The Origin* (1861) and to all subsequent editions. Therefore, Darwin's originality rests largely upon the validity of his mechanism of evolution, natural selection, which is now regarded by the vast majority of biologists as irrefutable. However, it should not be forgotten that natural selection had remained very much a minority view from the time it was postulated until the advent of neo-Darwinism, having been strongly resisted during that entire period of nearly eighty years, as Ernst Mayr himself, who was the last surviving architect of the modern synthesis, reiterated throughout his book *What Makes Biology Unique*? (3). Not even Darwin's contemporaries, friends and foes alike, had been able to accept natural selection as a creative principle. Darwin's theory not only aroused fierce religious and philosophical antagonism, as is well known, but was also met with "very serious scientific objections", a fact that is little appreciated (4).

Critics argued that natural selection could act only as a negative force, eliminating the unfit and preserving the type, while some other cause must play the positive role of constructing the fit. In other words, although natural selection could account for the success of species after they have arisen, it could not explain their origin; hence, Darwin's theory was unproved and the title of his book a misnomer. Furthermore, Darwin's mechanism of natural selection was based upon an analogy with artificial selection, a comparison that was thought by his peers to be completely inappropriate, for not only does speciation not occur under domestication but the plants and animals chosen for propagation are precisely those that would not survive in the wild, as the characters that are useful to breeders would be deleterious to organisms in a feral state. In fact, according to Ruse (5) everyone who had invoked artifical selection before *The Origin* (including Charles Lyell, Darwin's mentor) had done so in order to disprove evolution.

In the face of such an unfavourable response, Darwin began to backtrack, drastically revising later editions of *The Origin* and admitting in *The Descent of*

Man that in the earlier editions he had probably attributed too much to the action of natural selection (6). Darwin also introduced Herbert Spencer's expression "the survival of the fittest" as a synonym for natural selection in an attempt to counter charges of anthropomorphism, for opponents said that it was obvious that nature's selection required as much thought and control as man's selection.

Darwin maintained that small heritable variations occurred among populations of plants and animals but that they were not directed towards an organism's needs (or, as it is put today, that mutation was random, not adaptive); that natural selection, or the survival of the fittest, determined which variants predominated in any particular environment; and that it was the most successful members of a population that over time after many generations gave rise to a new species, while those lineages that had been outcompeted were driven to extinction.

However, it is possible that Darwin got it wrong and that it is the less fit organisms, not the fittest, that evolve. This is suggested by John T Bonner's concept of "pioneering", which holds that the basis of speciation is escape from competition and predation, not only by flight to new habitats but also by the adoption of novel strategies for survival that go right back to the first bacteria and their struggle for a source of energy. Bonner lists the various solutions arrived at, and he observes: *"Each of these profoundly different ways of obtaining energy is an innovation, a bit of pioneering. By inventing any one of these methods of capturing energy, the bacteria can avoid competition; they make a new world of their own*" (7).

Bonner also argued that another option for pioneers is to become too large and complex to be subdued, as Mark Ridley explained: *"Because earlier living things were small and simple, species could always escape from competition by evolving to be larger and more complex. The ecological niche that could be occupied by organisms that were larger and more complex than any other organisms existing at the time was always vacant and selection could have favoured pioneers that evolved to occupy it.* [But only, of course, after they had evolved!] *The net effect of the process will be for ever larger and more complex organisms to arise – if Bonner is correct, biological competition, and the divergence it produces, has been the main motor of the pattern of increasing size and complexity – of progress, some would say – in the history of life"* (8).

Although Bonner sees his scenario as compatible with Darwinian theory, pioneering is obviously a desperate do-or-die effort of the less fit that enables them to survive in the only possible way they can at that particular point in time. Moreover, pioneering incurs considerable costs, for it drives species to seek refuge in inhospitable environments such as the polar regions or the great depths of the sea, as well as to explore the extremes of complexity. In contrast, successful organisms do not need to change their lifestyle: they go on being themselves in the same old way, in the same old habitat.

As Ridley notes, Bonner's concept of pioneering is essentially the same as Darwin's "principle of divergence" which Darwin had remarked in a letter to botanist Joseph Hooker was one of the two keystones of his theory of evolution (the other, of course, being natural selection). In fact, the principle of divergence was so important to Darwin that he illustrated his discussion of the subject by the one and only diagram in *The Origin of Species* and gave a graphic hypothetical example: *"Take the case of a carnivorous quadruped, of which the number that can be supported in any country has long ago arrived at its full average. If its natural powers of increase be allowed to act, it can succeed in increasing (the country not undergoing any change in its conditions) only by its varying descendants seizing on places at present occupied by other animals: some of them, for instance, being enabled to feed on new kinds of prey, either dead or alive; some inhabiting new stations, climbing trees, frequenting water, and some perhaps becoming less carnivorous.* [These are all clearly pioneering strategies]. *The more diversified in habits and structure the descendants of our carnivorous animal became, the more places they would be enabled to occupy"* (9).

The late Stephen Jay Gould cited the same passage from *The Origin* in his *magnum opus, The Structure of Evolutionary Theory* (10), and he showed convincingly that Darwin had tried and failed to establish that his principle of divergence followed as a consequence of natural selection operating at the organismic level. In other words, Gould was of the opinion, as are many other biologists, that macro-evolution cannot be explicated by extrapolation from micro-evolutionary processes. As Ernst Mayr commented: *"From Darwin's day to the present, there has been a heated controversy over whether macro-evolution is nothing but an unbroken continuation of micro-evolution, as Darwin and his followers had claimed, or rather is disconnected from micro-evolution, as asserted by his opponents, and that it must be explained by a different set of theories" (11).*

Significantly, more and more pioneering-type scenarios are being put forward these days, even for such major transitions as the origin of multicellularity and of the first tetrapods. For instance, behavioural biologist Simon M Reader concludes his article on the pros and cons of intelligence in evolution: *"– the story of the evolution of human creative intelligence is perhaps not one of successful individuals innovating to do still better, but rather one of losers innovating to do less badly"* (12).

However, if it is the inferior and not the superior organisms that are evolving, then obviously natural selection can be playing no part in the process as a creative force, in which case Darwin's cardinal postulate that mutation is random becomes untenable. Instead, genetic variation must arise preferentially in adaptive directions, as was proposed by

Jean-Baptiste de Lamarck, the French naturalist who was the first to formulate a consistent and comprehensive theory of evolution.

This was the most fundamental difference between Lamarck and Darwin, and today the question of whether or not mutation is directed towards an organism's needs is still the crux of the evolution debate.

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