evolutionary theory past and present

"It's Only a Theory," or At My Back I Cringe to Hear / The Texas School Board Drawing Near

Books Under Review

The Greatest Show on Earth: The Evidence for Evolution
by Richard Dawkins. Free Press, 2009.

Why Evolution Is True
by Jerry A. Coyne. Viking, 2009.

HAROLD FROMM

> Ignorance more frequently begets confidence than does knowledge: it is those who know little, and not those who know much, who so positively assert that this or that problem will never be solved by science.
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> —Charles Darwin, *The Descent of Man*, Introduction (1871)

In a moment of cocky self-assurance, I told myself that reviewing Richard Dawkins' latest book, *The Greatest Show on Earth: The Evidence for Evolution*, would be a breeze. Familiar stuff, same-old same-old, I confidently thought as I geared up for the task.

Wrong!

The physical book alone should have given away the show. From its larger than routine type size and generous spacing between the lines to its aesthetically gratifying paper, not to mention the very attractive black and white drawings throughout complemented by several sections of glossy colored illustrations, this sensuous physical artifact was definitely telling me something, to wit: the Free Press regards this as an important, maybe even a classic book. And if so, they're right!

I couldn't help trying to imagine what the fate of reading might be in the not-so-distant future if Kindles and iPads were ever to become the default matrices for the experience of reading. There can be little doubt that the vehicle is an aspect of the significance of the text.

After the magisterial achievement of *The Ancestor's Tale*, how much motivation and stamina could Dawkins possibly have left for a roll in the muck

with creationists? "More than 40 percent of the American people believe literally in the story of Noah's Ark. We should be able to ignore them and get on with our science, but we can't afford to because they control school boards, they home school their children . . . and they include many members of the United States Congress" (269–70). And yet, instead of world-weariness, what results here is another Olympian performance.

Early on, Dawkins reprints a cartoon that sets the stage for what follows: seven creatures are seated at a bar, drinking. They range from a fish at one end, through various mammals, an ape, and then a *Homo sapiens* at the other end, all being lectured to by a very *Homo sapiensy* clerical type wearing glasses, who says, "I still say it's only a theory." The four hundred or so pages that follow demonstrate why Dawkins is such a celebrated personage. Immense knowledge, uncommon rhetorical skill, and very little obeisance to pieties. Right off the bat he sticks it to Plato, the true begetter of all our denialist woes, for his idealist essentialism. "The discovery of evolution was held back by the dead hand of Plato" (21). (Twenty-first-century essentialist "history-deniers" are given their own what-for in a little appendix.) But this book is not merely "an anti-religion book," Dawkins remarks. "I've done that, it's another T-shirt, this is not the place to wear it again. . . . Rather, I realized that the evidence for evolution was nowhere explicitly set out, and that this was a serious gap that I needed to close" (6). Of course, he can't resist other jabs at superstition when the occasions arise. (A ten-thousand-year-old planet, anyone? As I write this, the Texas school board is ensuring the creationist spin of future science textbooks.)

After dealing with the "only a theory" folks, patiently explaining (as does Jerry Coyne) the meaning of "theory" in the sciences as opposed to everyday life, Dawkins provides an especially rich chapter on the ways in which artificial and natural selection tend to blend, strikingly so in the case of the effects of male birdsongs on females and the results of selective breeding of wolves for tameness, which brought with it other, unexpected, physical traits along for the ride. "If we imagine the sheer quantity of difference that separates a pye-dog from a peke, which took only a few centuries of evolution . . . it becomes rather easy to accept that evolution could accomplish the amount of change that it took to transform a fish into a human" when two million centuries are involved (81–82).

In the chapter on methods of dating the age of fossils and geological remains, Dawkins goes into great detail, teaching us a good deal about dendrochronology (tree ring dating), radioactive half-lives, and carbon dating, which he characterizes as types of clocks more complex than ordinary tick-tocks, digital watches, or the visible physical locations of fossils in rock strata. Still, ocular evidence is often enough for seeing evolution in action, as when bacteria and fruit flies are bred in labs so that thousands of generations can be witnessed as they undergo mutation. As for the so-called missing links (to which a chapter is devoted), they are less missing all the time. I write this as reports have surfaced of the discovery of 1,500 post-Cambrian fossils in Morocco that revise the datelines and fill in various gaps in the evolutionary calendar.

In an especially inspired chapter, "You Did It Yourself in Nine Months," Dawkins finishes off once and for all the "irreducible complexity" mantra of intelligent design fanatics who seem completely impenetrable when it comes to the concept of gradual development of complex functions that are nevertheless viable at each stage. They can't seem to understand that the intermediate stages between all those primitive stages and the sublime "us" do quite well, however clumsily, with the equipment they've got. There is no blueprint, no knowledge or plan in advance that results in complex creatures. Rather, like the sheet of paper that origami transforms into complex objects, one of Dawkins' inspired analogies for development, "Your hands may do the folding, but you are emphatically not following a blueprint for a Chinese junk. . . . You are following a set of folding rules that seem to have no connection with the end product until it finally emerges like a butterfly from its chrysalis" (224). Development (as embryology) does not follow global rules, only local ones. (And there is an implied connection here with the "folding" of proteins.) "A cell is a versatile chemical factory, capable of spewing out massive quantities of a wide variety of different substances, the choice being made by which enzyme is present. And how is *that* choice made? By which gene is *turned on*" (241). We

learn a good deal here too about what it means to "fold" proteins: "When a gene is turned on in, say, a cell of the pancreas, its sequence of code letters directly determines the sequence of amino acids in a protein; and the sequence of amino acids determines . . . the shape into which the protein folds itself; and the shape into which the protein folds itself determines the precisely shaped sockets that marry up substances drifting around in the cell" (242).

There are brilliant digressions throughout that instantiate the more difficult ideas, though Dawkins is aware that not all his readers like his digressions (244). "I hope my euphoric digression on the elegance of *Caenorhabditis* research has not distracted us too far from the point I was making about how cell types change in their shape and character as they branch away from one another in the embryonic family tree" (245). Far from it, since these rich asides are repositories of difficult concepts made graphic.

After a look at the ways in which plate tectonics have influenced speciation, Dawkins goes on to surprise us with examples of how stupid "intelligent design" really is, given the serious "design" flaws in most organisms. Since natural selection cannot invent anything from scratch, its work is mainly to patch up existing low-survival structures with modifications, add-ons, or subtractions. The chest arteries as survivors of fish gills, the detours taken by the laryngeal nerve in humans that in a giraffe are "beyond a joke"(360), the preposterous route of our vas deferens from testis to penis: "History is written all over the body, not just once but repeatedly, in exuberant palimpsest" (367). Consider too the flightless birds whose vestigial wings serve other purposes or gradually diminish and disappear altogether. And those roadrunners outside my window here in Tucson can do a few flaps of their wings but not much more.

Even the arms race that increases the skills of predator and victim is testimony to the incompetence of the Creator: the cheetah's efficiency as a killer is diminished by the gazelle's increasing speed as a runner, "a heavy dose of futility" (384), since legs that are long and thin for running are more likely to break, ultimately fatal whether it happens to gazelle or cheetah. "Natural selection can drive a population to extinction, while constantly favouring, to the bitter end, those competitive genes that are destined to be the last to go extinct" (390). And the conclusion to such a reality? "Natural selection is *all* futile" (392).

In the last chapter of this remarkable book, "There Is Grandeur in This View of Life," Dawkins exhibits a final display of his own virtuosity by analyzing the famous concluding sentences of Darwin's masterpiece. Although he is dubious about higher animals being "the most exalted object which we are capable of conceiving," he readily assents to the "war of nature" and "famine and death" as the engines of evolution. He explains his omission of "by the Creator," in his quotation of "originally breathed into a few forms or into one," as his own preference for the first edition of *On the Origin of Species* over the later ones that inserted it to pander to early critics. In defense of the omission, he quotes from a letter by Darwin to Joseph Hooker in 1863: "I have long regretted that I truckled to public opinion, and used the Pentateuchal term of creation, by which I really meant 'appeared by some wholly unknown process.' " (404).

The discovery of genes, DNA, and multitudes of new fossils since Darwin's speculations has resulted in major refinements that Dawkins has at his disposal. So with regard to "into a few forms or one," he is in a position to tell us that

> Darwin was right to hedge his bets, but today we are pretty certain that all living creatures on this planet are descended from a single ancestor. The evidence . . . is that the genetic code is universal, all but identical across animals, plants, fungi, bacteria, archaea and viruses. The 64-word dictionary, by which three-letter DNA words are translated into twenty amino acids and one punctuation mark, which means "start reading here" or "stop reading here," is the same 64-word dictionary wherever you look in the living kingdoms. (408–09)

As for the notion of "from so simple a beginning," Dawkins is prepared to concede that "we know little more than Darwin did about how it [evolution] got started in the first place," but undaunted, Dawkins offered miscellaneous speculations unsuited to summary here.

In a brief appendix, Dawkins gives the history-deniers one last what-for. Are they worth it? Is there a limit to tolerance of stupidity or, to borrow a Kierkegaardian phrase, faith in the absurd? Dawkins answers this question: "More than 40% of Americans deny that humans evolved from other animals, and think that we—and by implication all of life—were created by God within the last 10,000 years. This book is necessary." So be it!

Like Dawkins' book, Jerry Coyne's *Why Evolution Is True* was published in 2009, but both authors were clearly aware of each other's production and, indeed, by one method or another (given the time constraints) they each managed to make at least one quite cordial cross-reference. And why not? Despite these books' coverage of similar territory, they are hardly redundant. Coyne has been a professor of ecology and evolution at the University of Chicago for more than twenty years now, with a specialty in genetics and species origins that is pretty apparent from the emphases of his book. Dawkins' blurb for Coyne on the book jacket is characteristic of his ebullience and helps to define the differences in persona between the two authors and their work. "Anybody who doesn't believe in evolution is stupid, insane, or hasn't read Jerry Coyne," he writes, among other things. And it's hard to dispute that anyone who happens to read these two books seriatim as I did, and who nonetheless continues to deny the fact of evolution, is clearly certifiable and should move to Wasilla, Alaska, or Texas. If Dawkins is the rhetorical virtuoso, literary, allusive, demotic, multimedia, irreverent, Coyne is the clean-prosed, learned descendant of Hume, though not quite as ironic. If you think lucid, transparent writing is a cinch to produce, think again. It's the most difficult of all.

Coyne's first chapter sets the stage for what follows:

> Life on earth evolved gradually beginning with one primitive species—perhaps a self-replicating molecule—that lived more than 3.5 billion years ago; it then branched out over time, throwing off many new and diverse species; and the mechanism for most (but not all) of evolutionary change is natural selection.
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> When you break that statement down, you find that it really consists of six components: evolution, gradualism, speciation, common ancestry, natural selection, and nonselective mechanisms of evolutionary change. (3)

In "Written in the Rocks," one of several rich chapters, Coyne explains that even though there have been an estimated seventeen million to four billion species on the planet—in other words, *mostly* "gaps"—the fossil record is revelatory nonetheless, especially since we now have such useful methods of dating it. After accounts of plankton and trilobites, Coyne asks, "How did early fish evolve to survive on land?" What was the transitional phase like? "After five long years of fruitless and expensive search," he reports, his colleague Neil Shubin "finally hit pay dirt" on Ellesmere Island in the Arctic Ocean north of Canada. "When Shubin first saw the fossil face poking out of the rock, he knew that he had at last found his transitional form. In honor of the local Inuit people and the donor who helped fund the expeditions, the fossil was named *Tiktaalik roseae* . . . a direct link between the earlier lobefinned fish and the later amphibians" (37). One of the many beautiful drawings illustrating the book shows how *Tiktaalik* serves as a stepping stone to the early footed fish that eventually became us. "*Tiktaalik* shows that our ancestors were flat-headed predatory fish who lurked in the shallow waters of streams. It is a fossil that marvelously connects fish with amphibians" (38).

In a chapter on vestiges, embryos, and bad design, Coyne, like Dawkins, shows the inability of evolution to clear the decks and start from scratch, so that many species have either disappeared altogether or survived as a result of cockamamie workarounds by natural selection. "Organisms are palimpsests of history—evolutionary history. Within the bodies of animals and plants lie clues to their ancestry, clues that are testimony to evolution. . . . What's more, in their development from embryos, many species go through contortions of form that are bizarre: organs and other features appear, and then change dramatically or even disappear completely before birth" (56). And when you see a photograph of a human infant born with the rudiments of a tail (that will need to be surgically removed) even a somewhat dense specimen of *Homo sapiens* might begin to think ill of a supposedly intelligent designer.

In a chapter on biogeography, the unlikely distribution of rare plants and animals at only certain points around the globe is explained by means of fossils of the *Glossopteris* tree, "scattered in swatches across the southern continents. The pattern can't be explained by overseas dispersal, because *Glossopteris* had large, heavy seeds that almost certainly couldn't float. Could this be evidence for *creation* [italics added] of the plant on different continents? Not so fast" (98–99). The explanation is irrefutable: during the late Permian period the giant continent of Gondwana had not yet broken apart into the ones we recognize today. "It isn't the trees that migrated from continent to distant continent, then: it is the continents themselves that moved, carrying the trees with them" (99). In sum, Coyne concludes, "The main lesson of biogeography is that only evolution can explain the diversity of life on continents and islands. But there is another lesson as well: the distribution of life on earth reflects a blend of chance and lawfulness" (109).

Turning pointedly to "us," Coyne tells the story of Lucy, the 3.2-million-year-old fossil found in 1974 and named after the Beatles' "Lucy in the sky with diamonds," a hot item at the time. "She was between twenty and thirty years old, three and a half feet tall, weighing a scant sixty pounds, and possibly afflicted with arthritis. But most important, she walked on two legs" (200). How do we know that? "From the way that the femur (thighbone) connects to the pelvis at one end and to the knee at its other. In a bipedally walking primate like ourselves, the femurs angle in toward each other from the hips so that the center of gravity stays in one place while walking. . . . In knuckle-walking apes, the femurs are slightly splayed out, making them bowlegged" (200). So if you look at the fit of femur with pelvis, you can tell if a creature walked on two legs. Fossils tell an evolving story, even with gaps.

So much that was unavailable to Darwin is now common information we take for granted, yet the discoveries continue to grow and to surprise us anew with a still more enriched picture of our own evolution. Not only the fossil record, which seems to be expanding rapidly, but the genetic record made possible by DNA analyses. Of course politics always intervenes in the acquisition of knowledge, having its own axes to grind and bulls to gore. A few years ago to speak of "race" was verboten as little more than bigotry (my very use of scare quotes gives away the show) but now it is back with more multivalence and subtlety than ever, which Coyne rightly reviews with approval for its real world information. Moreover, as a putdown to our sense of smug superiority, we were told how tiny a percentage of genetic difference exists between apes and us. Now, however, Coyne can deflect us into unlearning yesterday's political correctness:

> Now that we've finally sequenced the genomes of both chimp and human, we can see directly that more than 80 percent of all the proteins shared by the two species differ in at least one amino acid. Since our genomes have about 25,000 protein-making genes, that translates to a difference in the sequence of more than 20,000 of them. . . . More than 6 percent of genes found in humans simply aren't found *in any form* in chimpanzees. (211)

Why Evolution Is True concludes with a chapter outlining some of the moral and ethical concerns and fears that have developed over the years about the meaning of human life in a purely material and naturalistic universe. Most of these concerns have the stale aroma of antiquated ultra-conservative religious narcissism rather than "piety." As for the small band of intellectuals who waste their time and others' with casuistries to reconcile religion and science, the few eminent scientists among them constitute a sort of rear-guard Tea Party of feel-goodism. The seventeenth-century physician and brilliant prose stylist, Sir Thomas Browne, bragged modestly in his *Religio Medici* ("the religion of a doctor") that he was a "true amphibian" who easily lived in "divided and distinguished worlds," by which he meant the world of science and the world of conventional piety and faith. But what was charming in him four hundred years ago is just metaphysical pie-throwing today.

These first-rate books by Dawkins and Coyne ought to serve as a *terminus ad quem* of books attacking creationism and intelligent design. Is it necessary still to produce

books against geocentrism, the theory of the humours, the self-existence of souls, spirits, and spooks? There's now not much left to say about creationism, given the overwhelming collection of multidisciplinary evidence that Dawkins and Coyne bring to bear on the truth of evolution. As for the "it's only a theory" folks, maybe it's now time to leave them to heaven—or the Templeton Foundation.