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Essay Reviews

An American Malaise: The Debate between Darwin and Christian Fundamentalism[1]

Francisco J. Ayala

Department of Ecology and Evolutionary Biology
University of California
Irvine, CA 92697-2525, USA

KENNETH R. MILLER, *Finding Darwin's God. A Scientist's Search for Common Ground Between God and Evolution,* New York: Cliff Street Books/HarperCollins Publishers, 1999, xiii + 338 pp., illus., $25.00.

RONALD L. NUMBERS, *Darwinism Comes to America*, Cambridge, MA / London: Harvard University Press, 1998, 218 pp., $39.95 ($18.95 paperback).

JOHN C. GREENE, *Debating Darwin*, Claremont, CA: Regina Books, 1999, 288 pp., $34.95.

The United States spends annually more than $200 thousand million on scientific research and technological development (R&D). Between 1995 and 1999, the outlays for R&D grew at a rate greater than 9% per year, in constant dollars, and the rate of yearly increase itself has been increasing. This expenditure is widely perceived as sound and as a high-return investment. President Clinton's Council of Economic Advisors estimated that 50% of all economic growth in the U.S. over the last 50 years can be directly credited to scientific discoveries and technological developments performed over the same period. The returns on the investment are splendid: the country invests 3% of the yearly gross domestic product (GDP, currently valued at more than $7 million million) on R&D and gets in return 50% of the GDP annual growth,

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substantially greater than the value of the investment. Astonishingly, the favorable impact of R&D on the U.S. economy seems to be accelerating over time. The large expansion of the U.S. economy over the last decade (and its unanticipated association with virtually full employment without inflation) has been attributed to the investment in R&D by Alan Greenspan, the Federal Reserve Chairman. In the summer of 1999, he said: 'The evidence ... for a technology-driven rise in the prospective rate of return on new capital, and an associated acceleration in labor productivity, is compelling' (President's Committee of Advisors on Science and Technology, *Wellsprings of Prosperity*, Office of the President, 2000, p. 29). Scientific discoveries and technological achievements pervade the gamut of human activities and concerns: health care, agriculture, industrial development, transportation, information technologies, and more.

The United States enjoys a formidable assortment of universities and research institutes, where scientists and engineers receive superb training, as do millions of college, graduate, and postdoctoral students and researchers.

An observer from a different planet, or a casual spectator from a different country, might conclude that, underlying the great research institutions and the endless scientific discoveries, and subjacent to the country's enormous investment in R&D, there must be in the U.S. an excellent school system, engaged in the education of the young and preparing them for productive careers in scientific research and technological development. Alas, the observers would be wrong. Surely, there are in the U.S. many excellent elementary and secondary schools, where superior science education is imparted as part of the curriculum. But there are many others, perhaps a majority, where science courses are degraded or, in extreme cases, virtually absent from the curriculum. One reason is that there are no nationally prescribed program of studies, course requirements, or assessment standards for either elementary or secondary education. There are 16,000 school districts in the United States, each of which largely independently decides the school curriculum, the subjects to be studied and assessed, and the textbooks to be used. These matters are, to some extent, determined at the state level, and each of the 50 states of the Union zealously protects its right to self-determination in educational goals, as in many other matters.

An example of aberrant behavior is the decision by the Kansas Board of Education on 11 August 1999 to remove all references to cosmology and evolution from the State's education standards and assessments. The public schools are not forbidden to teach cosmology and evolution, but these would not be subjects for assessing scholastic achievement. Subject matters not subject to examination are unlikely

to be taught in the schools, at least at any length and depth, which is precisely the objective sought by the Board.

The Governor of Kansas, the moderate Republican Bill Graves, called the School Board's decision 'a terrible, tragic, embarrassing solution to a problem that did not have to exist', and announced that he would seek to erase the decision through legislation or otherwise. This may now be unnecessary, since recent events make it likely that the Board will reverse its decision after the elections due on 7 November 2000. The Board had passed the decision with a 6 to 4 vote. In the Republican Party primary elections held on 1 August 2000, four of the six Republicans who favored the decision were due for reelection; three of them were defeated by candidates who have promised they would vote against the decision. These Republican candidates will face, in November, Democratic candidates, who also oppose the decision. Whatever the outcome of the November election, only three conservatives will remain on the Board.

The decision of the Kansas Board of Education does not, however, represent an uncommon attitude in the United States. It rather reflects a conviction, common among biblical literalists and other Christian fundamentalists, that the teachings of science concerning the origin of the universe, the living world and, most importantly, humans, are contrary to the Biblical texts and the Christian faith. This conviction was not, however, the reason alleged by the Kansas Board members who endorsed the majority's decision. The United States Constitution's separation of Church and State, as forcefully set out in its First Amendment, and numerous decisions by federal courts, would have made the religious grounds obviously unconstitutional and subject to judicial challenge. Rather, members of the Kansas School Board ostensibly constituted themselves into fly-by-night scientists and epistemologists who rejected the recommendations of their own panel of experts and declared that the theory of evolution is nothing but theory, rather than fact; and that science relies on observation, replication, and experimentation, but nobody has seen the origin of the universe or the evolution of species, nor have these events been replicated in the laboratory or by experiment

The Kansas Board members, like other anti-evolution fundamentalists, fail to know that when scientists talk about the 'theory of evolution', they use the word 'theory' differently than in ordinary language. In everyday English, a theory is an imperfect fact, as in 'I have a theory as to what caused the explosion of flight TWA 800'. In science, however, a theory is based on and incorporates a body of knowledge. According to the theory of evolution, organisms are related by common descent. There is a multiplicity of species

because organisms change from generation to generation, and different lineages change in different ways. Species that share a recent ancestor are therefore more similar than those with more remote ancestors. Thus, humans and chimpanzees are, in configuration and genetic make-up, more similar to each other than they are to baboons or to elephants.

Scientists agree that the evolutionary origin of animals and plants is a scientific conclusion beyond reasonable doubt. They place it beside such established concepts as the roundness of the earth, its revolution around the sun, and the molecular composition of matter. That evolution has occurred is, in ordinary language, a fact.

How is this factual claim compatible with the accepted view that science relies on observation, replication and experimentation, since nobody has observed the evolution of species, much less replicated it by experiment? What scientists observe are not the concepts or, general conclusions of theories, but their consequences. Copernicus heliocentric theory affirms that the earth revolves around the sun. Nobody has observed this phenomenon, but we accept it because of numerous confirmations of its predicted consequences. We accept that matter is made of atoms, even though nobody has seen them, because of corroborating observations and experiments in physics and chemistry. The same with the theory of evolution. For example, the claim that humans and chimpanzees are more closely related to each other than they are to baboons leads to the prediction that the DNA is more similar between humans and chimps than between chimps and baboons. To test this prediction, scientists select a particular gene, examine its DNA structure in each species, and thus corroborate the inference. Experiments of this kind are replicated in a variety of ways to gain further confidence in the conclusion. And so it is for myriad predictions and inferences between all sorts of organisms.

Not everything in the theory of evolution is equally certain. Many aspects remain subject for research, discussion and discovery. But uncertainty about these aspects does not cast doubt on the fact of evolution. Similarly, we do not know all the details about the configuration of the Alps and how they came about, but this is no reason to doubt that the Alps exist.

The theory of evolution needs to be taught in the schools because nothing in biology makes sense without it. Modern biology has broken the genetic code, developed highly productive crops, and provided knowledge for improved health care. Students need to be properly trained in biology in order to improve their education, their chances for gainful employment and to enjoy a meaningful life in a technological world.

Does the teaching of evolution pose a threat Christianity or to religion? This question needs to be answered in two parts. There are those who profess a materialistic philosophy and seek to ground it on the theory of evolution and other scientific claims. They point out the great success of science in explaining the workings of the universe, and claim that there is no room for other kinds of explanations, no room for values, morality, or religion. We may grant these persons their right to think as they wish, but they have no warrant whatsoever to ground their materialistic philosophy on the achievements of science. Science seeks material explanations for material processes, but it has nothing definitive to say about realities beyond its scope. Science is a way of acquiring knowledge about ourselves and the world around us, but it is not the only way. We acquire knowledge in many other ways, such as through literature, the arts, philosophical reflection, and religious experience. Scientific knowledge may enrich aesthetic and moral perceptions, but these subjects transcend science's realm. Science has nothing to say for or against religious realities or religious values. Many religious authorities have made this point. In the United States, Catholic, Lutheran and other Protestant bishops have joined Jewish and other religious organizations in denying that the theory of evolution contradicts or threatens their religious beliefs.

There are, however, believers who see the theory of evolution and scientific cosmology as contrary to the creation narrative of the Book of Genesis. We may grant these believers their right to think thus, as, at the other extreme of the spectrum, we grant materialists their right to deny spiritual or religious values. But, as the counterpoint to what I just said above, I will aver that Genesis is a book of religious revelations, not a textbook of astronomy or biology. Pope John Paul II has made the point: 'The Bible speaks to us of the origins of the universe and its makeup, not in order to provide us with a scientific treatise, but in order to state the correct relationship of man with God and the universe. Sacred Scripture wishes simply to declare that the world was created by God, and in order to teach this truth, it expresses itself in the terms of the cosmology in use at the time of the writer. The sacred book likewise wishes to tell men that the world was... created for the service of man and the glory of God. Any other teaching about the origin and makeup of the universe is alien to the intentions of the Bible, which does not wish to teach how heaven was made but how one goes to heaven'[1]. St. Augustine had made the point

[1] Address to the Pontifical Academy of Sciences on 3 October 1981. Addressing the same Academy on 22 October 1996, the Pope again deplores interpreting the Bible's teachings as scientific rather than religious, and says: '[N]ew knowledge has led us to realize that the theory of evolution is no longer a mere hypothesis. It is indeed remarkable that this theory has been progressively accepted by researchers,

many centuries earlier: 'In the matter of the shape of heaven the sacred writers did not want to teach men facts that would be of no avail for their salvation' (*The Literal Meaning of Genesis,* Book 2, ch. 9).

The point made by St. Augustine and the Pope is that it is a blunder to mistake the Bible for an elementary textbook of astronomy, geology, and biology. Instead, it is possible to believe that the world has been created by God while also accepting that the planets, the mountains, the plants and the animals came about, after the initial creation, by natural processes. I can believe that I am God's creature without denying that I developed from a single cell in my mother's womb by natural processes. This is the second part of my answer to the purported opposition between scientific conclusions and religious beliefs. They do not stand in contradiction; they concern different sorts of issues, belong to different realms of knowledge.

William Paley, in his book *Natural Theology* (1802), read by Darwin as part of the canonical curriculum when he was a student at the University of Cambridge, developed the argument-from-design as a demonstration of the existence of the Creator. It would be absurd to suppose, he wrote, that the exquisite functional complexity of the human eye would have come about by mere chance. It was Darwin's genius that he discovered natural selection, the process that accounts for the adaptive organization, or design, of organisms and their parts. Evolutionists invest time, resources, and imagination designing observations and experiments to investigate how natural selection contributes to the evolution of particular adaptations. It seems, therefore, unbecoming that several authors have recently revived Paley's argument claiming that organisms and living processes give evidence of 'intelligent design', unaccountable by natural selection.

There is hardly any need to refute, once again, the argument, but I would like to say that it amounts to blasphemy to attribute the 'design' of organisms to God's special action. Consider the human jaw. We have too many teeth for the jaw's size, so that wisdom teeth need to be removed and orthodontists make a decent living straightening the others. Would we want to blame God for such a defective design? A human engineer could have done better. Evolution gives a good account of this imperfection. Brain size increased over time in our ancestors, and the remodeling of the skull to fit the larger brain entailed a reduction of the jaw. Evolution responds to the organisms' needs through natural selection, not by

following a series of discoveries in various fields of knowledge. The convergence, neither sought nor fabricated, of the results of work that was conducted independently is in itself a significant argument in favor of this theory.'

optimal design but by 'tinkering', as it were, by slowly modifying existing structures. Consider now the birth canal of women, much too narrow for easy passage of the infant's head, such that thousands upon thousands of babies die during delivery. Surely we don't want to blame God for this defective design or for the childrens' deaths. Science makes it understandable, a consequence of the evolutionary enlargement of our brain. Females of other animals do not experience this difficulty.

One more example: why are our arms and our legs, which are used for such different functions, made of the same materials, the same bones, muscles and nerves, all arranged in the same overall pattern? Evolution makes sense of the anomaly. Our remote ancestors' forelimbs were legs. After our ancestors became bipedal and started using their forelimbs for functions other than walking, these became gradually modified, but retained their original composition and arrangement. Engineers start with raw materials and a design suited for a particular purpose; evolution can only modify what is already there. An engineer who would design cars and airplanes, or wings and wheels, using the same materials arranged in a similar pattern, would surely be fired. The defective design of organisms could be attributed to the gods of the ancient Greeks, Romans and Egyptians, who fought with one another, made blunders, and were clumsy in their endeavors. But, in my view, it is not compatible with special action by the omniscient and omnipotent God of Judaism, Christianity, and Islam.

Kenneth R. Miller is a professor of biology at Brown University and a practicing Catholic. His *Finding Darwin's God* is a considerate but forceful sustained argument against antiscientific creationism. With clear and engaging prose, Miller examines the anti-evolutionary creationists, successively from the most fundamentalist ignoramuses, who would have the world created less than ten thousand years ago, to the recent renaissance of the intelligent-design argument, passing through positions that gradually grant more and more of the scientific conclusions, while still holding to some ultimate 'gap' that somehow would make it necessary to introduce special action from the Creator into natural processes. Chapter 2, 'Eden's Children' is an effective introduction to the methods and limits of science and describes the nineteenth century discovery of deep time, which challenged forever the conception of a recent universe, made famous by the Anglo-Irish Archbishop James Ussher, who, in the 1650s, based on his reconstruction of the biblical chronologies, dated the creation at 4004 BC.

Chapter 3 considers the likes of Henry Morris and his partners at the California-based Institute of Creation Research, who maintain that

the earth is less than 10,000 years old and claim that Noah's Flood was literally worldwide and accounts for the stratigraphic succession of fossils. 'God the Charlatan' is Miller's title for this chapter, because this is what Morris' claims imply. Chapter 4 is dedicated to those, such as the Berkeley Law Professor Phillip Johnson, who are willing to grant factual observations of evolutionary change, but deny that natural processes could account for much of evolution. Credit for the process must be attributed to a Creator, 'God the Magician', as Miller titles this chapter. Chapter 5, 'God the Mechanic' examines the position of those, such as Michael Behe, who grant the conclusions of historical geology and the validity of the fossil record showing descent with modification, but claim that evolution cannot account for the biochemical machinery of the living cell, whose complexity evinces 'intelligent design'. Miller's attentive and thoughtful consideration of the anti-evolutionists' positions in no way diminishes the forcefulness of the arguments and the scientific evidence used to unravel them.

In the ensuing chapters, Miller argues, no less forcefully, against those who see that what we know of evolution entails a denial of values, spirituality, and religion – the likes of Edward O. Wilson, Richard Dawkins, and George C. Williams. There is no room in Miller's universe for a naturalistic, Darwinian-grounded ethics, nor does evolution necessitate the negation of the spiritual, or the belief in God. Exemplary, although surely it will not be convincing to all readers, is the final chapter, 'Finding Darwin's God', where Miller professes his Christian faith and sees mutual enrichment between faith and science: 'Understanding evolution and its description of the processes that gave rise to the modern world is an important part of knowing and appreciating God. As a scientist and as a Christian, that is exactly what I believe. True knowledge comes only from a combination of faith and reason' (*Finding Darwin's God*, p. 267). Miller sees evidence for the existence of God in the 'harmony' of the natural world: '[T]he truly remarkable thing about the world is that it actually does make sense. The parts fit, the molecules interact, the darn thing works'. This would seem to be a reliance on the 'Anthropic Principle'. But in the next sentence he adds: '*To people of faith*, what evolution says is that nature is complete. God fashioned a material world in which truly free, truly independent beings could evolve. He got it right the very first time' (*Finding Darwin's God*, p. 268, *my italics*). If I read him correctly, Miller does not make the claim that the harmony of the universe and its suitability for the human experience is, in itself, evidence that God exists, but rather that those *who have faith* can thus enlarge their world view and nourish their religious convictions.

In 1986, David C. Lindberg and Ronald L. Numbers edited *God and Nature. Historical Essays on the Encounter between Christianity and Science* (University of California Press, Berkeley, California). The editors expressed their 'conviction that the interaction of science and Christianity has been of profound importance in the shaping of Western civilization ... [and that] In recent years historians of science and religion have substantially revised many of their opinions but have generally addressed themselves only to fellow professionals' (*God and Nature*, p. *ix*). The book, and the international conference from which it derives – held at the University of Wisconsin, Madison, on 23-25 April 1981 – were addressed to correct the situation by sharing the fruits of the historians' labors with the general reading public. *God and Nature*'s sweep is broad, from the early Christian Church and Medieval theology to twentieth century physics and process theology, with intermediate passes through the cleric Copernicus, the belligerent Galileo, the devout Newton, the quiet revolutionary Darwin, the tortuous excesses of creation-scientists, and much more. The book's scholarship and documentation are admirable; the prose clear and often crisp.

Chapter 16 of *God and Nature*, 'The Creationists' (pp. 391-423), was authored by Ronald L. Numbers, who showed that, contrary to the hopes of liberals and the fears of conservatives, creationism did not become extinct as a consequence of the 1859 publication of Charles Darwin's *Origin of Species* – not in the nineteenth century and not in the twentieth. In 1982, about the time Numbers was writing 'The Creationists', a 'public-opinion poll revealed that 44 percent of Americans, nearly a fourth of whom were college graduates, continued to believe that "God created man pretty much in his present form at one time within the last 10,000 years"' (*God and Nature*, p. 391). Numbers went on to show a great disparity of views among those professing to be creationists. William Jennings Bryan (1860-1925), who was three times the Democratic party candidate for the presidency of the United States, became, in the early 1920s, a highly visible and effective leader of the anti-evolution movement, a spokesman with immense prestige and national recognition. He predicted, in 1922, that 'we will drive Darwinism from our schools' and in 1925 agreed to assist in the prosecution of John Thomas Scopes by the State of Tennessee, in Dayton. In January 1925, the Tennessee House of Representatives had passed, by a vote of 75 to 5, a bill making it unlawful for state-supported schools 'to teach any theory that denies the story of the Divine Creation of man as taught in the Bible and to teach instead that man has descended from a lower order of animals'. A few weeks later the Senate approved the

bill by a 4 to 1 vote, and the Governor signed it. Scopes, a young high school teacher, had agreed to test the constitutionality of the law and the famed 'Scopes Trial' came to pass.

Darwinism Comes to America goes much beyond 'The Creationists', in the breadth of topics covered and in the depth with which they are covered. The Scopes trial merits a full chapter, where Numbers seeks largely to change the history of the trial as it is generally presented, in scholarly as well as in popular work. The received history (as popularized by the film *Inherit the Wind*, with Spencer Tracy and Fredric March playing the two leading roles) has it that Clarence Darrow, the famous Chicago lawyer and agnostic, crushed the fundamentalists' spokesman Bryan, presented as one who naively accepted the Genesis geology of Bishop Ussher, who had estimated that the world was created on 4004 BC (at 9:00 AM on October 23rd, as set in the film). All of this was aired by the caustic Baltimore journalist H.L. Mencken, who ridiculed Bryan, who thus became utterly vanquished in the public's perception if not in the legal proceedings.

Bryan, however, 'not only rejected the notion of a 6,000-year-old Earth but freely interpreted the days of Genesis as vast periods of time' (*Darwinism*, p. 30). 'Such beliefs may have struck Darrow ... as being inconsistent with hard-core Fundamentalism, but there is little evidence that Fundamentalists themselves expressed either shock or surprise' (*Darwinism*, p. 80). During the 1920s, we are told by Numbers, few Fundamentalists insisted on a young Earth. Rather, for most Fundamentalists a commitment to literalism did not rule out various interpretations of Scripture. In advocating the interpretation of Genesis' days as ages, 'Bryan found himself in impeccable Fundamentalist company. George Frederick Wright, author of an essay on evolution in *The Fundamentalists*, subscribed to the same view, as did William Bell Riley, head of the World's Christian Fundamentals Association, the organization that had sent Bryan to Dayton' (*Darwinism*, p. 81). Numbers shows that Bryan had no objection to 'evolution before man', as he had expressed shortly before the trial in a letter to Howard A. Kelly of Johns Hopkins University. He regarded prehuman evolution as silly rather than offensive, a position surely shocking to latter-day creationists down to our times.

The received history of the Scopes trial is also erroneous, according to Numbers, in that most Fundamentalists did not see the trial as a complete humiliation and ridicule of their position, but rather as a morality play in which goodness (the Christian faith) had vanquished evil (the agnosticism of evolutionists). Bryan was likened to religious

heroes of the past, in the words of a Baptist pastor: 'Moses challenging Pharaoh; it is Elijah arraigning Ahab; it is Paul defying Nero; ... It is the greatest battle of the centuries' (*Darwinism*, p. 83). Darrow, on the other hand, by the end of the trial came to be perceived by much of the non-Fundamentalist press, as overbearing and bullish, 'rather getting on the nerves of sober-minded people of this country', as observed by the *Boston Post*. Non-Fundamentalist criticism of Darrow grew so intense that after the trial the ACLU tried to dump him from the team of defense lawyers appealing Scopes' conviction to the Tennessee Supreme Court.

Numbers also shatters the legend in pointing out that the non-Fundamentalists saw the trial as a victory for the Fundamentalists. Thus, 'H.L. Mencken declared that Genesis has emerged completely triumphant from the battle' (p. 87). Some Fundamentalists, however, saw it as an unmitigated disaster for their cause. For example, the Fundamentalist George McCready Price portrayed the trial as 'evolution's great triumph'. This perception of the victory of evolutionists over the Fundamentalists at the trial has been perpetuated into the present by recent creationists, such as Henry M. Morris and Jerry Falwell. This is also the legend propounded by the film *Inherit the Wind*.

The trial subjected Bryan and Fundamentalism to much public ridicule, but it did not bring the anti-evolution movement to an end nor did it slow it down. But the recent history of creationism is not a main subject of *Darwinism*. Recent movements, such as the revival of Biblical geology, creation science, and intelligent-design are summarily presented in an introductory essay, 'Darwinism, Creationism, and Intelligent Design'.

Two major points of *Darwinism* are that: (1) The standard portrayal of the American South as hostile to Darwinism is a misrepresentation. 'Antievolution sentiment may indeed have been stronger there than elsewhere in the country ..., but southerners were far more tolerant of evolution there than one would suspect from reading most historical accounts. Most southern states, for example, rejected antievolution laws in the 1920s, and those that forbade the teaching of Darwinism limited the ban to human evolution' (p. 22). (2) The response to Darwinism is importantly different among Protestant denominations. Outside mainstream Protestantism, distinctive beliefs make a great deal of difference.

About one third of *Darwinism* explores the role played by Seventh-day Adventists (chapter 5) and the Pentecostal tradition (chapter 6).

Seventh-day Adventism arose out of the ashes of the Millerite disaster. The New York State Baptist William Miller acquired an enormous following with his prediction that Christ would return to

Earth in 1843 or 1844. When October 22, 1843, the date pinned down by many Millerites went by, the ensuing disappointment led to the disintegration of the movement. The teenage visionary Ellen G. White regrouped some of the followers into a movement that in the early 1860s became the Seventh-day Adventist Church, holding to the belief of an imminent second coming of Christ. Because of the belief in the seventh-day Sabbath as a memorial of the Creation, the Adventists insisted on the recent creation of life and the universality of the Noachian flood, which had deposited the fossil-bearing rocks. This distinctively Adventist interpretation of Genesis became, in the 1970s, the hard core of so-called 'scientific creationism' and was incorporated into the Arkansas 'Balanced-treatment' law, which was challenged in 1981 in a Federal District Court. The trial was held in early 1982, and resulted in the important court decision known as *McLean v. Arkansas*. (I was one of the expert witnesses, as an evolutionary biologist, at that trial.) An identical law passed, also in 1981, by the State of Louisiana, led to the 1987 U.S. Supreme Court decision, *Edwards v. Aguilar*. (The U.S. National Academy of Sciences presented an *amicus brief* to the court. The scientific component of this amicus brief has been published by the NAS as a booklet, *Science and Creationism. A View from the National Academy of Sciences*, prepared by a committee, but drafted by me; I also chaired the committee that saw the preparation of a second edition of the same booklet in 1999.)

The Pentecostal (originally known as Holiness) movement emerged in the U.S. in the late nineteenth century among Methodist followers of John Wesley. On the first day of the twentieth century, Charles Fox Parham, an itinerant Holiness healer, and a small group of followers began speaking in tongues in Topeka, Kansas, a practice that motivated the name of 'Pentecostalism', by reference to the gifts of the spirit received by the early Christians during the Day of Pentecost that allowed them to speak in unknown languages. In the second half of the twentieth century, the flamboyant televangelists Oral Roberts, Jimmy Swaggart, and others propagated the movement converting masses throughout the world, promoting 'charismatic practices' among Christians. 'By the mid-1990s roughly one fourth of the two billion Christians in the world had embraced the Pentecostal-Charismatic faith' (*Darwinism*, p. 112).

In the last decades, many Pentecostals have largely adopted and endorsed the tenets of creation-science, including the recent origin of the Earth and Noah's Flood geology. But they differ from Seventh-Day Adventists and other creationists in their tolerance of diverse views and the limited import they attribute to the evolution-creation

controversy. 'Though mostly staunch creationists, Holiness people have remained reluctant antievolutionists. Moreover, instead of fretting like some Fundamentalists over the lack of consensus on the correct reading of Genesis, they have rarely worried about the diversity of creationist views in their midst' (*Darwinism*, p. 135).

Chapter 1 of *Darwinism*, 'Darwinism and the Dogma of Separate Creations: The Responses of American Naturalists to Evolution' catalogues the attitudes about evolution of the eighty American naturalists elected to the National Academy of sciences between its foundation in 1863 and 1900. A short notice on each naturalist is given in an appendix (pp. 137-159). After the 1859 publication of the *Origin of Species*, we see initially some enthusiasm but much reluctance to accept Darwin's ideas, soon followed by acceptance of evolution by a large majority of the Academy's naturalists. This chapter and appendix are of some interest, but their inclusion in this book is a bit strained.

John C. Greene is a distinguished intellectual historian who, in 1959, published *The Death of Adam. Evolution and Its Impact on Western Thought*, where he sought (p. 7), 'to describe ... the tremendous revolution in human thought which took place in the interval between John Ray's *The Wisdom of God Manifested in the Works of Creation* (1691) and Charles Darwin's *Origin of Species* (1859) and *Descent of Man* (1871)'. Isaac Newton published his *Principia Mathematica* in 1687. Greene's theme was the revolutionary, if gradual, transition from the static view of the universe portrayed in the *Principia* to the dynamic view of Darwin's evolutionary vision. This transition happened not only in the biological sciences, as represented by Ray and Darwin, but in the whole range of sciences, from geology, mechanics, and astronomy to paleontology, biology and anthropology.

The transition from a static to a dynamic view of the Universe, fundamental as it was, is not the only conceptual revolution that was consummated by Darwin and may not have been the most significant for the history of ideas. Darwin's Revolution also and most importantly consists in that he completed the Copernican Revolution, started three centuries earlier: the commitment to 'the concept of nature as a lawbound system of matter in motion' (*Death of Adam*, p. 7). Newton, like the Irish chemist Robert Boyle and the English naturalist Ray, sought to weld the concept of nature as a lawbound system of matter in motion with the assent to a religious view of nature created for the use and edification of humankind by an omnipotent and all-wise Creator. The two conceptions of nature co-existed, ill at ease, or so at least it seems to us now, until Darwin's *Origin*. Tension between the

two disparate views had gradually built up. I noted earlier the valiant efforts of William Paley's *Natural Theology* in seeking to salvage the active presence of an all-wise and omnipotent Creator in the intelligent design of organisms. A few years later, eminent scientists and philosophers would write the eight Bridgewater Treatises, published between 1833 and 1840, to set forth 'the Power, Wisdom, and Goodness of God as manifested in the Creation'.

Darwin provided ample evidence for the occurrence of evolution, and for this he is appropriately given credit. But Darwin's greatest achievement is that he discovered natural selection, a process that provides a natural explanation of the design of living beings. This extended the Copernican Revolution to the world of living things. The origin and design of organisms could now be explained, like the phenomena of the inanimate world, as results of natural laws manifested in natural processes. Darwin had shattered the foundations for a natural theology based on design. Thereby all of nature was brought within the scope of science, as an intellectual exercise seeking natural explanations for natural phenomena.

Greene, in *Death of Adam,* saw ambiguities in Darwin's vision, which claims scientific explanations while bringing in values that are outside science's explanatory reach, notions like 'progress', 'creation', 'function' and 'design'. Greene's pointed criticisms of Darwinism as a worldview brought him into dialogue and controversy with two great evolutionary theorists; first with Theodosius Dobzhansky, starting already in 1959, and 20 years later with Ernst Mayr. Much of the exchanged correspondence is included in *Debating Darwin. Adventures of a Scholar,* combined with ten essays critically probing the writings of Dobzhansky, Mayr, and other evolutionists.

One topic that engages sustained correspondence is 'evolutionary progress'. On November 23, 1961, Dobzhansky writes to Greene: 'I cannot follow your advice and put these things in watertight compartments, and see only 'change' and no 'progress' ... For *as a scientist I observe* that evolution is on the whole progressive' (*Debating Darwin*, p. 100; emphasis added). On December 1, 1961, Greene refers to this statement and responds: 'I don't believe you' (p. 104).

'For years,' Greene writes, 'I had been impressed with the ambiguous status of the idea of progress in evolutionary discourse. Biologists, it seemed, could neither live with it nor without it. They could not live with it because they could not define it without introducing value judgments which, according to the conception of science that had prevailed since the scientific revolution of the seventeenth century, were supposed to be excluded from science... Yet the evolutionary literature was full of words like "progress",

"improvement", "advance", "higher", and "lower" and figures of speech implying striving, purpose, and achievement' (p. 14).

Darwin was, indeed, convinced that his theory implied progressive improvement in the long run, although not in every instance of evolutionary change. Best known are his rhapsodic words in the final two paragraphs of *Origin*: 'And as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection... Thus, from the war of nature, from famine and death, the most exalted object that we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life,...from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved'.

Greene is appalled that this kind of language be taken as scientific by Darwin or by later evolutionists. 'Darwin found himself caught between biological facts which seemed to cry aloud for interpretations involving concepts of value, direction, aim, etc. and the pitiless logical implications of the mechanistic philosophy of nature. His attempt to define "progress", higher and lower, etc. in terms of survival was a desperate effort to make sense of the facts without abandoning the mechanistic philosophy ... "Life" does not struggle to survive; it has no concept of better or worse. I can't make philosophical sense of this language, *much less scientific sense*' (Greene's letter to Dobzhansky of December 1, 1961, p. 102; his emphasis).

Dobzhansky is baffled. 'Why should biologists shun such words as "creativity", "improvement", "trials and errors", etc.? By God, this is what they observe happening or having happened' (Nov. 13, 1961, p. 93). Mayr is determined to vindicate the idea of evolutionary progress, while excluding any reference to outside agents or their final causes: '...who can deny that overall there is an advance from the prokaryotes that dominated the living world more than three billion years ago to the eukaryotes...; within the metazoans from the ectotherms that are at the mercy of the climate to the warm-blooded endotherms, and within the endotherms from types with a small brain and low social organization to those with a very large central nervous system, highly developed parental care, and capacity to transmit information from generation to generation?' (p. 187).

On November 30, 1989, Mayr tells Greene: 'Even if I should be attacked for this belief I do believe that man is somehow "higher" than the chimpanzee' (p. 241-242). Greene responds that science cannot at all deal with values and refers to my own writings endorsing this view: 'Science ignores the value aspect of reality because it has no way of dealing with it (cf. [Francisco] Ayala's statements to this effect

in *Evolutionary Progress*)' (Letter to Mayr of November 30, 1989; p. 242). The defining consideration that excludes the notion of progress from scientific discourse had been clearly set forth by Greene in a letter to Dobzhansky: 'Our modern concept of natural science holds that value-judgments and notions of levels of being (the "nobility" of natural objects) are excluded from science' (January 5, 1962; p. 107).

Evolutionists see sustained directional change by focusing, for example, on the successive appearance through time of prokaryotes, unicellular eukaryotes, multicellular organisms, primitive chordates, fish, amphibians, reptiles, mammals, primates, and humans. This sort of sequence, for Dobzhansky and Mayr, is evidence of progress in evolution (noticing, nevertheless, as Darwin had, that not all evolutionary change is progressive). I, rather, would say that this sequence may well be described as directional change, or trend, but there is nothing within scientific methodology, as Greene correctly argues, that justifies seeing it as improvement or progress.

There is, however, something else in the prokaryote →eukaryote→vertebrate→human sequence; namely, that the changes are of a kind that elicits the interest of the biologists because they match or illuminate their particular worldview. Thus also, for example, increases in encephalization or socialization. To label these changes as 'progress' is something that the evolutionists find soothing because that seems to show that the natural world has changed (in some respects, at least) for the better, something consistent with their wishes and hopes. The evolutionists are satisfied that this 'demonstration' that the world is becoming better is actually an outcome of their professional practice as evolutionists. Dobzhansky and Mayr, like other evolutionists, are elated that their scientific practice evinces a worldview that they find most congenial.

Mayr is quite explicit in his affirmation that his worldview (indeed, any rational worldview that would be acceptable at this time in world history) comes from evolutionary biology. '[W]e now realize that the scientist also has social obligations. When optimistically inclined, he will say that he is helping to build a better world; when pessimistically inclined, he will say he is trying to prevent a further deterioration of this world. But he cannot do this unless he has a sound understanding of Man and the world in which he lives. And it is *precisely the study of diversity and evolutionary history* [emphasis added] which has made a major contribution toward the development of a *new image of Man*' (Mayr's emphasis; E. Mayr, *Toward a New Philosophy of Biology*, 1988, p. 293).

Dobzhansky recognizes the insurmountable boundary between science and values (ethical and religious), but sees the need to

integrate both in his personal worldview, and affirms the compatibility between evolutionary biology and Christian values: '[N]either [science and religion] is deducible from the other. But both have to be somehow integrated in one's philosophy of 'ultimate concern' ... I still insist that scientific generalization... leads to results *compatible* with this affirmation, and that such *compatibilities* are what make scientific research exciting' (Letters to Greene of November 23 and December 6, 1961; p. 100 and 104. Dobzhansky's emphasis). Dobzhansky is, of course, right about the compatibility of evolutionary biology with Christian and other values that many of us consider acceptable and good. But nothing follows from that compatibility. Evolutionary biology is also compatible with Nazism and other philosophies that many of us detest, and with moral values that most of us abhor, such as those that justify genocide and racism.

The insistence of evolutionists in the reality of the observations of directional change is justified. But when the changes are labeled 'progress', or when it is affirmed that improvements have occurred in evolution, the scientist has left the realm of science and entered into the legitimate, but not scientific, realm of human considerations of value, meaning, and purpose. (See my 'Can "Progress" be Defined as a Biological Concept?' In: *Evolutionary Progress*, M. H. Nitecki ed., University of Chicago Press, 1988, pp. 75-96.)

Greene 'cannot conceive' how a process that is not somehow guided by intelligence could 'have produced and still be producing improvements, higher forms of life, new levels of being' (Letter to Dobzhansky, November 17, 1961, p. 94). Dobzhansky had written (November 13, 1961): 'Certain evolutionary processes are "creative" because they bring about (a) something new, (b) having an internal coherence since it maintains or advances life, and (c) may end either in success or in failure. One of the notable successes, let us say the greatest success, was the origin of man' (p. 93). Greene would have none of this: 'It does not help matters to say that the cosmic process is "naturally creative" or that it "transcends itself". An enigma rephrased in poetic language is still an enigma ... How did such creatures come to be? Did a process devoid of intelligence, of direction, of will, etc. produce beings possessing all these things? You may answer that here we are as a matter of fact – we *have been* produced. I agree, but that only proves that the process that produced us is not devoid of intelligence, aim, etc. Whether the intelligence is immanent in the process or whether in some sense also transcends the process... is a secondary question' (p. 95).

The philosophical disconnect is, on this matter, complete. Dobzhansky is all but astonished that Greene's philosophical

presuppositions would not allow 'creative' possibilities within a natural, material, unguided process. 'Your surprise at the fact that a process devoid of intelligence and will has produced beings that have intelligence and will is for me hard to understand. I cannot follow you in saying that this *proves* that this process itself is (and was?) not devoid of these things. Evolution, biological and especially human, is a process that generates novelties. Very remarkable indeed; but not a proof of the action of a creative ground shuffling genes' (Dobzhansky's letter of Nov. 23, 1961, p. 99).

I side with Dobzhansky on this matter. One can turn Greene's retort around and ask about the sort of philosophy that impedes him accepting that complex entities, exhibiting properties not manifest in their component elements, may arise by a natural process that is not guided by intelligence, immanent or external. Perhaps the hampering doctrine is in the fashion of the Aristotelian philosophy of sufficient cause and unmoved prime mover. Hume and Kant had disposed once and for all of such philosophy, or so it seems to me. Even Aquinas, who upheld a philosophy of sufficient cause, accepted the possibility of true 'novelty' arising by natural processes without divine intervention or the guidance of immanent intelligence. In the *Summa Theologiae* he raises the question whether life can arise from non-living matter, as was commonly asserted at the time to be the case, based on the observation that maggots spontaneously appear in decaying organic matter. Aquinas carefully drafted analysis finds no philosophical (nor theological or Scriptural) obstacles against the origin of living beings from non-living matter. (He was, however, far from ready to accept that indeed maggots originate spontaneously from dead matter; this, he wrote, is for the experts on such matters to determine.)

Natural selection produces combinations of genes that would otherwise be highly improbable, because natural selection proceeds stepwise. The vertebrate eye did not appear suddenly in all its present complexity. Its formation requires the appropriate integration of many genetic units, and thus the eye could not have resulted from random processes alone. The ancestors of today's vertebrates had for more than half a billion years some kind of organs sensitive to light. Perception of light, and later vision, were important for these organisms' survival and reproductive success. Sunlight is, and has been for millions of years, a pervasive feature of the environments in which many animals live. Accordingly, natural selection has favored genes and gene combinations promoting the functional efficiency that an eye provides. Such genetic units gradually accumulated, eventually leading to the highly complex and efficient vertebrate eye. Natural

selection can account for the rise and spread of genetic constitutions, and therefore of types of organisms, that would never have existed under the uncontrolled action of random mutation. In this sense, natural selection is a creative process.

Natural selection has no foresight, nor does it operate according to some preconceived plan. Rather it is a purely natural process resulting from the interacting properties of physicochemical and biological entities. Natural selection is simply a consequence of the differential multiplication of living beings. It has some appearance of purposefulness because it is conditioned by the environment: which organisms reproduce more effectively depends on which variations they possess that are useful in the environments where the organisms live. But natural selection does not anticipate the environments of the future; drastic environmental changes may be insuperable to organisms that were previously thriving.

There is no ontological necessity for demanding the existence of some sort of intelligence guiding the evolutionary process, or some 'creative ground' that could account for the origin of novel, complex and directively organized beings. Even for Aquinas, with his Aristotelian mindset, there was no such ontological necessity. If, in Aquinas' view, complex animals, such as maggots, can (=ontologically possible) arise from non-living matter, why could not evolution yield also other animals with complex nervous systems, even humans with their large brains and ability to create science, art, and literature.

As I have noted above, evolutionists, myself included, find it difficult to see organisms, including humans, as outcomes of *intelligent* design (whether immanent or external). How come that we have too many teeth for the size of our jaw? No such problems in our close primate relatives or in other animals. And what about our back problems and the pains of childbirth? If there was a designer, he certainly did not do a great job. Seeing these problems as consequences of ongoing evolution – mutation and natural selection and previous history – they make sense. Attributing our poor design – so much inferior to what a human engineer can do – to God or some overarching intelligence makes no sense to me. The evolutionary process is much too messy and imperfect for that. Think also of the Rube Goldberg devices that prevail in organisms, such as the blood clotting mechanism of vertebrates. A human engineer starting from scratch could have designed a simpler and better clotting mechanism or a more suitable jaw or pelvis.

Greene is very critical of the evolutionists' terminology, from Darwin to the present. Why would Darwin choose the phrase *natural*

selection, 'a metaphor implying intelligent choice to designate a complex set of processes involving random variation, population pressure, and differential survival to reproductive age?' (p. 35). Greene sees here traces of Darwin's evolutionary deism. He objects to 'struggle for existence', 'the good of each being', 'evolutionary success', 'improvement', 'transformation', and the like because they imply an active subject or reflect particular philosophical preconceptions. Good warning, I would say, but why not to retain 'natural selection' and some other useful terms, so long as their intended meaning is clear by context or statement? Semantic economy calls for using certain terms in scientific discourse rather than the descriptions they stand for. And there seems little reason for an intolerant semantic brigade that would seek to eliminate any possible connotation of subjective agency or some other undesirable meaning. Physics and chemistry also use terms 'subjective' in their origin, which are nevertheless accepted in their restricted scientific meaning; the likes of 'force', 'gravity', 'oxygen', and endless others. Words have power and semantic hygiene is a virtue. But it is not an ultimate virtue. I am not aware of any expert evolutionist who would use the phrase 'natural selection' implying anything else than differential survival and reproduction, or connoting that natural selection is an agency of some sort or represent the action of some agent.

Greene correctly argues, as noted earlier, that evolutionists (other scientists as well) often see biological evolution as a source of meaning and value in the world, and thus transgress the scope of science. As he sees it, scientists affirm that scientific knowledge is 'objective', but then proceed to argue, when the opportunity arises, that evolution furnishes, or at the least justifies, an optimistic view of the world, as well as moral and other values that most of us accept and live by. Greene does not buy this 'justification'. What these scientists are doing, he says, is bringing in Christian and other western values and seeking their justification in biological evolution. One could say, at best, he argues, that biological evolution (more generally, scientific knowledge) is 'consistent' with such values, but so is it consistent with any other values, whether they be those of communistic materialism, Spencerian *laissez faire*, or anything else for that matter. Science, he correctly holds, is not and cannot be determinative of values. (It is, however, of some social consequence to point out, as Kenneth Miller does, that evolution is *compatible* with Christian values, rather than seeing the two in contradiction, as fundamentalists would have it in order to justify their attacks against the teaching of evolution in the schools.) Greene's overarching

concern, however, is the *de facto* transformation of scientific knowledge, necessarily materialistic, into a materialistic worldview. But I would argue that one can accept the evolutionary origin of humans and other organisms without implying that evolution (science) conveys all that we may want to know about human life and the universe. Science does not imply, of necessity, a materialistic worldview.