

Books

Design for living

Michael J. Behe The Edge of Evolution: The Search for the Limits of Darwinism. Free Press, 320 pages, \$28

reviewed by *Paul R. Gross*

Nothing in modern biology, which is willy-nilly evolutionary biology, rules out supernatural intervention in the processes of life. But neither is there any scientific evidence for it, although, in principle, evidence might emerge. (Not, I hasten to acknowledge, that science and religion appeal to the same canons of justification.) Despite many defeats, including a disastrous trial of the Dover, Pennsylvania school district, the Intelligent Design (I.D.) movement, which insists that *scientific* evidence does exist for such supernatural interventions, continues to gain worldwide support. This has little to do with the substance of the target—misnamed “Darwinism.” (It is misnamed because the disciplines of evolution have advanced far beyond Darwin and Wallace of 150 years ago.) The success of I.D. has had nearly—but not quite—everything to do with funding, public relations, a deluge of words, and politics.

As to “not quite everything”: Whether or

not they are *good* science, a few I.D. arguments are within the relevant scientific area. But to date there has been just one working biologist offering them: Professor Michael J. Behe, a biochemist of Lehigh University. His publisher pitches Dr. Behe’s new book as “a masterwork of science and logic . . . a revelation and a bombshell”—this presumably in the field of evolution. Writers of the dust-cover endorsements include, however, no evolutionists. Instead they are a chemist, a psychiatrist, a writer of anti-evolution texts, and the physicist co-author of a paper with Behe. The subtitle is good: this is a hunt for the failure of evolution.

The producers of science-like anti-evolution theories are a very small set. Each one offers some claim that Darwinism is wrong, with the (unwarranted) conclusion that life is *therefore* the work of an intelligent agent. Among the biologist sub-set, the most important and energetic is Behe. Like most others, he is associated with I.D.’s spearhead organization, the Center for Science and Culture, an anti-evolution think-tank within the Discovery Institute of Seattle, Washington. Behe insists that his (conservative Catholic) religion has nothing to do with his scientific views on evolution. His earlier book, *Darwin’s Black Box* (1996), started the I.D. assault. He named its key argument “irreducible complexity,” a putative quality of structures and processes within the living cell. “Black box” refers to the cell, because a *sub*-cellular biology arose only after Darwin’s death. The cell, Behe argued, includes irreducibly complex (I.C.) molecular machines. Like human-built machines, they work only if all parts are present and functional.

He provided fine textbook descriptions of several such machines, including the bacterial flagellum, the chain of reactions in blood clotting, and the system of adaptive immunity. “Darwinism,” as Behe glossed it, requires every structure or process of life to have been built up gradually in small steps. But, he declared, I.C. objects in cells cannot work if any part is missing. They must, therefore, have been *designed* from the start, or brought into existence “in one fell swoop.”

Ergo an agent with purpose, an Intelligent Designer, must be the maker of life. This is the 1802 natural theology of Paley, resurrected in 1996 using biochemical language.

It was quickly shot down. (Behe's own department colleagues took the trouble to dissociate themselves from it in print.) How was I.C. shot down? By many demonstrations—in the scientific literature, on several hundred web sites, online discussion lists, and blogs, and in the federal courtroom—that “irreducibly complex” biological objects can in principle and do in fact evolve in “Darwinian” fashion. They specified cases, including some of Behe's own, and pointed to a sixty-year-old resolution of these issues in the literature of genetics. Behe had failed to understand “exaptation” (the use of an available part in function “B” despite its original function “A”).

In response, Behe and the I.D. movement shifted ground, first by redefining I.C. in an effort to meet the flood of negation, finally (in effect) by scanting it in favor of more general claims. *The Edge of Evolution* is Behe's heroic effort to snatch victory from the jaws of defeat by way of such claims. Hence this is an important book. It represents the best the I.D. movement can do today in its effort to overcome “Darwinism” with science. Behe is a fine lecturer and an effective writer: the new book will convince many lay readers, as did its predecessor.

The only “bombshell,” however, is the towel thrown in on creationist convictions. Larry Arnhart, a political scientist and advocate of “Darwinian conservatism,” writes for his blog: “[T]he most remarkable feature of the book is [Behe's] attack on Biblical creationism. . . . Behe says that to treat the Bible as a ‘science textbook’ is ‘silly.’ . . . In embracing Darwinian common descent, Behe accepts the idea that human beings evolved from primate ancestors shared with the Chimpanzees . . . so Behe agrees with Darwin's declaration that the human species was ‘created from animals.’ . . . *Behe also doubts the power and morality of the intelligent designer.* . . .” (my emphasis). The qualification seems to support Behe's insistence that he is

offering scientific, as distinct from religious or metaphysical, arguments.

Nevertheless, Behe is clearly attempting to provide aid and comfort to I.D.ers by drawing a line in the sand beyond which Darwinism cannot go. That line in the sand is “the edge of evolution.” Behe makes a colossal claim, summarized in the book's front matter. He argues that among life-forms, all processes *up to* the making of species are adequately understood in standard science. (Behe concedes that speciation can be Darwinian.) But beyond species, he claims, on the higher taxonomic categories—genera, families, orders, classes, phyla—standard science fails. Moreover, Behe argues, standard science incorporating Darwinism fails to comprehend what is fundamental in *all* physical reality.

He had already offered irreducible complexity as proof of intelligent design: he now hitches it to the strong anthropic principle: a universe fine-tuned for human life, and not by accident. After fifty years of similar announcements, mainstream biology and cosmology remain unimpressed. Is there anything new, then, about *The Edge of Evolution*? Indeed yes. Behe has made a study of the literature of evolutionary genetics, and has written a detailed, selective, tendentious account of a few cases. The clear goal is to justify his original claim that the purposeful complexity of life cannot be a product of “random mutation,” that there must be intelligent design, and (*en passant*), that I.D. is the great scientific discovery of our age. Rare is the non-biologist reader, wishing to judge these technical arguments, who will come away from the reading with a grasp of evolutionary genetics or knowledge of what Behe has left out. Most of them may come away believing they have understood. That was the case with *Darwin's Black Box*.

It attempts to rescue the original I.C. argument. The claim is now that the I.C. systems Behe named are even more complicated than was known. This argument fails because numerous simpler, well-characterized versions of those systems exist in

other species, and they work. The book's central, and much better, argument goes like this: standard evolution builds its story on the three legs of Darwin's theory: random mutation, natural selection, and common descent. (Error: Darwin knew nothing of mutation, random or otherwise. "Mutation" came after his death. For him the material resource for natural selection was *variation*, which is universally observed but whose mechanism was unknown. Biological variation, which has no necessary connection to the organism's well-being, is omnipresent. It has allowed us, during our insignificant time on this planet, to domesticate and alter beyond recognition a host of plants and animals—by artificial selection.) But Behe does accept *natural* selection as the driver of biological change (he doesn't see it as a particularly brilliant idea). And he recognizes the consequence: common descent.

Once genetics appeared, with the discoveries of Mendel, the pool of spontaneous variations was recognized as due to gene mutation, upon which Behe focuses *The Edge*. Today evolutionary biology knows mutation as random change in genes by known physical-chemical processes, change indifferent to effect on the body in which it takes place. It characterizes mutations, as does Behe, as mostly but by no means entirely neutral or deleterious.

Behe explores several situations in which multiple mutations must occur in protein-encoding genes if some new function is to appear. Using selected numbers from the literature and assumptions about the frequency of the needed "random" mutations in the relevant populations (some unwarranted, as reviews in the major science journals promptly showed), he estimates the probability of evolution of a required new trait or protein-protein interaction. That probability, he finds, is too low to account for any but minor changes at the molecular level in simple organisms, and is therefore far too low for the creation of life's diversity.

His test cases include host/parasite relations in malaria (especially the evolution in

the pathogen of resistance to an antimalarial drug, chloroquine) and evolution of the AIDS virus, HIV. In both he concludes that Darwinian evolution has occurred. But these changes have been, in Behe's view, small, slow, damaging, mere trench warfare. (They are not "mere" for the host resisting infection or the parasite avoiding immune detection and death). According to his calculations, anything more complex, more *coherent*, any structural change of the kind that distinguishes the higher taxa of animals, could not happen in the time available—if the raw material were *random* mutation.

This is the common creationist claim that only micro-, never macro-evolution, can result from "random" or "chance" events. But Behe is too good a biochemist to deny that the differences between species, and genera, and families, all the way up the hierarchy, are *genetic* differences, that is, different sets of genes that have diverged via mutation and other forms of molecular rearrangement. How then can this biochemist deny what biochemistry and genetics display? He doesn't. He simply asserts that the mutations needed to make *important* changes *aren't random!*

According to Behe's calculations, proteins can't evolve by random mutation alone. The needed mutations must be designed. He compares his conclusions to the celebrated Michelson-Morley experiment (Nobel Prize, 1907) demonstrating the power of a negative result, which shattered forever the notion that interplanetary space is filled with a universal *aether*. In reference to his malaria argument, Behe writes:

This is where Darwin rules, in the land of antibiotic resistance and single tiny steps . . . but if just one or a few steps have to be jumped to gain a beneficial effect, as with chloroquine resistance, random mutation starts breathing hard. Skipping a few more steps appears to be beyond the edge of evolution.

Such trifling adjustments as drug resistance, in other words, are irrelevant to creation.

Mutations that combine to build new body plans are not of that Darwinian kind: they are instead fingerprints of the Designer.

Are Behe's model calculations sound? No. Had these arguments been submitted to peers in biochemistry and molecular biology, those expert in evolutionary genetics—at scientific meetings, via papers in scientific journals—would have enlightened him and he might have gone elsewhere in search of alternatives to Darwinism. But it seems that he did not do this. The scientific flaws are of two kinds: errors of the model itself and in the associated calculations, and (as in Behe's earlier book) ignoring important conflicting material in the primary literature. It would need a book longer than *The Edge* to restate the model together with its already noticed (in print and online) errors and omissions. This much, however, can be said: First, the calculated probabilities, upon which the main argument of the book depends, come from a single report in the literature on the frequency of spontaneous resistance to a drug in the malaria parasite (*Plasmodium*). That frequency was in the first place a mere guess by its author, and it does not anyway measure the likelihood of what Behe thinks it measures. Reviews swiftly explained this mistake. The facts of drug resistance in this and other pathogens illustrate—by measurement, not just theory—vastly greater probabilities.

Second, Behe assumes simultaneous mutations at two sites in the relevant gene, but there is no such necessity and plenty of evidence that cumulateness, rather than simultaneity, is the rule. As *Nature's* reviewer (Kenneth R. Miller) notes, "It would be difficult to imagine a more breathtaking abuse of statistical genetics." Third and finally, the book's grand argument ignores the known, frequent appearance, by Darwinian pathways, of protein-protein interactions in small populations. There is a vast experimental and theoretical literature on protein evolution.

That is no reason for Professor Behe or anyone else to stop questioning. Behe has once or twice had a few biologists hopping

and their responses have enriched the literature. But success in toppling "Darwinism," uncovering honest evidence of interventions so far undetected in the history of life, supernatural or otherwise, will come—if ever—only through painstaking work in natural science, which includes rigorous peer review.