

# “Intelligent Design” and Evolutionary Developmental Biology

*All I have seen of [your book] awes me; both with the heap of facts and the prestige of your name, and also the clear intuition that if you are right, I must give up much that I have believed and written. In that I care little. “Let God be true and every man a liar.” Let us know what is ... follow up the villainous shifty fox of an argument, into whatsoever unexpected bogs and brakes he may lead us.*

—Charles Kingsley, Chaplain to Queen Victoria, in a letter to Charles Darwin.

## Scientific Creationism

The 1960s not only heralded a revolution in the biological sciences, but also signaled a counter-revolution called "scientific creationism." What is creationism and why are its proponents now calling it "scientific"? Creationism is the doctrine that each species had an independent origin directly from God during the first six days of Creation. Its proponents call it scientific for two reasons. First, they claim that scientific facts, far from refuting the Biblical account of Creation, actually confirm it. Thus, science is seen to affirm that the world is only a few thousand years old, that it could be created in six days, and that all the species of animals presently on Earth had representatives on Noah's ark. As we shall see, science does not affirm these views at all. The second reason for its proponents calling Creationism "scientific" (as opposed to "religious") is so they can try to supplant existing courses in biological science.

At first glance, this entire concept may seem strange. According to Scientific Creationism, two representatives of each of the world's 750,000 known species of insects, 850 species of bats, and every species of worm, salamander, and bird were present on the ark. A couple of ants from the Central American rainforest would be expected to travel across the ocean to the Near East and bring their specific food plant with them. Since one has to be "scientific," one cannot merely say that some miracle was performed. Moreover, each species is thought to have been independently created, the black-throated green warbler and the black-throated blue warbler each being separate acts of divine creation.

Why, then, should "scientific creationism" have so much popularity in America? To answer this question, one has to sort out some complex strands in American social and intellectual history. Creationism has been able to unite three philosophical traditions that have been very popular among Americans: Natural Theology, Fundamentalism, and Scientism. Although these three traditions in their pure states are not reconcilable, and although each has been discredited by philosophers, parts of each has found its way into the mix of "scientific creationism." We will discuss each in turn.

## Natural Theology

The most important of these three traditions is Natural Theology. Natural theology is the belief that knowledge of God can be acquired directly from Nature. Natural theologians claimed that God wrote two books. One was the Bible, the other was his creation, Nature. Nature could be experienced directly, and knowledge of God's goodness, power, and all-knowingness was accessible to anyone without interpretation. In the middle of the nineteenth century, one of the most widely read books in America was Reverend William Kirby's *On the Power, Wisdom, and Goodness of God as Manifested*

*in the Creation of Animals and in their History, Habits, and Instincts*. What does such a book look like? Actually, it looks very much like an introductory biology text, with sections on ecology, embryology, and with an especially good treatment of animal structure and function. It is also illustrated with prints of different representative animals. Kirby's descriptions of animal anatomy are meticulous, and his analysis of animal migrations goes into as much detail as was then known and more than many textbooks include today. However, here is how he completes the unit on animal migration: "What can more strongly mark design, and the intention of an all-powerful, all wise, and beneficent Being, than that such a variety of animals should be so organized?" Elsewhere, Kirby discusses the intricate features of the wing of the bird: "Wonderful is the structure of the feathers that compose them, and each is a masterpiece of the Divine Artificer."

These observations are representative of the spirit of this book (and hundreds like it). It combines a highly mechanistic science with the notion of God being the chief architect or mechanic of the universe. In fact, a pious Christian need have no fear of science, for the more detailed the mechanisms discovered in Nature, the more glory was to be found in the creator of that mechanism. Here we see an incredibly important role of Natural Theology; it allowed for the emergence and encouraged the practice of a highly mechanistic science. It encouraged people to make discoveries about Nature.

It is not surprising, then, that many of the people whom we respect today as scientists thought of themselves as Natural Theologians. (They couldn't think of themselves as "scientists" before 1840 when the word was first used). Isaac Newton and Robert Boyle were only two of the seventeenth century pioneers of science who thought of themselves primarily as theologians. Their discoveries of physical laws were made "to think God's thoughts after Him." Boyle (who left money in his will to establish a lecture series in natural theology) referred his accomplishments "to the glory of the great Author of Nature."

Much excellent science was done in this manner, and Natural Theology became the norm for science in the English-speaking Protestant world. It had very little influence in Catholic countries since Natural Theology, while it may lead one to a rational belief in God, did not necessarily lead one to the Catholic conception of God. Secondly, the Catholic hierarchy was (and is) suspicious of theologies that are directly accessible to laypeople without the mediation of a religiously trained priest. In addition, Catholic thought has tended to focus less on the Bible than upon the interpretations of the Church leaders. Similarly today, "scientific creationism" has remained a predominant Protestant cause. Among Jews, belief is not a precondition for salvation, and the actions of God in history are generally considered more important than his acts at creation. Thus, "scientific creationism" is primarily a concern in Protestant countries.

Natural theology also became linked with the Industrial Revolution occurring in Great Britain and the United States. The God of Natural Theology made *contrivances*. Oil didn't merely pour down the goose's back. Rather, there was a remarkable gland at the base of the quill that allocated the proper amount of oil at the appropriate times. There was a minute correspondence between means and ends. In an age which heralded inventions as evidence of a bright new future, God was seen as a Divine Mechanic.

This way of thinking became very strong in the United States, where even our Declaration of Independence holds that our break from England was sanctioned by "the laws of Nature and Nature's God." It remains popular today and is almost always present in Creationist literature and films.

## Criticism of Natural Theology

For all its popularity, though, Natural Theology has not fared well among contemporary philosophers or scientists. David Hume showed that Natural Theology was based on a selected set of analogies.

A watch is to an intelligent human creator as a wing is to x. This x would have to be a remarkably higher intelligence. x would be God. But Hume claimed that this was a fallacious argument. First, from a finite world, one could at best extrapolate a finite God. Second, if one took one's focus off the particular contrivance of a wing or eye or ability to migrate and focused on the entire world, where there is much pain and suffering, then God turns out to be a rather incompetent mechanic. This second point is what gave Darwin particular trouble.

Charles Darwin was trained to be an Anglican clergyman, and he received his B.A. in theology from Cambridge. He was much influenced by natural theology and thought that he could readily study nature as a clergyman. He went on the *H.M.S. Beagle* while waiting for a parish to become available. After his return, in 1856, Darwin wrote to his friend, Joseph Hooker, "What a book a devil's chaplain might write on the clumsy wasteful, blundering, low, and horribly cruel works of nature." To another friend, Harvard biologist Asa Gray, Darwin confided, "I cannot persuade myself that a beneficent and omnipotent God would have designedly created the *Ichneumonidae* with the express intention of their feeding within the living bodies of caterpillars."

Natural theology had played a very important role in allowing the emergence of science during the Renaissance and in motivating individuals to study the mechanics of nature. However, it was philosophically untenable and eventually impeded rather than stimulated scientific thought. To declare that "the wing of the bird is so constructed because God designed it that way," or that "animals migrate for the enjoyment and nourishment of mankind" (as Kirby indeed does) is not to pursue knowledge but to end its pursuit.

## Fundamentalism

Fundamentalism is a movement within American Protestantism that claims that the belief in the literal infallibility of the Bible is necessary for being a true Christian. There is a common misconception that Fundamentalism arose as a reaction to Darwinism, but Fundamentalism was already strong by the time that *The Origin of the Species* was published in 1859. The first Fundamentalist pamphlets were published in the 1830s. These tracts claimed that the Bible was inerrant and that American churches had perverted the messages of the Bible with modern interpretations. Fundamentalism was not confined to any one particular Protestant sect, but grew as "a church within a church" in nearly all denominations.

Central to the Fundamentalist movement is the notion that only those people who are properly awake to the Biblical truths will be saved from the imminent Apocalypse. According to the Fundamentalists, all around us are evidences that the end of the world is at hand. If one does not accept the Bible word for word, one is lost to sin and cannot be redeemed.

As might be expected, the history of Fundamentalism is a history of compromises with Biblical interpretation. Did God create Adam and Eve together (Genesis 1:27) or was Eve created second (Genesis 2:22)? Did the animals enter into Noah's ark in groups of two (Genesis 7:15) or in sevens and twos (depending on whether they were kosher) (Genesis 7:2)? During the seventeenth century, the Catholic Church and the newly founded Protestant denominations were trying to outdo each other in piety. Galileo and others had to defend their theories against the statement (Joshua 10:12-13) that Joshua successfully commanded the sun to stand still. This was considered as evidence against the Copernican model of the heliocentric solar system. (To my knowledge, no Fundamentalist has tried to change high school or college mathematics texts, but if one looks literally at 1 Kings 7:23, the Biblical value of pi is 3.000). In order to get around these errors and contradictions, some Fundamentalists have separated out passages that they consider to have been mistranslations of a true original, while others have separated out some passages that they claim were meant solely for the Jews from others that they claim were meant for a Christian audience. One cannot accept the Bible without interpretation. Otherwise, God and Satan might be the same (2 Samuel 24:1 compared with 1 Chronicles 21:1).

All three Scriptural traditions have affirmed that the Bible can be interpreted in terms of analogies. In the twelfth and thirteenth centuries, serious religious thinkers such as Maimonides, Aquinas, and Ibn Rushd wrestled with the conflicting demands of Holy Scripture and Aristotelian science. All three found examples where the meaning of the passage was more important than whether the passage was literally true. Similarly today, religious men and women can believe that the passages in Genesis provide a meaningful description of the relationships between God, humanity, and nature without having to believe the literal depiction of Adam, Eve, and the serpent.

Fundamentalism grew strong in America during the early 1900s and was able to pass state laws forbidding the teaching of evolution in public schools. Fundamentalism received national attention as the result of the trial of John Scopes in Dayton, Tennessee in 1925. Scopes was convicted (he had indeed violated a Tennessee law), but the case was thrown out on a technicality, so it was not possible to bring the case before a higher court to test its constitutionality. Anti-evolution laws survived in Tennessee, Arkansas, and Mississippi until the 1960s. What is even more important is that fear of boycotts by Fundamentalists caused most high school and college-level biology textbooks to downplay or leave out any mention of evolution. Only after the Soviet Union launched Sputnik in 1957 did Americans begin to take science education more seriously and allow evolution to return to the classroom.

## Fundamentalism as a Social Phenomenon

Dorothy Nelkin, a sociologist at Cornell University has tried to explain the emergence of Fundamentalism and its resurgence at particular times. Reading the Fundamentalist literature has led her to conclude that Fundamentalism is a reaction to what some earnest people view as a moral breakdown in society. The cause of Fundamentalism, according to Nelkin, is not fear of science, but fear of rising crime rates, sexual profligacy, the breakdown of the family, and other social ills. These disturbances are caused by major social changes such as happened during the industrial revolution in England and during urbanization in the United States during the early 1900s. In these times of upheaval, people attempt to find sources of lasting and eternal values. In the Protestant tradition, these are found in the Bible. Fundamentalism is seen to be especially strong among people who have moved from rural areas into cities and among those who find themselves at the mercy of a technological system that they cannot control.

Social upheavals and unrest were certainly prominent during the 1960s. Authority was being undermined throughout America, the "sexual revolution" changed the dating habits of a young nation, the crime rate was rapidly rising, new technologies threatened to do away with the family farm and other American institutions, and even the armed forces was being ridiculed. In this setting, a new Fundamentalism arose. In 1963, the Creation Research Society was founded by 10 Fundamentalist members of the American Scientific Affiliation, an organization founded in 1941 to unite science with Evangelical Christianity. Unlike the older Fundamentalists who mocked science, the Creation Research Institute set out to convince the public that true science supported the Biblical view of creation. In this manner, they have sought to have the Genesis account of earth history and species formation taught as science, and they have successfully introduced bills into 15 state legislatures to teach "scientific creationism" as a viable alternative to evolution. In at least three cases, Arkansas, Mississippi, and Louisiana, these laws have been passed (only to be found as introducing religious belief into public education and thus unconstitutional).

To achieve their aims of getting Creationism to be taught as science, "scientific creationists" have had to deny their being Fundamentalist Christians. However, despite these new denials, there is no reason to think of them other than as Fundamentalists. As one position paper from the Creation Science Research Center in San Diego stated, "Bible-believing students of the biological sciences possess a guide for their interpretation of the available data, the Biblical record of divine creation contained in Genesis."

## Scientism

Scientism is the faith that science will lead us to a better world and that what science says is unalterably true. This was the view of many scientists in the nineteenth century, but it certainly is not the view of most scientists today. However, at the turn of the century, scientism became a major part of the American view of progress. This belief that what science says is absolutely true makes the connection between science and Creationism all the easier. If science is unerringly true, and if the Bible is unerringly true, then they must be the same. Thus, for the Bible to be really true, it is not enough for it to be true in the metaphorical sense or in the poetic sense. It has to be true in the scientific sense. This also allows the Creationists to pit Moses (or Jesus) against Darwin as if their respective "truths" were on the same level.<sup>i</sup>

Although it seems odd, fewer people have more faith in the word of science than do the Fundamentalists. For them, science is the sole test of the Bible's content. They claim, however, that science has been so corrupted by the world that it cannot see clearly. "True science" shows that the scripture is unerringly factual.

In claiming the factual nature of the Bible, "scientific creationists," like other Fundamentalists, have abandoned the distinction between wisdom and knowledge. Moses, Jesus, Mohammed, and the Buddha didn't know a thing about photosynthesis, oxidative phosphorylation, or DNA replication. They probably would not have cared, for they taught wisdom, not facts. Facts change. As one anti-Fundamentalist clergyman in nineteenth century Britain noted, "God did not inspire the Bible in order to teach science to the Hebrews." The "scientific creationists" claim He did.

## The Arguments of "Creation Science"

The last chapter presented some of the evidences for the theory of evolution. What are some of the arguments against evolution put forth by the "creation scientists" and what do they seek to put in its place?

The answer to the second question is very easy. A chart made by H. M. Morris, the director of the Institute for Creation Research, shows that the "creation scientists" already know the way that the Earth was created and animals were formed. It is the Fundamentalist reading of Genesis. As mentioned above, the I.C.R. is a Fundamentalist organization. Scientists wishing to join must sign a confession of faith that they believe in the literal inerrancy of the Bible. It should be noted that Table 1 is not a caricature that I am making of the creationist position, but a list put forth by the head of this creationist organization. According to Morris, the Earth existed before the sun and the stars, mankind (or at least one male representative of it) existed before the first rainfall on Earth, and there were no deaths on Earth before the creation of man. Let us now look at some of the arguments used by creation scientists to try to establish the Genesis view.

## The Age of the Earth

Scientists believe the universe to be some 15 billion years old, with the Earth forming about 4.5 billion years ago. The sun and most of the other stars preceded Earth's creation by many billions of years. Creationists, however, believe that the Earth was created during the same six day period as the sun and the stars, about a day ahead of the stars. While Creationists have not concerned themselves with the astrophysical calculations for the age of the universe, they have invested a huge effort in trying to show that the Earth is less than 10,000 years old. To do this, they must somehow invalidate the radioactive dating data provided by the decay of uranium, potassium, and 40 other isotopes, all of which confirm an age for the Earth of several billion years.

## **The Creationist Argument against Radioactive Dating**

The methods for dating the Earth were presented in the last chapter. The explanations of radioactive decay measurement provided by the "creation-science" literature are cartoon-like caricatures of the highly controlled and cross-checked methods actually used. The creationist literature makes the scientists look like buffoons who do not know how to control for obvious errors. In one instance, a leading "creation scientist" told an audience that the entire process of radioactive dating had been discredited because physicists had recently discovered that radioactive decay is not constant but could change over geologic time. Thus, a major assumption of the dating process was shown to be in error and the dates provided were worthless. What he did not say was that under enormous temperature and pressure, the radioactive decay could be lessened as much as 4 percent. This would give a figure for the Earth's age that might be 0.05 billion years less than the 4.5 billion presently considered. This does not invalidate the procedure, and it certainly doesn't give an age for the Earth anywhere near the Creationists' 6,000.

## **The Creationist Argument from Magnetic Field Decay**

The use of half-truth is widespread in Creation-science literature. One argument for the young age of the Earth has been the decay of the Earth's magnetic field. The rate of present decay, if extrapolated back, would suggest that the world was created within 10,000 years. However, this assumes that the Earth's magnetic field has been decreasing slowly and smoothly since its formation. The record of rocks throughout the world's crust shows that this assumption is preposterous. The magnetic field of the Earth has fluctuated violently in some epochs and has even reversed itself numerous times. The creation-scientists do not mention these fluctuations and reversals. To do so would acknowledge the enormous age of our planet.

## **The Creationist Argument from Meteoritic Dust Accumulation**

Another argument that has been used by Creationists to demonstrate that the Earth was created less than 10,000 years ago concerns the accumulation of meteorite dust. Creationists have claimed that according to scientific calculations, the Earth and its moon (where meteorite dust could be more easily measured since there is no erosion) should accumulate an inch of meteorite dust every 2n3 million years. There should, therefore, be a layer of dust over 150 feet deep. The fact that we aren't so covered and that Neil Armstrong didn't sink into the lunar surface indicates that the Earth and its satellite are relatively young and have not acquired this dusty envelope. However, the calculations that the Creationists have used for these predictions were based on Earth-bound experiments performed in 1959. Unlike Divine revelation, science changes. Both the United States and the Soviet Union have amassed data on meteorite dust from their numerous satellites and find that about  $10^{16}$  grams of dust should accumulate on the moon each second. If the moon were 5 billion years ( $10^{17}$  seconds) old, there should be about 10 grams of dust per square centimeter of lunar surface. This is, in fact, what the lunar landing models have found.

## **The Creationist Argument from Ocean Composition**

Reading Creationist literature is frustrating for scientists in the field of research, because the Creationists will often point to a problem whose answer has been known to workers for years. If the planet were old, they say, there should be a great deal more aluminum in the oceans. Why don't we see it? They state that the reason is that the planet is too young to accumulate large quantities of aluminum in the ocean. The more likely answer is that aluminum rapidly combines with other

compounds in the water to form kaolinite, the major component of clay. Kaolinite precipitates, thus removing the aluminum from the water.

## Creationist Arguments from Thermodynamic Laws

Another argument often used by Creationists involves the second law of thermodynamics. Even the scientific creationists state that this is a true law and that nothing on Earth can disobey it. In a closed system, disorder must increase. The thermodynamic argument was first used against evolution by Darwin's contemporary, Lord Kelvin. The sun, he said, could not have emitted such prodigious amounts of energy for billions of years. It would have long since depleted its material reserves. His calculations were unimpeachable, and Darwin went to his grave worrying about Kelvin's calculations. What Kelvin didn't know about, however, was the existence of nuclear fusion. He had based his calculations on standard chemical combustion mechanisms. We now are aware that the sun is a nuclear furnace, fusing hydrogen nuclei into helium in a cyclical process that liberates more energy than anyone of Kelvin's generation could have thought possible. The sun's energy has been radiating for billions of years and should persist for several more billion.

The more modern use of the thermodynamic argument is that you cannot generate order and complexity out of relative simplicity. Thus, complex beings (such as humans and arthropods) could not have evolved from relatively simple protists. Rather, the Creationists claim, one must start with complexity. There may be some degeneration from this point, but order can only decrease, not increase. Since there has not been a great deal of degeneration<sup>1</sup>, the Earth must be young. What the Creationists do not remember, though, is that the second law of thermodynamics specifies that the system be closed. The Earth is by no means a closed system. Indeed, life on Earth would undergo degeneration were it not provided with an enormous supply of energy from outside and within it. Again, we behold the sun whose energy flows into living beings as they warm themselves and as they eat. Radioactive decay within the Earth's crust also provides heat. The evolution of life is perfectly compatible with the laws of thermodynamics. (The mechanisms by which order could be generated from random chaos without violating the laws of thermodynamics won a Nobel Prize for Ilya Prigogine in 1977.) To say that one cannot generate order and complexity from less complex and less ordered systems would be to deny that one ever was a zygote. Both development and evolution can generate order and complexity without disobeying thermodynamic laws.

The last Creationist argument is used when others fail; for it takes the discussion out of the scientific realm entirely. Creationists have claimed that the earth is only 6,000 years old, but the Creator purposefully designed it to appear much older! Thus, scientific dating procedures just discover that which God put there to trick us and to test our faith. This "appearance of age" argument is a total sham of both religion and science.

In some of the Creationist literature, degeneration is seen from the original divinely created forms. One widely distributed tract uses degeneration as its explanation for the formation of human races. It can't use evolution, so it states that "All races descended from the first man and woman. Some developed more highly than others building on accumulated knowledge. Some progressed for a time, then retrogressed." This degeneration is due to sin, for "His sin caused a 6,000-year-long decline morally and physically." Where Scientific Creationism sees decline and degeneration, biological science sees evolution from less complex forms to beings of greater complexity.

**Table 1**

<b>Evolutionary Science</b>	<b>Scientific Creationism</b>
Matter created in the beginning	Matter created by God
Sun and stars before earth	Earth before sun and stars
Land before oceans	Oceans before land
Marine organisms first life	Land plants first life
Fish formed before fruit trees	Fruit trees created before fish
Insects formed before birds	Birds created before insects
Sun formed before land plants	Land plants exist prior to sun
Reptiles formed before birds	Birds created before reptiles
Reptiles formed before whales	Whales formed before reptiles
Rain existed before mankind	Mankind created before first rain
Formative processes still continuing	Creation completed
Struggle and death before mankind emerges	Mankind the cause of struggle and death

# Special Creation Versus the Fossil Record: Creationists Assert that Creation Cannot Be Scientifically Studied

You have read about mechanisms whereby new species can be generated from existing ones. The Creationists deny that this process of species formation ever occurs. They claim that all species were created during the first week of Creation. What scientific mechanism, then, do they use to account for the origin of species? The most succinct answer to this question comes in the 1978 book, *Evolution? The Fossils Say No!* written by one of the leading proponents of "Creation Science," Duane Gish: "We cannot discover by scientific investigations anything about the creative processes used by the Creator." In other words, creation is miraculous, so there is nothing we can scientifically say about it. So much, then, for the "scientific" component of "Scientific Creationism" and "Creation Science". We have Creationism, pure and simple.

## The Fossil Record Denies a Single Creation Event

If the Creationist view were true, though, we would expect there to be evidence that all living things coexisted together from the earliest times we could find evidence of life. This should be readily demonstrable in the fossil record. There are thousands of dinosaur fossils that have been unearthed. Does one ever find evidence of human remains in the same fossil beds? Two of the most common forms of fossilized animals are trilobites and boney fish. Both lived in the oceans. Does one ever find a trilobite fossil among the numerous fossils of boney fish? The answer to both these questions is no. The last dinosaur fossils are in rock strata 60 million years old, whereas the first human fossils are found in strata only 4-5 million years old. Similarly, trilobites are seen to have died out over a hundred million years before the first boney fishes appeared on this planet. Land plants such as ferns are seen as early as 350 million years ago, preceding the flowering plant species by some 200 million years.

It was the evidence of fossils that convinced most scientists that life was not created simultaneously some 6,000 years ago. Many of the original and most startling findings were made by devoutly Protestant naturalists such as Georges Cuvier (who revised animal classification), Richard Owen (who coined the word "dinosaur" and described the *Archeopteryx*, a fossil showing characteristics of both reptiles and birds), and Louis Agassiz (who discovered the existence of the Ice Ages and who was the world's authority on living and extinct fish). Although each of these men had strong religious convictions, they did not feel bound to a literal interpretation of Genesis once their studies had shown that the creation of organisms could not have happened simultaneously. How then do Creationists explain the fossil record? How do they explain why one finds fossils of boney fish only in the most recent strata, while the fossils of cartilaginous fish such as sharks are seen in strata hundreds of millions of years older?

## Creationist Account of Fossil Strata Formation

The Creationist account of fossil formation assumes that all the organisms (humans, dinosaurs, *Archeopteryx*, trilobites, flowering trees, etc.) were created together some 6,000 years ago. They continued this coexistence until the great Flood drowned all the animals that weren't on Noah's ark. According to the Creationist account, the corpses resulting from the flood were buried according to their density and ability to resist the rising waters, the denser, weaker corpses being deposited deeper than the lighter, stronger beasts.

This model is at odds not only with biology but with physics and geology, as well. Indeed, the Flood as the basis for fossil stratification was abandoned by serious Protestant naturalists such as Cuvier more than a century ago. The authors of *The Genesis Flood* do not support this remarkable idea with any data at all. What might happen if they were to go into a laboratory and test their hypothesis with dead organisms? Would a dead jellyfish sink more rapidly than a dead squirrel or a dead cockroach? Moreover, as paleontologist Kenneth Miller has pointed out, a single class of animals such as mammals contains species varying enormously in their hydrodynamic properties, ecological niches, differential mobility, and strength. Ocean-dwelling whales, tree-climbing monkeys, burrowing field mice, and flying bats are all mammals, and each appears late in the fossil record. And they appear only after the most mammal-like reptile has appeared, and not before it!

## **The Paluxy River Bed Hoax: Fred Flintstone Finds Dino in Texas**

Until 1987, the Creationists would delight in telling the story of the Paluxy river bed. Here, they claimed footprints of dinosaurs and human beings could be found together. Book chapters and special films (which can still be ordered) "document" this remarkable occurrence. When a noted paleontologist, G. G. Simpson, claimed the human tracks to be fraudulent, Creationists wrote that he was just trying to cover up a discovery that would, in one blow, destroy his life's work. Since the Creationists placed so much emphasis on these footprints, a group of scientists decided that they would have to investigate this claim seriously. What they found was a remarkable piece of human social history. During the Depression, some of the local inhabitants made money by carving footprints in the rock and selling them. Eventually, Morris and other Creationists announced that they, too, felt the Paluxy claims were a hoax. However, this example still remains in many Creationist books as evidence that human and dinosaurs once lived together.

In short, Creationists have no evidence that life was created during a single week of Creation. The fossil evidence is decidedly against this view. Neither do Creationists have any way of explaining how fossils were formed and layered in a way that mimics an evolutionary history so remarkably well. Despite their claims to the contrary, Creationists have not put forth any scientific alternative to the evolutionary account of fossil formation.

## **Creationist Arguments against the Fossil Record**

Given that "scientific creationists" do not have any scientific explanation for the origin of species and have a physically impossible model for the occurrence of fossil strata, they spend a great deal of time criticizing the fossil record that does exist. Chief among their arguments is that the fossil record lacks any transitional species between recognized phyla. There isn't, they claim, a fossil of an animal midway between a reptile and a mammal or between a fish and an amphibian. Such transitional forms would be expected by evolutionary theory.

## **The Existence of Transitional Forms in the Fossil Record**

As Gershwin said, "It ain't necessarily so." Transition forms abound in the fossil record. Duane Gish states that there are no transition forms known between reptiles and mammals. He then goes on to imagine what such a beast would look like, and he comes up with an amusing composite with jaw bones protruding through its ears. In fact, there are at least ten well-defined transitional forms intermediate between an obvious reptile and an obvious mammal. In the middle of this transition series, it is a matter of preference whether one calls the species a reptile or a mammal.

Another transitional form, *Ichtheostega*, appears to be a fish that has modified its fins and fin musculature to get up on to land. Paleontologist Edwin Colbert analyzed this fossil species and found that *Ichtheostega's* tail was actually the caudal region of the fish fin rays. The vertebra, too, resembled that of a fish. The pectoral and pelvic girdles, however, had been modified to produce an amphibian-like shoulder and pelvis that would be capable of moving the animal on the ground. Gish, on the other hand, states that "Not a single transitional form has ever been found showing an intermediate stage between the fin of the crossopterygian [fish] and the foot of the ichtheosteid." The drawing of *Ichtheostega* in Gish's book differs from the way that paleontologists represent this species, and it leads one to think that there is no fish-like structure in this animal. Obviously, although *Ichtheostega* seems made up of some mix of fish and amphibian parts, it is not the transition that Gish wants. Other transitional forms are also well-documented. *Seymouria*, the first animal with reptilian characteristics in its skull and limbs, still had jaw and vertebral features typical of amphibians. The earliest known bird, *Archeopteryx*, is known from two well-preserved fossils. It would probably have been classified as a reptile were it not for the definite imprints made by its large feathers.

## Complete Creation or Evolution Over Time? The Pre-Cambrian Stones Speak

The simultaneous creation (within a single week) of all living organisms demands that the fossil record show a sudden burst of life occurring all at once. This is what the Creationists say happened during the Cambrian era. As Gish claims, "What do we find in rocks older than the Cambrian? Not a single, indisputable, multicellular fossil has ever been found in Pre-cambrian rocks!"

This is wishful thinking. Gish has been contradicted again and again. Not only have blue-green algae been found in the pre-Cambrian rock strata, but so have fossil imprints of jellyfish, coelenterates, and even a species that looks like a transition form between the annelid worms and the arthropods. These fossils are rarer than those of the Cambrian, because the bodies of these invertebrates are soft and are not preserved as well as the hard-bodied animals.

Thus, the fossil record supports the generation of species over a long period of geological time rather than a sudden explosion of life upon the planet. The fossil record is also full of the transitional species whose existence the Creationists wish to deny. Moreover, there is no evidence for the Creationist views that life was created within the past 10,000 years in a single week of creative activity and that the fossil strata were formed by the differential sedimentation of the corpses during Noah's Flood.

## Thermodynamics and Complexity

Another Creationist attack on science claims that life is too complex to create without divine miracles. Creationists claim that to get a protein of 200 amino acids, the chances of its occurring by chance would be  $(1/20)^{200}$ , or essentially zero. As Gish puts it, "The time required for a single catalytically active protein molecule to arise by pure chance would be billions of times the assumed age of the earth." But this is like saying that adults must be formed immediately since there is no way that an egg can give rise to the complex adult structures. One does not need to have the entire 200 amino acid protein in order to have catalytic activity. Most biochemists view that primitive enzymes might have been composed of only a few amino acids. These might not have had more than 3% the catalytic activity of the enzyme as we now know it. However, during natural selection, the efficiency of that enzyme could improve by adding other amino acids that could function as regulatory units.

In fact, two such enzymes have been discovered, which are believed to result from just the sort of random ordering of amino acids that Gish decries. These enzymes result from a frameshift mutation

in a *Flavobacterium* bacteria. The frameshift causes a new sequence of amino acids to be produced. This new sequence has a new type of enzymatic activity not associated with the original protein. Although this hydrolase activity is only 2 percent that of other cellular hydrolases, it is a new function associated with a random sequence of amino acids. Research on the origin of life by Stuart Kauffman and his colleagues have shown that catalysis can be accomplished reasonably well by four amino acids. Evolution is not only chance. Natural selection acts as an editor to keep what works and discard what doesn't. Proteins and nucleic acids can be made without divine creation. For a more detailed account on the origins of complexity, see Dyke's *The Evolutionary Dynamics of Complex Systems*.

## Science and Fundamentalism

As we have seen above, there is precious little "science" in "Creations Science," for the necessary components to make a discipline "scientific" are totally lacking. There is no testing of hypotheses, nor is there any framing of testable theories. In some instances, Creation Scientists explicitly state that they do not care what answer is given by a scientific experiment, since they already know the truth. The Truth, as we have seen repeatedly, is that of the literal interpretation of Genesis. This truth was not discovered by thought and the trial-and-error of experimentation. Rather, it was provided by Divine Revelation. Instead of providing confirmable or deniable hypotheses for the origin of species, the "scientific creationists" provide confessions of faith or models based, not on previous experiments, but on what would be expected from Holy Scripture. "Scientific Creationism" is only religious Fundamentalism in a new guise.

The one thing that such Fundamentalists do have that evolutionary biologists lack is the certainty of divine authority. Neither Darwin nor any other evolutionary biologist can provide dogma; for a scientific truth is very different from a religious truth. Unlike religious dogma, science is open-ended. There is still so much more to learn. Creationists see the tentativeness of scientific "facts" and the incompleteness of scientific knowledge as weaknesses of science. After printing a paragraph from a science text stating that biologists still do not understand how birds know when and where to migrate, one Creationist text continues, "Evolution has no explanation for the instinctive wisdom of animals. But the Bible does."

This is a theologically dangerous ploy. It evokes what is sometimes called "the God of the Gaps." In other words, when science doesn't know something, that's God's domain. There are many problems with this notion. The first is that God's domain keeps getting smaller. When a child asks, "Why is the sky blue?" and gets an answer, "God made it that way," that child will be disappointed when learning the physical reasons for the blue sky. It also sets up an adversarial relationship between religion and science. Science is obviously chipping away at religion's domain. The belief in this God of the Gaps is probably one of the major causes for the mistrust of science among the American public.

Although the incompleteness of science may seem to be a weakness to a Creationist observer, to a scientist it indicates an interesting area of research. Developmental biology, neurobiology, and the ecology of tropical rainforests are each interesting to scientists not because we know the answers, but because we do *not* know the answers. There would be no reason to pursue research in an area wherein everything was known (which may explain why almost none of the money raised by the creation research institutes actually goes into research. Most all of it goes into the making of propaganda).

Another point where Creationists have proclaimed the weakness of science is in its lack of consensus. To a Fundamentalist, disagreement is a horrible thing to have within one's field. How can one disagree as to what is the truth? One side or the other must have the truth, while the others are heretics. Science, however, proceeds by respectful argumentation. It is a sign of a field's good health when researchers debate one another. Graduate classes in biology are primarily exercises in trying to discover possible flaws in the experimental technique of some recent study.

In recent years, there has been much argumentation and debate within the field of evolutionary biology. The debate between the supporters of punctuated equilibrium and those of phyletic gradualism is indicative of a robust and exciting science. But Creationists see such division as a weakness (as it would be in theological communities that already know the truth) and decided that there was a major split among the evolutionary biologists. One of the pamphlets that reported this debate was entitled, *Harvard Scientists Agree Evolution is Hoax*. According to this propaganda, the "facts of punctuated equilibrium...are forcing Darwinists to swallow the picture that [Scope's trial prosecutor W.J.] Bryan insisted on, and which God revealed to us in the Bible."

Punctuated equilibrium hardly fits anything in the literal interpretation of Genesis. The debate involves two groups of evolutionary biologists, one of which believes that evolution occurs at a different rate than the other. Neither side denies evolution. However, the supporters of punctuated equilibrium note that Darwin had assumed a gradual mode of evolution and had not proven it. The supporters of punctuated equilibrium think that Darwin was wrong—not about evolution, but about the tempo of evolution. This is their prerogative. Darwin was neither God nor His messenger. He was wrong on some other details of evolution, too, but his major views have held up remarkably well for a theory proposed over 125 years ago. The strength of science is in the vigorous but respectful debates of its members concerning what has been proven to their critical satisfaction.

## Fair Play for Biology

In their recent attempts to get Creationism to be taught in public schools, Creationists have often used a "fair play argument." Jerry Falwell's printed letter solicits tax-deductible donations with a plea for open-mindedness: "Special creation should be taught in public schools alongside the concept of evolution...in the name of academic freedom" (ellipses are in the original letter). It seems that the Creationists are complaining that the Biblical view of creation is not getting "balanced treatment" in high school science courses. Scientists are portrayed as belonging to a small-minded club which has excluded creationists and has kept creationism out of the schools. After all, they say, evolution is only a theory and Creationism is only a theory, so they have equal right to be taught in the classroom. Often, philosopher Thomas Kuhn's notions that science has changed due to changing paradigms are brought into the discussion by Creationists. They claim that evolutionism and Creationism are two paradigmatic approaches to the same questions and should thus be taught. Let the student decide which is right.

This, of course, twists around all the ideas of academic freedom and tolerance that have evolved in the academic community for the past century. It is fine to bring in other points of view, but this does not mean that we have to relinquish all standards of judgement. The astrologers have been claiming for thousands of years that our personalities are influenced, if not determined, by the constellations of the zodiac. Must we give them equal time in our psychology courses? There are still people who claim that the world is flat despite the evidence of our space satellites. Does that mean we have to change our textbooks to accommodate them? Of course it doesn't. The facts are totally against them. But what is a "scientific fact"? Such a fact, though not a claim for an eternal truth, is an observation or idea "confirmed to such a degree that it would be perverse to withhold provisional consent." This definition is that of Stephen J. Gould, who illustrates it by noting that apples might start rising towards the sky tomorrow, but this possibility should not merit equal time in physics courses.

Science prides itself on debate and open-mindedness. But the minority opinion must have data that it can present in opposition to the main view. A good case in point is Alfred Wegener's championing the theory of Continental Drift. In 1915, Wegener proposed that the continents did not always occupy the positions they now hold. Rather, they were once united in a single land mass and had drifted apart. This theory, he said, would account for the shapes of the continents (such that Africa seems to fit nicely on the contours of South America), the apparent continuity of mountain ranges from one continent to the other, the distribution of similar animal and plant species on distant continents, and

the types of fossils which indicate that large regions had climates dramatically different than they are experiencing today. By carefully documenting his claims, he made a forceful case that his theory could explain geographic phenomena better than any existing theory. However, he could not produce any mechanism for how the continents could move. In the absence of such a mechanism, most geologists agreed that Wegener had an interesting theory, but that it couldn't be correct. Continents couldn't move. However, the data that Wegener obtained were good enough to remain in scientific discussion as a counter-theory to the accepted ones. It remained in the textbooks, too. When plate tectonics was discovered in the 1960s, it provided the mechanism that Wegener had lacked, and the geologists were quick to accept the theory of continental drift.

As we have seen from the above discussion in this chapter, "scientific creationism" has offered science nothing in the way of new data or experiments. All it has provided are statements of Fundamentalist faith. Equal time? Since when have Creationists wanted that? Morris has written that "True education in every field should be structured around creationism, not evolutionism." They are fighting for our souls, and they cannot go half way in this endeavor. Do they allow a "balanced account" of Creation in their churches? Of course not. Here, the congregation is required to believe and is told that they will roast in hell for all eternity if they do not. (Far worse, I think, than not scoring well on a biology test). Yes, students should hear "both sides of the story." But first there has to be honesty on both sides. Teachers should not be forced to present creationism as if it had the same intellectual respectability as evolution and as if it were backed by a set of critically discussed experiments. At present, there is no reason why the Genesis account of creation should get more "balanced treatment" than the Hopi creation story, the Yoruba creation story, or the Hindu creation tale. Each of these is based on faith and has no scientific evidence in its favor. Rather than hearing "both sides of the story," those interested in "fair play" should be lobbying for students hearing "all sides of the story."

The "scientific creationists" have not provided any alternative scientific model to counter that of evolution. When pressed, they have retreated into confessions of faith, saying that only God knows the mechanisms whereby species are created. Lacking a scientifically based model of their own, they have tried to show where the evolutionary model is flawed. In this textbook chapter, we have tried to show that this attempt has failed miserably and demonstrates that the Creationists are either ignorant of the observations of nature or willfully twisting them to suit their own ends. We have also tried to show that the view of science held by the "scientific creationists" is at odds with everything that science has become in the past four hundred years. In short, we have tried to show that "scientific creationism" is merely what it set out to be, a religious Fundamentalism that is trying to destroy science and have all the students in this country be told in their high schools that the Bible is literally True.

## Literature Cited

Anyone wishing to be involved in these debates should first get hold of the standard arguments of the Creationists. The Watch Tower Bible and Tract Society of the Jehovah's Witnesses publishes *Did Man Get Here by Evolution or By Creation*. This well illustrated book (with Adam and Eve shown in Caucasian beauty) is a classic of the genre and illustrates the art of taking quotations from famous evolutionists out of context. *The Genesis Flood* by J. C. Whitcomb and H. M. Morris is often credited with initiating the Creation Science movement. Morris also authored two other important Creationist texts, *The Remarkable Birth of Planet Earth* (1972) and the summary of the field, *Scientific Creationism* (1974). Both of these books are published by the Creation-Life Publishers, San Diego. This organization also publishes Duane Gish's *Evolution? The Fossils Say No!* The text on natural theology that is mentioned in this chapter is William Kirby's *Bridgewater Treatise On the Power, Wisdom, and Goodness of God as Manifested in the Creation of Animals and in their History, Habits, and Instincts*. This volume was published in London in 1853, and was published in Philadelphia for an American volume.

Most of the general creationist arguments against evolution have been mentioned in the text, but more are being devised (not discovered) continually. More detail about these and other arguments and their scientific rebuttals can be found in Philip Kitcher's book *Abusing Science* (MIT Press 1983) and in an excellent series of essays edited by Ashly Montagu, *Science and Creationism* (Oxford Press 1984). The articles by Miller, Gould, and Halstead in that volume contributed largely to this chapter. These chapters can also direct the reader where to find specific information concerning topics such as the transitional forms between reptiles and mammals or more detailed accounts (including the mathematics) of questions involving the age of the Earth.

The periodical *Creation/Evolution*, published by the American Humanist Association, Buffalo, NY, provides an excellent review of ongoing arguments in this field. The reference to the creation of a new protein activity from a random sequence of amino acids can be found in Ohno, S. (1984). *Proc. National Acad. Sci. USA* 81: 2421-2425.

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<sup>i</sup> The Genesis account of Creation can certainly be true in other modes than the literal. The relationship between God, humanity, and the other living species might be a valid relationship, and the story of Noah's Ark, so stupid in the literal sense, is being used as a rallying point to join biology and religion in a campaign to save biodiversity. According to this view, the Noah story says that all Nature depends on man's moral behavior and that just as Noah was a righteous man in his generation to save the animals, so must we be in ours. To discount the Genesis stories because they are not "scientifically" valid may be as foolish a behavior as trying to claim that the stories must be scientifically valid.