the weekly Standard

Teaching Darwin
Why we're still fighting about biology textbook.
by Paul McHugh
03/28/2005, Volume 010, Issue 26

EIGHTY YEARS AGO THIS SUMMER, the Scopes trial upheld the effort of the state of Tennessee to exclude the teaching of Darwinian evolution from Tennessee classrooms. The state claimed Darwinism contradicted orthodox religion. But times change, and recently a federal judge ruled that a three-sentence sticker stating that "evolution is a theory not a fact" must be removed from Georgia high school biology texts because it contradicts orthodox science and represents an unconstitutional endorsement of religion. Both legal mandates--no Darwin yesterday, nothing but Darwin today--look less like science than exercises in thought control.

Everyone agrees that the Scopes trial (viciously caricatured in the play and movie *Inherit the Wind*) was a setback for the teaching of scientific reasoning. But the same is true of the Georgia ruling, Darwinism being quite obviously a biological theory and open to dispute. To claim otherwise is to be woefully misinformed.

Science, as high school students need to know, is a logically articulated structure of beliefs about nature that are justified by methods of reasoning one can evaluate. It is whether the methods pass muster that counts for or against a scientific opinion, not how the opinion fits our preconceptions.

Charles Darwin proposed that random variation within life forms, working together with natural selection ("the preservation of favorable variations and the rejection of injurious variations") across the vast expanse of time since the earth was formed, explains "how the universe created intelligence," as Francis Bacon had stated the problem a few centuries before. To judge whether the matter is now closed to all criticism, such that Darwinism stands with scientific facts like "the earth is a planet of the sun" or "the blood circulates in the body," demands we consider Darwin's method of reasoning.

The leading Darwinist in America, Ernst Mayr, describes the method:

> *Evolutionary biology, in contrast with physics and chemistry, is a historical science--the evolutionist attempts to explain events and processes that have already taken place. Laws and experiments are inappropriate techniques for the explication of such events and processes. Instead one constructs a historical narrative, consisting of a tentative reconstruction of the particular scenario that led to the events one is trying to explain.*

Darwin, Mayr goes on, "established a philosophy of biology . . . by showing that theories in evolutionary biology are based on concepts rather than laws."

After noting Mayr's fearless use of the words "tentative," "philosophy," and "theory," one surely is justified in responding: No wonder Darwinism, in contrast to other scientific theories, seems an argument without end! It's *history*--indeed, history captured by that creative-writing-class concept *narrative*. If historical narrative--and the "philosophy" it propounds--are what justify the Darwinian opinions, the textbook writers of Georgia can legitimately claim that Darwin's "tentative reconstruction" is not only a theory but a special kind of theory, one lacking the telling and persuasive power that theories built on hypothesis-generated experiment and public prediction can garner.

DARWIN HIMSELF UNDERSTOOD that questions raised about his narrative had substance. In Chapter IX of *On the Origin of Species*, he noted that the fossil record had failed to "reveal any . . . finely graduated organic chain" linking, as he proposed, existing species to predecessors. He called the record "imperfect" and went so far as to say, "This, perhaps, is the most obvious and gravest objection which can be urged against my theory." Darwin presumed that the problem rested on the "poorness of our palaeontological collections" and would be answered when more of "the surface of the earth has been geologically explored."

In the same Chapter IX, Darwin also acknowledged that the fossil record does suggest the "sudden appearance of whole groups of allied species all at once." He noted that if this fact were to stand, and "numerous species belonging to the same genera or families have really started into life all at once, . . . [it] would be fatal to the theory of descent with slow modification through natural

selection." He forestalled that fatal blow to his theory by asking his readers not to "over-rate the perfection of the geological record."

Any sympathetic reader of Darwin's history would readily allow him the point--that earlier life forms might have all come and gone elsewhere than where later forms emerged and might have done so without leaving a fossil record to demonstrate the smooth gradation between species. But such a reader should admit, as Darwin did, that the absence of the record is a serious matter--especially when it persists to this day, nearly a century and a half after Darwin's book was published. This imperfection of the historical record was, after all, sufficiently embarrassing to provoke some evolutionary biologists nearly 100 years ago to try to improve on the record by manufacturing the counterfeit fossil Piltdown Man.

Even among committed Darwinists, the imperfection of the fossil record has been a source of huge argument. The Darwinian fundamentalist Richard Dawkins of Oxford believes in smooth and gradual evolutionary processes. He became a vicious antagonist to Stephen Jay Gould of Harvard, who championed "punctuated equilibrium," with abrupt species generation after millennia of stability. Dawkins attacked Gould in large part because Gould's idea greatly shortened the time evolutionary processes had to generate species.

All the more reason, then, for our sympathetic reader to look for other means of supporting Darwin's narrative. Perhaps the demonstrable variations that occur in species living under altered circumstances might answer objections.

With this in mind, Darwin devotes the very first chapter of *On the Origin of Species* to describing variations in plants and domestic animals produced over time by methodical selective breeding by farmers and fanciers. Plainly their practice of permitting only the most choice individuals to reproduce and so "enhance the breed" demonstrates how hereditary modification of members of a given species is possible--indeed, it displays the process.

Darwin, however, then makes an extrapolation. Beginning with the reasonable presumption that the hereditary mechanisms involved in producing these enhancements in the barnyard must be available and randomly active in nature, he proposes that from such random variation can spring new species. Variation--repeated ad infinitum down the ages, with its products culled by natural selection rather than by artful human breeding--is the process by which Darwin links up all of biologic creation. This is the Darwinian narrative in its clearest form--history by extrapolation--and it is not problem-free.

MANY OF US were taught these Darwinian extrapolatory links to the evolutionary narrative in high school, usually with photographs of the European peppered moth (*Biston betularia*), which became darker with environmental pollution and thus less conspicuous to bird predators in industrial areas. The same idea springs up in discussions of the development of bacterial resistance to antibiotics, or of the transformation of the beaks of finches under the pressure of drought. We were taught in high school that these observable biologic changes display evolution "in front of your eyes."

But not everyone agreed with this conclusion. Many criticized the Darwinists for extrapolating too far, and now the Darwinists confess that actual, observable variation--whether in the barnyard or in nature--demonstrates only the capacity of a species population to vary within limits. The original species picture reappears when either the farmer's selective enterprise or the natural environmental pressure on the species population stops and crossbreeding recurs. The finches' beaks never turn into pelican pouches but revert to their original shape when the rains arrive.

No farmer or experimental scientist has ever produced a new species by cultivating variations. The peppered moth didn't become a butterfly, and the closely and repeatedly studied fruit fly, despite gazillions of generations producing varieties in the laboratory, always remains a fruit fly. Again, Darwin himself was more honest than his followers have been. He knew the distinction between variations that could be observed and those posited according to the theoretical extrapolation that was key to his narrative. For this reason he repeatedly notes, as in Chapter IV of *On the Origin of Species*, that "natural selection will always act very slowly, often only at long intervals of time, and generally on only a few of the inhabitants." In this way he puts the process of species generation outside the reach of experimental demonstration.

At this point, the sympathetic reader eager to secure Darwin's narrative might resort to searching the "biochemical record." Surely the molecular structures of DNA, RNA, and proteins contain the long-sought evidence**.** Again, though, molecular biology helps in some ways in that it shows commonalities across species--just as other aspects of anatomical structures show commonalities--but again it's the distinctions--and the means by which they are generated--rather than the similarities that must be explained to support the theory.

If one turns to DNA to show how Homo sapiens gradually emerged by small and random variations from predecessors, one faces an immediate problem. At the level of DNA, humans and chimpanzees differ by a mere 1 percent, yet the chimpanzee is not 99 percent human in body, brain, or mental faculties--far from it. We need something more than the DNA record to support a narrative linking chimps and men.

Perhaps it's enough for the friendly guardian of the Darwinian narrative to propose that the genes that control the switching on and off of other genes simply changed in some random way, allowing humans to branch off the primate line. And maybe they did. But again, notice, this is a molecular narrative, not a proposition demonstrable by experiment. It's a story that fits the facts--but so might another.

SURELY AT THIS POINT the friendly reader might agree that, like any historical account, the Darwinian narrative can fairly be challenged--not to say that it must be wrong, only that it needs more supportive evidence. Perhaps there are statistical proofs or engineering concepts that could be found, or something else that might emerge that would be subject to verification by the scientific method.

But our would-be friend to evolution will soon discover that *any* questioning of the Darwinian narrative, no matter how sympathetic, is shouted down. If mathematicians try to say that even with the immense span of geological time available for random genetic variations to act, there is not time enough to produce the human eye, the response--typical for historians, who routinely argue backward from observations to their causes--is, Since the eye exists the math must be wrong.

If Michael J. Behe, the cellular biochemist who wrote *Darwin's Black Box*, proposes that the complicated molecular mechanisms sustaining the integrity of the cell seem impossible to explain as the result of random variations, the president of the National Academy of Sciences counters by pronouncing, "Modern scientific views of the molecular organization of life are entirely consistent with spontaneous variation and natural selection driving a powerful evolutionary process." That is, he affirms the Darwinian narrative by restating it, not by offering compelling proof that it is true. Lots of views are consistent with the cell's complexity--including the view Behe explores, that an intelligent creator designed the cell to work. But cellular formation needs identified generative mechanisms, not simply a consistent narrative, to *explain* it--a problem both for those who call on Darwin and those who call on an "intelligent designer."

Official science is too much at ease with the Darwinian narrative--primarily because it can't come up with anything better. As a result, many scientists are driven by an ideological bias and by fear--the thought that any challenge to the narrative will plunge the republic back into some dark age. Richard Dawkins and his associate Niall Shanks predict that, as Shanks wrote, "discriminatory, conservative Christian values [will be imposed] on our educational, legal, social and political institutions" should the public schools permit any airing of questions about the Darwinian narrative. This fear is way over the top, but it's of long standing, and in the past has provoked some loss of judgment among scientists.

When the most distinguished biological scientist of the 20th century, Francis Crick, saw the same complications as Michael Behe, he also concluded that time on Earth and random variation were not adequate to produce the viable cell. Crick resolved the dilemma, in a fascinating book called *Life Itself* published in 1981, by suggesting that living cells arrived on an unmanned spaceship from another planet, perhaps sent by intelligent beings facing extinction. He called his concept "directed panspermia," and this strange concept (I prefer to call it "life from Krypton") received a respectful hearing from biologists. With this imaginative device Crick could keep the narrative alive. He explained life's cellular origins without worrying about time, kept the God he hated out of the picture, and preserved the possibility of random variation and natural selection working their magic from these "seedlings" from a "galaxy far far away."

BY NOW, it would seem that a sympathetic reader of Darwin, if honest, could conclude the following. Darwinism is an imperfect theory, based as it is on a historical narrative, and carrying as it does the remarkable capacity to explain anything and exclude nothing. It has great strengths, and it has great evidential lacunae that seem no closer to resolution than when Darwin himself called attention to them 146 years ago.

The biological evidence--life rests on the cellular organization of nucleotides and proteins--compels the conclusion that all the various forms of life on Earth derive from a common source, as Darwin emphasized. Life is not recreated with every new species--this is now undeniable. The Darwinian concept of descent with modification seems the most plausible way to relate life and its varieties. Modifications within species are often responses to environmental challenges, and they sustain a species with the variety of expressions necessary for it to survive these challenges.

But when one tries to grasp how the distinct species, as against varieties, are generated--by what mechanism they separate--a pause to reflect is warranted. Darwin's random variation and natural selection may well offer the best available narrative, the most compelling theory. Yet something seems missing--for example, any sense of what propels life's forms toward a progressive complexity, rather than toward a simplicity of design that would guarantee survival come what may.

The discipline of evolutionary biology today resembles astrophysics when Galileo was attempting to explain the planetary orbits and the oceanic tides but lacked the concept of the force of gravity. His observations were accurate enough, but explanations awaited an Isaac Newton.

Evolutionary biology awaits its Newton. And until such a thinker emerges--to provide a fuller conception of the history of life and especially the forces at play that explain how things happened as they did--those who would expel all challenges to the Darwinian narrative from the high school classroom are false to their mission of teaching the scientific method.

Scientists as they engage in dialogue with others should abhor attempts to close off the conversation by excessive claims for any privileged access to truth. Scientists should tell what they actually know and how they know it, as distinct from what they believe and are trying to advance. If all of us, scientists and non-scientists alike, accepted that guiding principle, the 80-year history of attempts to use law to stifle the teaching of science--stretching as it does from the courtrooms of Dayton, Tennessee, to those of

Cobb County, Georgia--could perhaps finally be brought to a close.

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