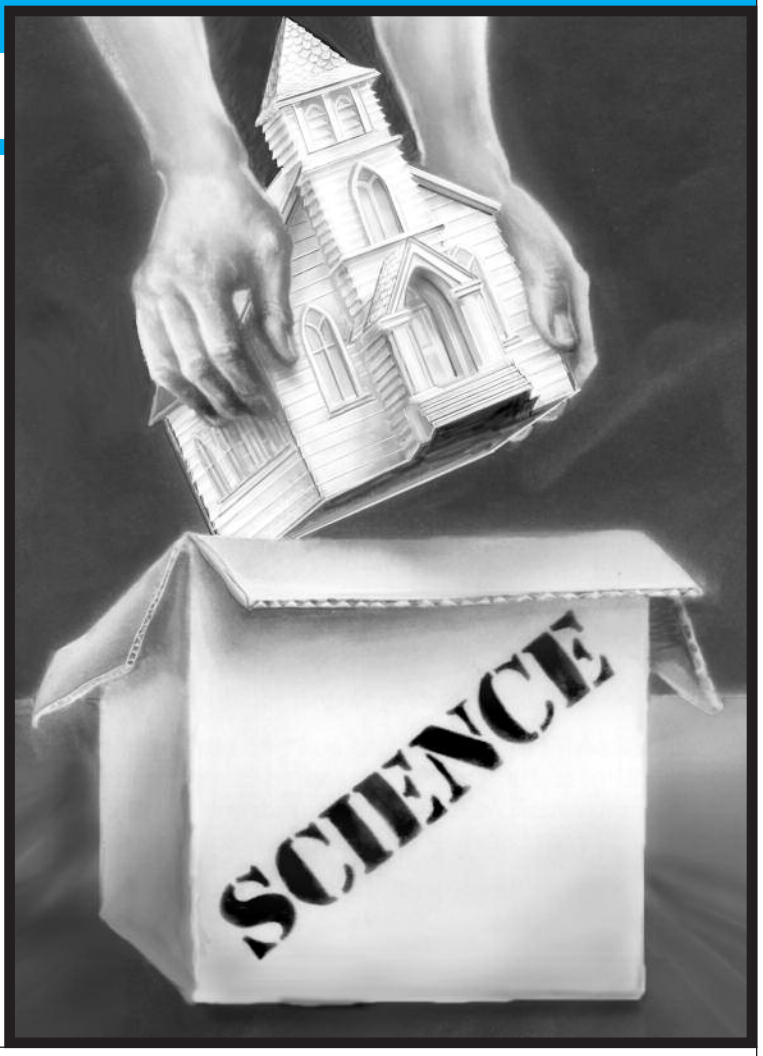
How to DEBATE A CREATIONIST

handout edition

25 Answers To Classic Creationist Arguments
10 Answers To Intelligent Design Creationist Arguments



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25 Creationists' Arguments and 25 Evolutionists' Answers

The following is a list of arguments put forth by creationists and answers put forth by evolutionists. The arguments are primarily attacks on evolutionary theory and secondarily (in a minor way) positive statements of creationists' own beliefs. The arguments and answers are simplified due to space constraints; nonetheless, they provide an overview of the principle points of the debate. This list is not meant to substitute for critical reading, however. While these answers might be adequate for casual conversation, they would not be adequate for a formal debate with a well-prepared creationist. Numerous books offer fuller discussions (e.g., Berra 1990; Bowler 1989; Eve and Harrold 1991; Futuyma 1983; Gilkey 1985; Godfrey 1983; Gould 1983a, 1991; Lindberg and Numbers 1986; Numbers 1992; Ruse 1982; and, especially, Strahler 1987).

PHILOSOPHICALLY BASED ARGUMENTS AND ANSWERS

1 *Creation-science is scientific and therefore should be taught in public school science courses.*

Creation-science is scientific in name only. It is a thinly disguised religious position rather than a theory to be tested using scientific methods, and therefore it is not appropriate for public school science courses, just as calling something Muslim-science or Buddha-science or Christian-science would not mean that it requires equal time. The following statement from the Institute for Creation Research, which must be adhered to by all faculty members and researchers, is a powerful illumination of creationist beliefs:

> The scripture, both Old and New Testaments, are inerrant in relation to any subject with which they deal, and are to be accepted in their natural and intended sense…all things in the universe were created and made by God in the six days of special creation described in Genesis. The creationist account is accepted as factual, historical and perspicuous and is thus fundamental in the understanding of every fact and phenomenon in the created universe (in Rohr 1986, p. 176).

Science is subject to disproof and is ever-changing as new facts and theories reshape our views. Creationism prefers faith in the authority of the Bible no matter what contradictory empirical evidence might exist: "The main reason for insisting on the universal Flood as a fact of history and as the primary vehicle for geological interpretation is that God's Word plainly teaches it! No geological difficulties, real or imagined, can be allowed to take precedence over the clear statements and necessary inferences of Scripture" (in Rohr 1986, p.190). Here is an analogy. Professors at Caltech declare Darwin's *Origin of Species* dogma, the authority of this book and its author absolute, and any further empirical evidence for or against evolution irrelevant.

2 *Science only deals with the here-and-now and thus cannot answer historical questions about the creation of the universe and the origins of life and the human species.*

Science does deal with past phenomena, particularly in historical sciences such as cosmology, geology, paleontology, paleoanthropology, and archaeology. There are experimental sciences and historical sciences. They use different methodologies but are equally able to track causality. Evolutionary biology, for examle, is a valid and legitimate historical science.

3 *Education is a process of learning all sides of an issue, so it is appropriate for creationism and evolution to be taught side-by-side in public school science courses. Not to do so is a violation of the principles of education, and of the civil liberties of creationists. We have a right to be heard, and, besides, what is the harm in hearing both sides?*

Exposure to the many facets of issues is indeed a part of the general educational process, and it might be appropriate to discuss creationism in courses on religion, history, or even philosophy but most certainly not science; similarly, biology courses should not include lectures on American Indian creation myths. There is considerable harm in teaching creation-science as science because the consequent blurring of the line between religion and science means that students will not understand what the scientific paradigm is and how to apply it properly. Moreover, the assumptions behind creationism comprise a two-pronged attack on all the sciences, not just on evolutionary biology. One, if the universe and Earth are only about ten thousand years old, then the modern sciences of cosmology, astronomy, physics, chemistry, geology, paleontology, paleoanthropology, and early human history are all invalid. Two, as

soon as the creation of even one species is attributed to supernatural intervention, natural laws and inference about the workings of nature become void. In each case, all science becomes meaningless.

4 There is an amazing correlation between the facts of nature and the acts of the Bible. It is therefore appropriate to use creation-science books and the Bible as reference tools in public school science courses, and to study the Bible as a book of science alongside the book of nature.

There is also an amazing correlation between acts in the Bible for which there are no facts in nature and between facts in nature for which there are no acts in the Bible. If a group of Shakespeare scholars believe that the universe is explained in the bard's plays, does that mean science courses should include readings of Shakespeare? Shakespeare's plays are literature, the Bible contains scriptures sacred to several religions, and neither has any pretensions to being a book of science or a scientific authority.

5 The theory of natural selection is tautological, or a form of circular reasoning. Those who survive are the best adapted. Who are the best adapted? Those who survive. Likewise, rocks are used to date fossils, and fossils are used to date rocks. Tautologies do not make a science.

Sometimes tautologies are the beginning of science, but they are never the end. Gravity can be tautological, but its inference is justified by the way this theory allows scientists to accurately predict physical effects and phenomena. Likewise, natural selection and the theory of evolution are testable and falsifiable by looking at their predictive power.

For example, population genetics demonstrates quite clearly, and with mathematical prediction, when natural selection will and will not effect change on a population. Scientists can make predictions based on the theory of natural selection and then test them, as the geneticist does in the example just given or the paleontologist does in interpreting the fossil record. Finding hominid fossils in the same geological strata as trilobites, for instance, would be evidence against the theory. The dating of fossils with rocks, and vice versa, could only be done after the geological column was established. The geological column exists nowhere in its entirety because strata are disrupted, convoluted, and always incomplete for a variety of reasons. But strata order is unmistakably nonrandom, and chronological order can be accurately pieced together using a variety of techniques, only one of which is fossils.

6 There are only two explanations for the origins of life and existence of humans, plants, and animals: either it was the work of a creator or it was not. Since evolution theory is unsupported by the evidence (i.e., it is wrong), creationism must be correct. Any evidence that does not support the theory of evolution is necessarily scientific evidence in support of creationism.

Beware of the either-or fallacy, or the fallacy of false alternatives. If A is false, B must be true. Oh? Why? Plus, shouldn't B stand on its own regardless of A? Of course. So even if evolutionary theory turns out to be completely wrong, that does not mean that, ergo, creationism is right. There may be alternatives C, D, and E we have yet to consider. There is, however, a true dichotomy in the case of natural versus supernatural explanations. Either life was created and changed by natural means, or it was created and changed by supernatural intervention and according to a supernatural design. Scientists assume natural causation, and evolutionists debate the various natural causal agents involved. They are not arguing about whether it happened by natural or supernatural means. And, again, once you assume supernatural intervention, science goes out the window—so there can be no scientific evidence in support of creationism because natural laws no longer hold and scientific methodology has no meaning in the world of evolution deniers.

7 Evolutionary theory is the basis of Marxism, communism, atheism, immorality, and the general decline of the morals and culture of America, and therefore is bad for our children.

This partakes of the *reductio ad absurdum* fallacy. Neither the theory of evolution in particular, nor science in general is any more the basis of these "isms" and American's so-called declining morals and culture than the printing press is responsible for Hitler's *Mein Kampf* or *Mein Kampf* is responsible for what people did with Hitler's ideology. The fact that the atomic bomb, the hydrogen bomb, and many even more destructive weapons have been invented does not mean we should just abandon the study of the atom. Moreover, there may well be Marxist, communist, atheist, and even immoral evolutionists, but there are probably just as many capitalist, theist, agnostic, and moral evolutionists. As for the theory itself, it can be used to support Marxist, communist, and atheist ideologies, and it has; but so has it been used (especially in America) to lend credence to laissez-faire capitalism. The point is that linking scientific theories to political ideologies is tricky business, and we must be cautious of making connections that do not necessarily follow or that serve particular agendas (e.g., one person's cultural and moral decline is another person's cultural and moral progress).

8 Evolutionary theory, along with its bedfellow, secular humanism, is really a religion, so it is not appropriate to teach it in public schools.

To call the science of evolutionary biology a religion is to so broaden the definition of religion as to make it totally meaningless. In other words, religion becomes any lens that we look through to interpret the world. But that is not what religion is. Religion has something to do with the service and worship of God or the supernatural, whereas science has to do with physical phenomenon. Religion has to do with faith and the unseen, science focuses on empirical evidence and testable knowledge. Science is a set of methods designed to describe and interpret observed or inferred phenomenon, past or present, and aimed at building a testable body of knowledge open to rejection or confirmation. Religion—whatever it is—is certainly neither testable nor open to rejection or confirmation. In their methodologies, science and religion are 180 degrees out of phase with each other.

SEA CREATION STORIES

"The world was created from out of the sea."

Representative cultures:
Sumerian, Egyptian, Burmese, Choctaw Indians, Maui, Icelandic

COSMIC EGG CREATION STORIES

"The world was generated from an egg."

Representative cultures:
Japanese, Samoan, Persian, Finnish, Chinese, Greek, Hindu

NO CREATION STORY

"The world has always existed as it is now, unchanging from eternity."

Representative culture:
Jainism (India)

9 *Many leading evolutionists are skeptical of the theory and find it problematic. For example, Eldredge and Gould's theory of punctuated equilibrium proves Darwin wrong. If the world's leading evolutionists cannot agree on the theory, the whole thing must be a wash.*

It is particularly ironic that the creationists would quote a leading spokesman against creationism—Gould—in their attempts to marshal the forces of science on their side. Evolution deniers, in their denial, have misunderstood, either naively or intentionally, the healthy scientific debate among evolutionists about the causal agents of organic change. They apparently take this normal exchange of ideas and the self-correcting nature of science as evidence that the field is coming apart at the seams and about to implode. Of the many things evolutionists argue and debate within the field, one thing they are certain of and all agree upon is that evolution has occurred. Exactly how it happened, and what the relative strengths of the various causal mechanisms are, continue to be discussed. Eldredge and Gould's theory of punctuated equilibrium is a refinement of and improvement upon Darwin's theory of evolution. It no more proves Darwin wrong than Einsteinian relativity proves Newton wrong.

10 *"The Bible is the written Word of God…its assertions are historically and scientifically true. The great Flood described in Genesis was an historical event, worldwide in its extent and effect. We are an organization of Christian men of science, who accept Jesus Christ as our Lord and Savior. The account of the special creation of Adam and Eve as one man and one woman, and their subsequent Fall into sin, is the basis for our belief in the necessity of a Savior for all mankind"* (Eve and Harrold 1991, p. 55).

Such a statement of belief is clearly religious. This does not make it wrong, but it does mean that creation-science is really creation-religion and to this extent breaches the wall separating church and state. In private schools funded or controlled by creationists, they are free to teach whatever they like to their children. But one cannot make the events in any text historically and scientifically true by fiat, only by testing the evidence; and to ask the state to direct teachers to teach a particular religious doctrine as science is unreasonable and onerous.

11 *All causes have effects. The cause of "X" must be "X-like." The cause of intelligence must be intelligent—God. Regress all causes in time and you must come to the first cause—God. Because all things are in motion, there must have been a prime mover, a mover who needs no other mover to be moved—God. All things in the universe have a purpose, therefore there must be a purposeful designer—God.*

If this were true, should not nature then have a natural cause, not a supernatural cause?! But causes of "X" do not have to be "X-like." The "cause" of green paint is blue paint mixed with yellow paint, neither one of which is green-like. Animal manure causes fruit trees to grow better. Fruit is delicious to eat and is, therefore, very unmanure-like! The first-cause and prime-mover arguments, brilliantly proffered by St. Thomas Aquinas in the fourteenth century (and more brilliantly refuted by David Hume in the eighteenth century) are easily turned aside with just one more question: Who or what caused and moved God?

Finally, as Hume demonstrated, purposefulness of design is often illusory and subjective. "The early bird gets the worm" is a clever design if you are the bird, not so good if you are the worm. Two eyes may seem like the ideal number, but, as psychologist Richard Hardison notes cheerfully, "Wouldn't it be desirable to have an additional eye in the back of one's head, and certainly an eye attached to our forefinger would be helpful when we're working behind

the instrument panels of automobiles." Purpose is, in part, what we are accustomed to perceiving. Finally, not everything is so purposeful and beautifully designed. In addition to problems like evil, disease, deformities, and human stupidity which creationists conveniently overlook, nature is filled with the bizarre and seemingly unpurposeful. Male nipples and the panda's thumb are just two examples presented by Gould as purposeless and poorly designed structures. If God designed life to fit neatly together like a jigsaw puzzle, then what do you do with such oddities and problems?

12 *Something cannot be created out of nothing, say scientists. Therefore, from where did the material for the Big Bang come? From where did the first life forms that provided the raw material for evolution originate? Stanley Miller's creation of amino acids out of an inorganic "soup" and other biogenic molecules is not the creation of life.*

Science may not be equipped to answer certain "ultimate" type questions, such as what there was before the beginning of the universe or what time it was before time began or where the matter for the Big Bang came from. So far these have been philosophical or religious questions, not scientific ones, and therefore have not been a part of science. (Recently, Stephen Hawking and other cosmologists have made some attempts at scientific speculations on these questions.) Evolutionary theory attempts to understand the causality of change after time and matter were "created" (whatever that means). As for the origin of life, biochemists do have a very rational and scientific explanation for the evolution from inorganic to organic compounds, the creation of amino acids and the construction of protein chains, the first crude cells, the creation of photosynthesis, the invention of sexual reproduction, and so on. Stanley Miller never claimed to have created life, just some of its building blocks. While these theories are by no means robust and are still subject to lively scientific debate, there is a reasonable explanation for how you get from the Big Bang to the Big Brain in the known universe using the known laws of nature.

SCIENTIFICALLY BASED ARGUMENTS AND ANSWERS

13 *Population statistics demonstrate that if we extrapolate backward from the present population using the current rate of population growth, there were only two people living approximately 6,300 years before the present (4300 B.C.E.). This proves that humans and civilization are quite young. If the Earth were old—say one million years—over the course of 25,000 generations at 0.5 percent rate of population growth and an average of 2.5 children per family, the present population would be 10 to the power of 2,100 people, which is impossible since there are only 10 to the power of 130 electrons in the known universe.*

If you want to play the numbers game, how about this. Applying their model, we find that in 2600 B.C.E. the total population on Earth would have been around 600 people. We know with a high degree of certainty that in 2600 B.C.E. there were flourishing civilizations in Egypt, Mesopotamia, the Indus River Valley, and China. If we give Egypt an extremely generous one-sixth of the world's population, then 100 people built the pyramids, not to mention all the other architectural monuments—they most certainly needed a miracle or two…or perhaps the assistance of ancient astronauts!

The fact is that populations do not grow in a steady manner. There are booms and busts, and the history of the human population before the Industrial Revolution is one of prosperity and growth, followed by famine and decline, and punctuated by disaster. In Europe, for instance, about half of the population was killed by a plague during the sixth century, and in the fourteenth century the bubonic plague wiped out about one-third of the population in three years. As humans struggled for millennia to fend off extinction, the population curve was one of peaks and valleys as it climbed uncertainly but steadily upward. It is only since the nineteenth century that the rate of increase has been steadily accelerating.

14 *Natural selection can never account for anything other than minor changes within species—microevolution. Mutations used by evolutionists to explain macroevolution are always harmful, rare, and random, and cannot be the driving force of evolutionary change.*

I shall never forget the four words pounded into the brains of the students of evolutionary biologist Bayard Brattstrom at California State University, Fullerton: "Mutants are not monsters." His point was that the public perception of mutants—two-headed cows and the like at the county fair—is not the sort of mutants evolutionists are discussing. Most mutations are small genetic or chromosomal aberrations that have small effects—slightly keener hearing, a new shade of fur. Some of these small effects may provide benefits to an organism in an ever-changing environment.

Moreover, Ernst Mayr's (1970) theory of *allopatric speciation* seems to demonstrate precisely how natural selection, in conjunction with other forces and contingencies of nature, can and does produce new species. Whether they agree or disagree with the theory of allopatric speciation and punctuated equilibrium, scientists all agree that natural selection can produce significant change. The debate is over how much change, how rapid a change, and what other forces of nature act in conjunction with or contrary to natural selection. No one, and I mean *no one,* working in the field is debating whether natural selection is the driving force behind evolution, much less whether evolution happened or not.

SLAIN MONSTER CREATION STORIES

"The world was created from the parts of a slain monster.

Representative cultures: Indo-chinese, Kabyles, of Africa, Gilbert Islanders, Korean, Sumero-Babylonian, Greek

SPOKEN EDICT CREATION STORIES

"The world sprang into being at the command of a god."

Representative cultures: Egyptian, Mayan, Maidu Indians, Hebrews, Sumerian, Greek

PRIMORDIAL PARENTS CREATION STORIES

"The world was created by the interaction of primordial parents."

Representative cultures: Zuñi Indians, Cook Islanders, Greeks, Luiseño Indians, Egyptian, Tahitians

15 *There are no transitional forms in the fossil record, anywhere, including and especially humans. The whole fossil record is an embarrassment to evolutionists. Neanderthal specimens, for example, are diseased skeletons distorted by arthritis, rickets, and other diseases that create the bowed legs, brow ridge, and larger skeletal structure.* Homo erectus *and Australopithecus are just apes.*

Creationists always quote Darwin's famous passage in the *Origin of Species* in which he asks, "Why then is not every geological formation and every stratum full of such intermediate links? Geology assuredly does not reveal any such finely graduated organic chain; and this, perhaps, is the gravest objection which can be urged against my theory" (1859, p. 310). Creationists end the quote there and ignore the rest of Darwin's chapter, in which he addresses the problem.

One answer is that plenty of examples of transitional forms have been discovered since Darwin's time. Just look in any paleontology text. The fossil *Archeopteryx*—part reptile, part bird—is a classic example of a transitional form. In my debate with Duane Gish, I presented a slide of the newly discovered *Ambulocetus natans*—a beautiful example of a transitional form from land mammal to whale (see *Science,* January 14, 1994, p. 180). And the charges about the Neanderthals and *Homo erectus* are simply absurd. We now have a treasure trove of human transitional forms.

A second answer is a rhetorical one. Creationists demand just one transitional fossil. When you give it to them, they then claim there is a gap between these two fossils and ask you to present a transitional form between these two. If you do, there are now two more gaps in the fossil record, and so on ad infinitum. Simply pointing this out refutes the argument. You can do it with cups on a table, showing how each time the gap is filled with a cup it creates two gaps, which when each is filled with a cup creates four gaps, and so on. The absurdity of the argument is visually striking.

A third answer was provided in 1972 by Eldredge and Gould, when they argued that gaps in the fossil record do not indicate missing data of slow and stately change; rather, "missing" fossils are evidence of rapid and episodic change (punctuated equilibrium). Using Mayr's allopatric speciation, where small and unstable "founder" populations are isolated at the periphery of the larger population's range, Eldredge and Gould showed that the relatively rapid change in this smaller gene pool creates new species but leaves behind few, if any, fossils. The process of fossilization is rare and infrequent anyway, but it is almost nonexistent during these times of rapid speciation because the number of individuals is small and the change is swift. A lack of fossils may be evidence for rapid change, not missing evidence for gradual evolution.

16 *The Second Law of Thermodynamics proves that evolution cannot be true since evolutionists state that the universe and life moves from chaos to order and simple to complex, the exact opposite of the entropy predicted by the Second Law.*

First of all, on any scale other than the grandest of all—the 600-million year history of life on Earth—species do not evolve from simple to complex, and nature does not simply move from chaos to order. The history of life is checkered with false starts, failed experiments, local and mass extinctions, and chaotic restarts. It is anything but a neat Time/Life book foldout from single cells to humans. Even in the big picture, the Second Law allows for such change because the Earth is in a system that has a

constant input of energy from the Sun. As long as the Sun is burning, life may continue thriving and evolving, automobiles may be prevented from rusting, burgers can be heated in ovens, and all manner of other things in apparent violation of the Second Law may continue. But as soon as the Sun burns out, entropy will take over and life will cease and chaos come again. The Second Law of Thermodynamics applies to closed, isolated systems. Since the Earth receives a constant input of energy from the Sun, entropy may decrease and order increase (although the Sun itself is running down in the process). Thus, because the Earth is not strictly a closed system, life may evolve without violating natural laws. In addition, recent research in chaos theory suggests that order can and does spontaneously generate out of apparent chaos, all without violating the Second Law of Thermodynamics (see Kauffman 1993). Evolution no more breaks the Second Law of Thermodynamics than one breaks the law of gravity by jumping up.

17 *Even the simplest of life forms are too complex to have come together by random chance. Take a simple organism consisting of merely 100 parts. Mathematically there are 10 to the power of 158 possible ways for the parts to link up. There are not enough molecules in the universe, or time since the beginning, to allow for these possible ways to come together in even this simple life form, let alone to produce human beings. The human eye alone defies explanation by the randomness of evolution. It is the equivalent of the monkey typing Hamlet, or even "To be or not to be." It will not happen by random chance.*

Natural selection is not random nor does it operate by chance. Natural selection preserves the gains and eradicates the mistakes. The eye evolved from a single, light-sensitive cell into the complex eye of today through hundreds if not thousands of intermediate steps, many of which still exist in nature (see Dawkins 1986). In order for the monkey to type the thirteen letters opening Hamlet's soliloquy by chance, it would take 26 to the power of 13 number of trials for success. This is sixteen times as great as the total number of seconds that have elapsed in the lifetime of our solar system. But if each correct letter is preserved and each incorrect letter eradicated, the process operates much faster. How much faster? Richard Hardison (1988) wrote a computer program in which letters were "selected" for or against, and it took an average of only 335.2 trials to produce the sequence of letters TOBEORNOTTOBE. It takes the computer less than ninety seconds. The entire play can be done in about 4.5 days.

18 *"Hydrodynamic sorting" during the Flood explains the apparent progression of fossils in geological strata. The simple, ignorant organisms died in the sea and are on the bottom layers, while more complex, smarter, and faster organisms died higher up.*

Not one trilobite floated upward to a higher stratum? Not one dumb horse was on the beach and drowned in a lower stratum? Not one flying pterodactyl made it above the Cretaceous layer? Not one moronic human did not come in out of the rain? And what about the evidence provided by other dating techniques such as radiometry?

19 *The dating techniques of evolutionists are inconsistent, unreliable, and wrong. They give false impressions of an old Earth, when in fact it is no older than ten thousand years, as proven by Dr. Thomas Barnes from the University of Texas at El Paso when he demonstrated that the half-life of the Earth's magnetic field is 1,400 years.*

First of all, Barnes's magnetic field argument assumes that the decay of the magnetic field is linear when geophysics has demonstrated that it fluctuates through time. He is working from a false premise. Second, not only are the various dating techniques quite reliable on their own but there is considerable independent corroboration between them. For example, radiometric dates for different elements from the same rock will all converge on the same date. Finally, how can evolution deniers deny all dating techniques with a sweep of the hand except those that purportedly support their position?

20 *Classification of organisms above the species level is arbitrary and man-made. Taxonomy proves nothing, especially because so many of the links between species are missing.*

The science of classification is indeed man-made, like all sciences, and of course it cannot prove anything about the evolution of organisms absolutely. But its grouping of organisms is anything but arbitrary, even though there is an element of subjectivity to it. An interesting cross-cultural test of taxonomy is the fact that Western-trained biologists and native peoples from New Guinea identify the same types of birds as separate species (see Mayr 1988). Such groupings really do exist in nature. Moreover, the goal of modern cladistics—the science of classification through nested hierarchies of similarities—is to make taxonomy less subjective, and it successfully uses inferred evolutionary relationships to arrange taxa in a branching hierarchy such that all members of a given taxon have the same ancestors.

21 *If evolution is gradual, there should be no gaps between species.*

Evolution is not always gradual. It is often quite sporadic. And evolutionists never said there should not be gaps. Finally, gaps do not prove creation any more than blank spots in human history prove that all civilizations were spontaneously created.

22 *"Living fossils" like the coelacanth and horseshoe crab prove that all life was created at once.*

The existence of living fossils (organisms that have not changed for millions of years) simply means that they evolved a structure adequate for their relatively static and unchanging environment, so they stopped once they could maintain their ecological niche. Sharks and many other sea creatures are relatively unchanged over millions of years, while other sea creatures, such as marine mammals, have obviously changed rapidly and dramatically. Evolutionary change or lack of change, as the case may be,

all depends on how and when a species' immediate environment changes.

23 *The incipient structure problem refutes natural selection. A new structure that evolves slowly over time would not provide an advantage to the organism in its beginning or intermediate stages, only when it is completely developed, which can only happen by special creation. What good is 5 percent of a wing, or 55 percent? You need all or nothing.*

A poorly developed wing may have been a well-developed something else, like a thermoregulator for ectothermic reptiles (who depend on external sources of heat). And it is not true that incipient stages are completely useless. As Richard Dawkins argues in *The Blind Watchmaker* (1986) and *Climbing Mount Improbable* (1996), 5 percent vision is significantly better than none and being able to get airborne for any length of time can provide an adaptive advantage.

24 *Homologous structures (the wing of the bat, flipper of a whale, the arm of man) are proof of intelligent design.*

By invoking miracles and special providence, the creationist can pick and choose anything in nature as proof of God's work and then ignore the rest. Homologous structures actually make no sense in a special creation paradigm. Why should a whale have the same bones in its flipper as a human has in its arm and a bat has in its wing? God has a limited imagination? God was testing out the possibilities of His designs? God just wanted to do things that way? Surely an omnipotent intelligent designer could have done better. Homologous structures are indicative of descent with modification, not divine creation.

25 *The whole history of evolutionary theory in particular and science in general is the history of mistaken theories and overthrown ideas. Nebraska Man, Piltdown Man, Calaveras Man and* Hesperopithecus *are just a few of the blunders scientists have made. Clearly science cannot be trusted and modern theories are no better than past ones.*

Again, it is paradoxical for evolution deniers to simultaneously draw on the authority of science and attack the basic workings of science.

Furthermore, this argument reveals a gross misunderstanding of the nature of science. Science does not just change. It constantly builds upon the ideas of the past, and it is cumulative toward the future. Scientists do make mistakes aplenty and, in fact, this is how science progresses.

The self-correcting feature of the scientific method is one of its most beautiful features. Hoaxes like Piltdown Man and honest mistakes like *Hesperopithecus* are, in time, exposed by the scientific method itself. Science picks itself up, shakes itself off, and moves on. t

Bibliography

Allen, S. 1993. "The Jesus Cults: A Personal Analysis by the Parent of a Cult Member." *Skeptic,* 2,2: 36-49.

Berra, T. M. 1990. *Evolution and the Myth of Creationism: A Basic Guide to the Facts in the Evolution Debate.* Stanford: Stanford University Press.

Bowler, P. J. 1989. *Evolution: The History of an Idea.* Revised Edition (1983). Berkeley: University of California Press.

Campbell, J. 1949. *The Hero with a Thousand Faces.* Princeton, NJ: Princeton University Press.

___. 1988. *The Power of Myth.* New York: Doubleday.

Darwin, C. 1859. *On the Origin of Species by Means of Natural Selection: Or the Preservation of Favoured Races in the Struggle for Life.* A Facsimile of the First Edition. Cambridge: Harvard University Press.

Dawkins, R. 1976. *The Selfish Gene.* Oxford: Oxford University Press.

___. 1986. *The Blind Watchmaker.* New York: W. W. Norton.

___. 1996. *Climbing Mount Improbable.* New York: W. W. Norton.

Dennett, D. C. 1995. *Darwin's Dangerous Idea: Evolution and the Meanings of Life.* New York: Simon and Schuster.

Desmond, A. and J. Moore. 1991. *Darwin. The Life of a Tormented Evolutionist.* New York: Warner Books.

Eldredge, N. 1971. "The Allopathic Model and Phylogeny in Paleozoic Invertebrates." *Evolution.* 25:156-167.

___. 1985. *Time Frames: The Rethinking of Darwinian Evolution and the Theory of Punctuated Equilibria.* New York: Simon and Schuster.

Eldredge, N. and S. J. Gould. 1972. "Punctuated Equilibria: An Alternative to Phyletic Gradualism." In *Models in Paleobiology.* T. J. M. Schopf (ed.).

Eve, R. A. and F. B. Harrold. 1991. *The Creationist Movement in Modern America.* Boston: Twayne.

Futuyma, D. J. 1982. *Science on Trial: The Case for Evolution.* New York: Pantheon.

Gardner, M. 1996. Interview with M. Shermer.

Gilkey, L. (ed.). 1985. *Creationism on Trial: Evolution and God at Little Rock.* New York: Harper & Row.

Godfrey, L. R. (Ed.). 1983. *Scientists Confront Creationism.* New York: W. W. Norton.

Gould, S. J. 1983. *Hen's Teeth and Horse's Toes.* New York: W.W. Norton.

___. 1985. *The Flamingo's Smile.* New York: W. W. Norton.

___. 1986. "Knight Takes Bishop?" *Natural History,* 5, 33-37.

___. 1987. "Darwinism Defined: The Difference Between Fact and Theory." *Discover*, January, pp. 64-70.

___. 1989. *Wonderful Life.* New York: W. W. Norton.

___. 1991. *Bully for Brontosaurus.* New York: W. W. Norton.

Hardison, R.C. 1988. *Upon the Shoulders of Giants.* New York: University Press of America.

Kauffman, S. 1993. *The Origins of Order: Self-Organization and Selection in Evolution.* Oxford University Press.

Lindberg, D. C. and R. L. Numbers. 1986. *God and Nature.* Berkeley: University of California Press.

Mayr, E. 1970. *Populations, Species, and Evolution.* Cambridge: Harvard University Press.

___. 1982. *Growth of Biological Thought.* Cambridge: Harvard University Press.

____ . 1988. *Toward a New Philosophy of Biology.* Cambridge: Harvard University Press.

Numbers, R. 1992. *The Creationists.* New York: Knopf.

Rohr, J. (ed.) 1986. *Science and Religion.* St. Paul, MN: Greenhaven Press.

Ruse, M. 1982. *Darwinism Defended.* Reading, MA: Addison-Wesley.

Segraves, N. 1977. *The Creation Report.* San Diego: Creation-Science Research Center. Pamphlet.

Somit, A. and S. A. Peterson. 1992. *The Dynamics of Evolution.* Ithaca: Cornell University Press.

Strahler, A. N. 1987. *Science and Earth History: The Evolution/Creation Controversy.* Buffalo: Prometheus.

Tipler, F. 1994. *The Physics of Immortality.* New York: Doubleday.

The New New Creationism

Intelligent Design Theory and its Discontents

In March of 2001 the Gallup News Service reported survey results that found that 45% of Americans agree with the statement "God created human beings pretty much in their present form at one time within the last 10,000 years or so," while 37% preferred a blended belief that "Human beings have developed over millions of years from less advanced forms of life, but God guided this process," and a paltry 12% accepted the standard scientific theory that "Human beings have developed over millions of years from less advanced forms of life, but God had no part in this process."

In a forced choice between the "theory of creationism" and the "theory of evolution," 57% chose creationism against only 33% for evolution (10% said they were "unsure"). Only 33% of Americans think that the theory of evolution is "well supported by evidence," while slightly more (39%) believe that it is not well supported, and that it is "just one of many theories." One reason for these disturbing results can be seen in the additional finding that only 34% of Americans consider themselves to be "very informed" about evolution. Clearly the 66% who do not consider themselves very informed about evolution have not withheld their judgment on the theory's veracity.

In any case, truth in science is not determined *vox populi*. It does not matter whether 99% or only 1% of the public believes a scientific theory—a scientific theory stands or falls on evidence, and there are few theories in science that are more robust than the theory of evolution. The preponderance of evidence from numerous converging lines of inquiry (geology, paleontology, zoology, botany, comparative anatomy, molecular biology, population genetics, biogeography, etc.) all independently converge to the same conclusion—evolution happened. The 19th-century philosopher of science, William Whewell, called this process a "concilience of inductions." I call it a "convergence of evidence." By whatever name, this is how historical events are proven.

The Evolution of Creationism

According to the first amendment of the United States Constitution, "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof." How this applies to the creationism controversy over the past century evolved, as it were, through three stages, that together set the stage for the birth of the new new creationism, Intelligent Design Theory.

1. The Banning of Evolution—that Old Time Religion. In the 1920s, a perceived degeneration of the moral fiber of America was increasingly linked to Darwin's theory of evolution. In 1923, Oklahoma passed a bill offering free textbooks to public schools on the condition that evolution not be included. The same year Florida went even further by passing an antievolution law. In 1925, the Butler Act, making it "unlawful for any teacher in any of the Universities, Normals and all other public schools of the state…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" was passed by the Tennessee legislature. The bill was perceived to be in obvious violation of civil liberties and resulted in the famous Scopes trial. Despite a supposedly "moral" victory for Scopes, the controversy stirred by the trial made textbook publishers and state boards of education reluctant to deal with the theory of evolution in any manner, and the subject was simply dropped for decades until the Sputnik scare of 1957, which rejuvenated science education. By 1961, the National Science Foundation, in conjunction with the Biological Science Curriculum Study, outlined a basic program for teaching the theory of evolution and published a series of biology books whose common fiber was the theory.

2. Equal Time for Genesis and Darwin—the Old Creationism. The creationists responded with a new approach in which they demanded "equal time" for the Genesis story, along with the theory of evolution, and insisted that evolution was "only" a theory, not a fact, and should be designated as such. This strategy was challenged by scientists in many states, and was ultimately defeated in Arkansas. In 1965 Susan Epperson, a high-school biology teacher in Little Rock, filed suit against the state on the grounds that an antievolution bill passed in 1929 violated her rights to free speech. After her victory, the case was overturned by the Arkansas Supreme Court in 1967 and later appealed. In 1968 the Court found Epperson in the right and ruled that the law was "an attempt to blot out a particular theory because of its supposed conflict with the biblical account." On the basis of the Establishment Clause, the Arkansas law was interpreted as an attempt to establish a religious position in a public classroom and was therefore overturned. The Arkansas Supreme Court ruled that all such antievolution laws were unconstitutional.

3. Equal Time for Creation-Science and Evolution-Science—the New Creationism. Since evolution could not be excluded from the classroom, and since the teaching of religious tenets was unconstitutional, the creationists invented "creation-science." Since academic honesty calls for a balanced treatment of competing ideas, they argued, creation-science should be taught side by side with evolution-science (note the clever parallel hyphenations). The creationists pressed state boards of education and textbook publishers to include the science of creation alongside the science of evolution. In 1981, Arkansas Act 590 was enacted into law by the governor, requiring "balanced treatment of creation-science and evolution-science in public schools; to protect academic freedom by providing student choice; to ensure freedom of religious exercise; to guarantee freedom of speech; …to bar discrimination on the basis of creationist or evolutionist belief." The constitutionality of Act 590 was challenged on May 27, 1981, with the filing of a suit by Reverend Bill McLean and others. The case was brought to trial in Little Rock on December 7, 1981, as *McLean v. Arkansas*. The contestants were, on one side, established science, scholarly religion, and liberal teachers (backed by the ACLU) and, on the other, the Arkansas Board of Education and the creationists.

Federal Judge William R. Overton of Arkansas ruled against the state on the following grounds: First, creation science conveys "an inescapable religiosity" and is therefore unconstitutional. "Every theologian who testified," Overton explained, "including defense witnesses, expressed the opinion that the statement referred to a supernatural creation which was performed by God." Second, the creationists employed a "two model approach" in a "contrived dualism" that "assumes only two explanations for the origins of life and existence of man, plants and animals: It was either the work of a creator or it was not." In this either-or paradigm, the creationists claim that any evidence "which fails to support the theory of evolution is necessarily scientific evidence in support of creationism." But as Overton clarified in this summary, "Although the subject of origins of life is within the province of biology, the scientific community does not consider origins of life a part of evolutionary theory." Furthermore, "evolution does not presuppose the absence of a creator or God and the plain inference conveyed by Section 4 [of Act 590] is erroneous." Finally, Overton summarized the opinions of expert witnesses that creation science is not science, as the enterprise is usually defined: "A descriptive definition was said to be that science is what is 'accepted by the scientific community' and is 'what scientists do.'" Overton then listed the "essential characteristics" of science (as outlined by the expert witnesses, including evolutionary biologists Stephen Jay Gould and Francisco Ayala): "(1) It is guided by natural law; (2) It has to be explanatory by reference to natural law; (3) It is testable against the empirical world; (4) Its conclusions are tentative…; and (5) It is falsifiable." Overton concluded: "Creation science as described in Section 4(a) fails to meet these essential characteristics."

What is Science?
The U.S. Supreme Court Ends the New Creationism

The final death knell of the creation science was sounded in the late 1980s when a Louisiana equal-time law, passed in 1985, was struck down by summary judgment (without trial) in the Federal Court of Louisiana when U.S. District Judge Adrian Duplantier ruled in concurrence with Arkansas Judge Overton that creation science was actually religious dogma. Judge Duplantier's decision centered on a religious argument—teaching creation science requires teaching the existence of a divine creator, which is in violation of the Establishment Clause. The decision was appealed to the United States Court of Appeals for the Fifth Circuit. That court, initially with a panel of three judges and subsequently "en banc" (sitting in a full panel) with all 15 judges voting, agreed with the district court that the statute was unconstitutional. But when a federal court holds a state statute unconstitutional, by "mandatory jurisdiction," the U.S. Supreme Court must hear the case. And since the vote was only 8-7, Louisiana submitted a "jurisdictional statement," thus establishing a substantial federal question. At least four of the nine U.S. Supreme Court justices concurred that it was substantial, and by the "rule of four" agreed they would hear the case.

The initial oral arguments in *Edwards v. Aguillard* were made on December 10, 1985, with Wendell Bird representing the appellants and Jay Topkis and the ACLU the appellees. Employing a minimalist approach, Topkis argued that creation science was merely religion imposturing as science and was therefore unconstitutional. In this instance, however, the argument failed on the grounds that religious or not, if the science were valid, it should have a place in the curriculum of public school science classes (an argument still made by the Intelligent Design theorists today). Thus, a strategy denying the scientific content of creation science seemed to be the only hope of the appellees in swinging the key votes. What was needed was a clear-cut and succinct definition of science in order to show that the scientific content of creation science failed to meet criteria that would legitimize its claim to "scientific" standing. This led to the submission to the court of an *amicus curiae* (friend of the court) brief on August 18, 1986, by 72 Nobel laureates, 17 state academies of science, and seven other scientific organizations, in which they defined and agreed upon the nature and scope of science.

The brief begins with a very general definition:

"Science is devoted to formulating and testing naturalistic explanations for natural phenomena. It is a process for systematically collecting and recording data about the physical world, then categorizing and studying the collected data in an effort to infer the principles of nature that best explain the observed phenomena." Next, the scientific method is discussed, beginning with the collection of "facts," the data of the world. "The grist for the mill of scientific inquiry is an ever increasing body of observations that give information about underlying 'facts.' Facts are the properties of natural phenomena. The scientific method involves the rigorous, methodical testing of principles that might present a naturalistic explanation for those facts."

Based on well-established facts, testable hypotheses are formed. The process of testing "leads scientists to accord a special dignity to those hypotheses that accumulate substantial observational or experimental support." This "special dignity" is called a "theory" that, when it "explains a large and diverse body of facts" is considered "robust" and if it "consistently predicts new phenomena that are subsequently observed" it is "reliable." Facts and theories are not to be used interchangeably or in relation to one another as more or less true. Facts are the world's data. Theories are explanatory ideas about those facts. "An explanatory principle is not to be confused with the data it seeks to explain." Constructs and other nontestable statements are not a part of science. "An explanatory principle that by its nature cannot be tested is outside the realm of science."

It follows from the nature of scientific method that no explanatory principles in science are final. "Even the most robust and reliable theory…is tentative. A scientific theory is forever subject to reexamination and—as in the case of Ptolemaic astronomy—may ultimately be rejected after centuries of viability." The creationists' certainty in their beliefs are in sharp contrast with the uncertainty scientists encounter as a regular and natural part of their work. "In an ideal world, every science course would include repeated reminders that each theory presented to explain our observations of the universe carries this qualification: 'as far as we know now, from examining the evidence available to us today'." Science also seeks only naturalistic explanations for phenomena. "Science is not equipped to evaluate supernatural explanations for our observations; without passing judgment on the truth or falsity of supernatural explanations, science leaves their consideration to the domain of religious faith."

According to the amici, any body of knowledge accumulated within the guidelines described above is considered "scientific" and suitable for public school education; and any body of knowledge not accumulated within these guidelines is not considered scientific. "Because the scope of scientific inquiry is consciously limited to the search for naturalistic principles, science remains free of religious dogma and is thus an appropriate subject for public-school instruction."

By this line of reasoning, the Louisiana act that singles out evolutionary theory as "speculative and baseless" compared to other "proven scientific facts" is not consistent. Rather, even though the theory of evolution is considered by virtually all biologists to be as robust and reliable as any in science, it has attracted the attention of the creationists because they perceive it as directly opposing their static and inflexible religious beliefs. The amici thus conclude, "the Act, however construed, is structured to 'convey a message that religion or a particular religious belief is favored or preferred,'" and is thus unconstitutional.

The case was decided on June 19, 1987, when the Court held that "the Act is facially invalid as violative of the Establishment Clause of the First Amendment, because it lacks a clear secular purpose" and that "[t]he Act impermissibly endorses religion by advancing the religious belief that a supernatural being created humankind." The Supreme Court voted 7-2 in favor of the appellees, and the creationists were defeated once again.

The New New Creationism
The Rise of Intelligent Design Theory

Out of the ashes of the Louisiana creation decision rose the phoenix of Intelligent Design theory (ID). Realizing that even a hint of religiosity in their science would doom them to extinction, the new generation of creationists took the decisions made by Overton and the U.S. Supreme Court justices seriously, and they began to focus solely on turning their religious beliefs into a genuine science—not just the transparent façade seen through by the courts, but an actual scientific infrastructure that covertly supports an unspoken (and never to be spoken) religious faith.

Throughout the 1990s this new generation of creationists turned to "bottom up" strategies of hosting debates at colleges and universities, publishing books with mainstream academic and trade publishing houses, and enlisting the aid of academics like University of California Berkeley law professor Phillip Johnson and Lehigh University biochemist Michael Behe. In 1997, they even roped the conservative commentator William F. Buckley into hosting a PBS Firing Line debated, where it was resolved that "Evolutionists should acknowledge creation." The debate was emblematic of a new new creationism, employing new euphemisms such as "intelligent design theory," "abrupt appearance theory," and "initial complexity theory," where it is argued that the "irreducible complexity" of life proves it was created by an "intelligent designer." What does all this new language mean, and who are these guys anyway? t

Ten Intelligent Design Arguments and Ten Answers

The New New Creationists are nothing if not prolific. Their arguments can be found in a number of works published over the past decade, the most prominent and widely quote of which include: William Dembski's *Intelligent Design* (Intervarsity Press), *No Free Lunch* (Rowman and Littlefield), and *Design Inference* (Cambridge University Press), Phillip Johnson's *Darwin on Trial* (InterVarsity Press), *Reason in the Balance* (InterVarsity Press), and *The Wedge of Truth* (InterVarsity Press), *Darwin's Black Box* by Michael Behe (Simon and Schuster), *Darwinism, Design, and Public Education* edited by John Angus Campbell and Stephen C. Meyer, *The Creator and the Cosmos* and *The Fingerprint of God* (NavPress) both by Hugh Ross, *Of Pandas and People* by Dean Kenyon and William Davis (Haughton), *Evolution: A Theory in Crisis* by Michael Denton (Adler and Adler), *Icons of Evolution: Science or Myth?* by Jonathan Wells (Regnery).

A number of scientists began responding to the New New Creationism within a few years of the movement's rise to prominence. Kenneth Miller's *Finding Darwin's God* (Perennial) and Robert Pennock's *Tower of Babel* (MIT Press) were the first two countershots that are indispensible in their analysis. Additional titles that should not be overlooked by those wishing a more in-depth analysis include: *Unintelligent Design* by Mark Perakh (Prometheus Books), *Creationism's Trojan Horse: The Wedge of Intelligent Design* by Barbara Forrest and Paul R. Gross (Oxford University Press), *God, the Devil, and Darwin: A Critique of Intelligent Design Theory* by Niall Shanks (Oxford University Press), *Darwin and Design: Does Evolution Have a Purpose?* by Michael Ruse (Harvard University Press), *The Devil's Chaplain* by Richard Dawkins (Houghton Mifflin), *Intelligent Design Creationism and its Critics* edited by Robert Pennock (MIT Press), *Denying Evolution* by Massimo Pigliucci (Sinauer). Arthur Strahler's *Science and Earth History* (Prometheus) remains a classic, as do Richard Dawkins' *The Selfish Gene* and *The Blind Watchmaker*, and a number of Stephen Jay Gould's essay collections, such as *The Flamingo's Smile*. The two best resources on the Internet on the evolution/creation topic are the Talk Origins forum at www.talkorigins.org and Eugenie Scott's National Center for Science Education at http://www.natcenscied.org/.

Following the format of the "25 Creationists' Arguments and 25 Evolutionists' Answers," we can review ID creationism in ten arguments and 10 answers.

***1 The Nature of the Intelligent Designer**. Many aspects of the universe and life indicate the fingerprint of intelligent design, thus an intelligent designer had a role in the creation of both the universe and of life. Since ID theory is a science it cannot comment on the nature of this intelligent designer, let alone personalize it. The goal of ID theory is simply to establish the fact that the evidence is overwhelming that an intelligent designer was involved in the creation and evolution of the universe and life.*

The duplicity of the IDers is most apparent, and appalling, in their claim that they are only doing science and, therefore, they cannot comment on the nature of the Intelligent Designer. Why not? Are they not in the least bit curious who or what this ID is? If ID operates on the universe and our world, don't they want to know *how* ID works? They claim, for example, that certain biological and chemical systems are "irreducibly complex"—a number of different parts of a system could not possibly have come together by chance or through any other Darwinian or natural system or forces, therefore it must have happened through intelligent design. Granting, for the sake of argument, that they are right, if ID really did put together a number of biochemical components into a single cell in order to enable it to propel itself with a flagellum tail, or if ID did string together a number of molecules twisted into a double helix of DNA, don't ID theorists want to know *how* ID did it? Any scientist worth his or her sodium chloride would want to know. Did ID use known principles of chemical bonding and self-organization? If so, then ID appears indistinguishable from nature, and thus no supernatural explanation is called for; if not, then what forces did ID use?

In any case, is a set of natural laws and forces the sort of God whom IDers wish to worship? No. IDers want a *supernatural* God who uses unknown forces to create life. But what will IDers do when science discovers those natural forces, and the unknown becomes the known? If they join in the research on these mysteries then they will be doing science. If they continue to eschew all attempts to provide a naturalistic explanation for the phenomena under question, IDers will have abandoned science altogether. What a remarkably unscientific attitude. What an astounding lack of curiosity about the world. The British evolutionary biologist Richard Dawkins poignantly spelled this out in a clever fictional dialogue between two scientists. "Imagine a fictional conversation between two scientists working on a hard problem, say A. L. Hodgkin and A. F. Huxley who, in real life, won the Nobel Prize for their

brilliant model of the nerve impulse," Dawkins begins.

> "I say, Huxley, this is a terribly difficult problem. I can't see how the nerve impulse works, can you?"
>
> "No, Hodgkin, I can't, and these differential equations are fiendishly hard to solve. Why don't we just give up and say that the nerve impulse propagates by Nervous Energy?"
>
> "Excellent idea, Huxley, let's write the Letter to *Nature* now, it'll only take one line, then we can turn to something easier."

2 ***Methodological Supernaturalism***. *Knowingly or unknowingly, scientists' adhere to an underlying bias of methodological naturalism (sometimes called materialism or scientism), the belief that life is the result of a natural and purposeless process in a system of material causes and effects that does not allow, or need, the introduction of supernatural forces. University of California, Berkeley law professor Phillip Johnson, a self-proclaimed "philosophical theist and a Christian" who believes in "a Creator who plays an active role in worldly affairs," claimed in his 1991 book* Darwin on Trial*, that scientists unfairly define God out of the picture by saying, essentially, "we are only going to examine natural causes and shall ignore any supernatural ones." This is limiting and restrictive. Theorists who postulate nonnatural or supernatural forces or interventions at work in the natural world are being pushed out of the scientific arena on the basis of nothing more than a fundamental rule of the game. Let's change the rules of the game to allow IDers to play.*

Okay, let's change the rules. Let's allow *methodological supernaturalism* into science. What would that look like? How would that work? What would we do with supernaturalism? According to ID theorists, they do not and will not comment on the nature of ID. They only wish to say, "ID did it." This reminds me of the Sidney Harris cartoon with the scientists at the chalkboard filled with equations, with an arrow pointing to a blank spot in the series denoting "Here a miracle happens." Although they eschew any such "god of the gaps" style arguments, that is, in fact, precisely what they are doing. They have simply changed the name from GOD to ID.

For the sake of argument, however, let's assume that ID theorists have suddenly become curious about how ID operates. And let's say that we have determined that certain biological systems are irreducibly complex and intelligently designed. As ID scientists who are now given entré into the scientific stadium with the new set of rules that allows supernaturalism, they call a time out during the game to announce, "Here ID caused a miracle." What do we do now? Do we halt all future experiments? Do we continue our research and periodically say "Praise ID." For the life of me I cannot imagine what we are suppose to do with *methodological supernaturalism* in the rules of the game of science.

There is, in fact, no such thing as the supernatural or the paranormal. There is only the natural, the normal, and mysteries we have yet to explain. It is also curious that ID miraculously intervenes just in the places where science has yet to offer a comprehensive explanation for a particular phenomenon. By a different name in a different time, ID (God) was thought to control the weather, but now that we have a science of meteorology ID has moved on to more obdurate problems, such as the origins of DNA or the evolution of cellular structures such as the flagellum. Once these problems are mastered then ID will presumably find even more intractable conundrums. Thus, IDers would have us teach students that when science cannot fully explain something we should look no further and declare that "ID did it." I fail to see how this is science. "ID did it" makes for a rather short lab lecture.

Finally, since ID creationists argue that what they are doing is no different from what the astronomers do who look for intelligent design in the background noise of the cosmos in their search for extraterrestrial intelligent radio signals (the SETI program, for example), then why not postulate that the design in irreducibly complex structures such as DNA is the result of an extraterrestrial experiment? Here is a viable hypothesis: ID = ET. Such theories have been proffered, in fact, by some daring astronomers and science fiction authors who speculated (wrongly it appears) that the earth was seeded with amino acids, protein chains, or microbes billions of years ago, possibly even by an extraterrestrial intelligence. Suffice it to say that no creationist worth his sacred salt is going to break bread or sip wine in the name of some experimental exobiologist from Vega. And that is the point. What we are really talking about here is not a scientific problem in the study of the origins of life, it is a religious problem in dealing with the findings of science.

3 ***Intelligent Design Intervention***. *According to the evidence, several billion years ago an Intelligent Designer created the first cell with the necessary genetic information to produce most of the irreducibly complex systems we see today. Then, the laws of nature and evolutionary change took over, and in some instances natural selection drove the system, except when totally new and more complex species needed creating. Then the Intelligent Designer stepped in again to intervene with a new design element.*

Just when and where ID intervened in the history of life is hotly disputed by ID theorists. Did ID trigger the Big Bang and laws of nature, then let the cosmos inflate and create its own sub-atomic and atomic particles? Or did ID do all of this, then let the stars create all of the other elements through natural processes? Did ID go so far as to generate all the stars and planets, along with the

biochemical conditions necessary for life to arise, which then did on its own through natural forces? Or did ID take care of all of the physics and chemistry of life's creation and then let evolution take it from there? And as for the history of life itself, after (and however) it was created, did ID create each genus and then evolution created each species? Or did ID create each species and evolution created each subspecies? Most ID theorists accept natural selection as a viable explanation for microevolution—the beak of the finch, the neck of the giraffe, the varieties of subspecies found on earth. If ID created these species why not the subspecies? If natural selection can create subspecies, why not species? Or genus for that matter? A species is defined as a group of actually or potentially interbreeding natural populations reproductively isolated from other such populations. We see evolution at work in nature today, isolating populations and creating new species, that is, new populations reproductively isolated from other such populations. If evolution can do this, why can't it also create higher order categories of organisms? And if ID created the species, how did he do it? Did ID personally tinker with the DNA of every single organism in a population? Or did ID simply tweak the DNA of just one organism and then isolate that organism to start a new population? We are not told. Why? Because ID theorists have no idea and they know that if they want to be taken seriously as scientists they cannot just say "ID did it."

An additional weakness in their argument can be seen in IDers arrogant and indolent belief that if they cannot think of how nature could have created something through evolution, it must mean that scientists will not be able to do so either. This argument is not unlike those who, because they cannot think of how the ancient Egyptians built the pyramids, these structures must have been built by Atlantians or aliens. It is a remarkable confession of their own inabilities and lack of creativity. Who knows what breakthrough scientific discoveries await us next month or next year? The reason, in fact, that Behe has had to focus on the microscopic world's gaps is that the macroscopic gaps have mostly been filled. They are chasing science, not leading it. Also, sometimes we must simply live with uncertainties. A scientific theory need not account for every anomaly in order to be viable. This is called the "residue problem"—we will always have a "residue" of anomalies. It is certainly acceptable to challenge existing theories, and call for an explanation of those anomalies. Indeed, this is routinely done in science. (The "gaps" that creationists focus on have all been identified by scientists first.) But it is not acceptable in science to offer as an alternative a nontestable, mystical, supernatural force to account for those anomalies.

Self-organization, emergence, and complexity theory form the basis of just one possible natural explanation for how the universe and life came to be the way it is. But even if this explanation turns out to be wanting, or flat out wrong, what alternative do Intelligent Design theorists offer in its stead? If ID theory is really a science, as IDers claim it is, then the burden is on them to discover the mechanisms used by the Intelligent Designer. And if those mechanisms turn out to be natural forces, then no supernatural forces (ID) is necessary, and IDers can simply change their name to scientists.

4 ***Irreducible Complexity***. *According to Lehigh University biochemist Michael Behe, in his book,* Darwin's Black Box*: "By irreducibly complex I mean a single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning." Consider the human eye, a very complex organ that is irreducibly complex—take out any one part and it will not work. How could natural selection have created the human eye when none of the individual parts themselves have any adaptive significance? Or consider the bacteria flagellum, proffered by William Dembski as a powerful case of irreducible complexity and as evidence of intelligent design—it is not like a machine, it is a machine, and a complex one at that, without antecedents in nature from which it could have evolved in a gradual manner.*

There are a number of answers that refute this argument. Starting general, Michael Behe concludes his discussion of irreducible complexity by stating: "An irreducibly complex system cannot be produced directly (that is, by continuously improving the initial function, which continues to work by the same mechanism) by slight, successive modifications of a precursor system, because any precursor to an irreducibly complex system that is missing a part is by definition nonfunctional." Philosopher Robert Pennock, in his 1999 book *Tower of Babel*, noted that Behe here employs a classic fallacy of bait-and-switch logic—reasoning from something that is true "by definition" to something that is proved through empirical evidence. This is not allowed in the rules of right reasoning.

Evolutionary biologist Jerry Coyne, in a review of

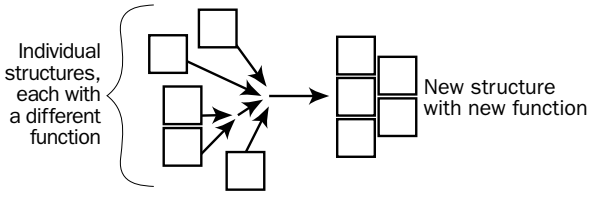


Figure 1. Co-Opting Nature. At each stage of an evolutionary sequence a particular structure, or series of structures, may serve one function, only to be co-opted later for some other use. The end product may appear to be designed for that final function, but it was not—because evolution does not look ahead to the future.

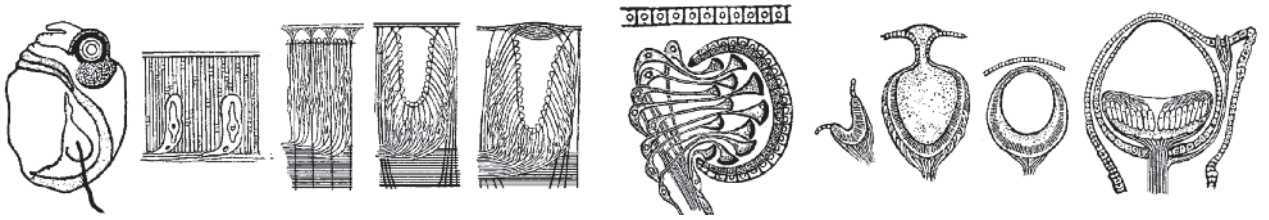


Figure 2. The Evolution of the Eye.
The evolution of the eye from a simple eyespot to the complex eye, which has occurred independently at least a dozen times in natural history, shows that the eye is neither irreducibly complex nor intelligently designed. It was constructed by natural selection over hundreds of millions of years from available parts and systems already in use.

Behe's book in *Nature* (September, 1996), explained that biochemical pathways such as those claimed by Behe to be impossible to explain without an intelligent designer, "did not evolve by the sequential addition of steps to pathways that became functional only at the end," as Behe argues. "Instead, they have been rigged up with pieces co-opted from other pathways, duplicated genes, and early multi-functional enzymes." Behe, for example, claims that the blood clotting process could not have come about through gradual evolution. Coyne shows that, in fact, Thrombin "is one of the key proteins in blood clotting, but also acts in cell division, and is related to the digestive enzyme trypsin."

This is the same answer given to the 19th century anti-evolution argument that wings could not have evolved gradually because, of what use is half a wing? The answer is that the incipient stages in wing development had uses other than for aerodynamic flight; in other words, half wings were not poorly developed wings, they were well-developed something elses. Likewise with the incipient stages in the evolution of blood clotting, the flagellum motor, and the other structures claimed by IDers to be inexplicable through evolutionary theory. The principle can be illustrated simply in Figure 1 on the preceding page.

As for the human eye, it is not true that it is irreducibly complex, where the removal of any part results in blindness. Any form of light detection is better than none—lots of people are visually impaired with any number of different diseases and injuries to the eyes, yet they are able to utilize their restricted visual capacity to some degree and would certainly prefer this to blindness. No one asks for partial vision, but if that is what you get, then like all life forms throughout natural history, you learn to cope in order to survive.

There is a deeper answer to the example of the evolution of the eye, and that is that natural selection did not create the human eye out of a warehouse of used parts lying around with nothing to do, any more than Boeing created the 747 without the ten million halting jerks and starts beginning with the Wright Brothers. Natural selection simply does not work that way. The human eye is

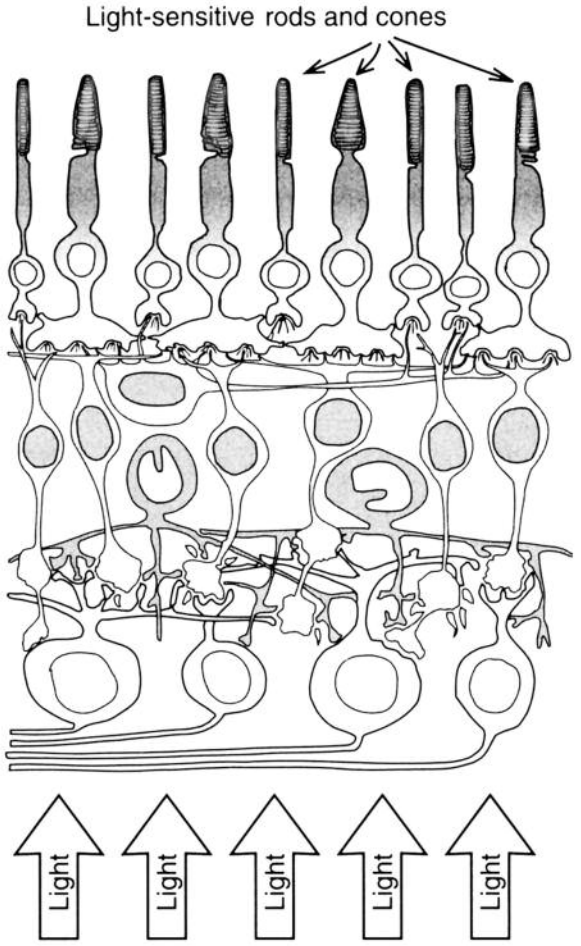


Figure 3. The Poorly Designed Human Eye.
The anatomy of the human eye shows that it is anything but "intelligently designed." It is built upside down and backwards, with photons of light having to travel through the cornea, lens, aqueous fluid, blood vessels, Ganglion cells, Amacrine cells, Horizontal cells, and Bipolar cells, before reaching the light sensitive rods and cones that will transduce the light signal into neural impulses, where they are then sent to the visual cortex at the back of the brain for processing into meaningful patterns.

the result of a long and complex pathway that goes back hundreds of millions of years: a simple eyespot where a handful of light sensitive cells provides information to the organism about an important source of the light—the sun; a recessed eyespot where a small surface indentation filled with light sensitive cells provides additional data in the form of direction; a deep recession eyespot where additional cells at greater depth provide more accurate information about the environment; a pinhole camera eye that is actually able to focus an image on the back of a deeply recessed layer of light-sensitive cells; a pinhole lens eye that is actually able to focus the image; a complex eye found in such modern mammals as humans. (See Figure 2.)

We should also note that the world is not always so intelligently designed, and the human eye is a prime example. The configuration of the retina is in three layers, with the light-sensitive rods and cones at the bottom, facing away from the light, and underneath a layer of Bipolar, Horizontal, and Amacrine cells, themselves underneath a layer of Ganglion cells that help carry the transduced light signal from the eye to the brain in the form of neural impulses. And this entire structure sits beneath a layer of blood vessels. (See Figure 3.) For optimal vision, why would an intelligent designer have built an eye backwards and upside down? This "design" only makes sense if natural selection built eyes from whatever materials were available, and in the particular configuration of the ancestral organism's pre-existing organic structures. The eye shows the pathways of evolutionary history, not intelligent design creation.

Another example of not-so-intelligent design can be seen in Figure 4. It is *Ambulocetus natans*, a transitional fossil between the quadrupedal land mammal *Mesonychids* and the direct descendent of modern whales, the *Archaeocetes*. *Ambulocetus natans* swam, according to its discoverers, "by undulating the vertebral column and paddling with the hindlimbs, combining aspects of modern seals and otters, rather than by vertical movements of the tail fluke, as is the case in modern whales." First of all, why would ID, in His infinite wisdom and power, create a mammal that appears midway between a land mammal and a modern marine mammal, that combines the movements of both land and marine mammals, and, most uniquely, paddles with hind limbs also well equipped for land locomotion? For that matter, why would ID create air-breathing, warm-blooded, breast-feeding marine mammals only moderately well designed for living in the oceans, when he could have just stuck with the much more efficient tried-and-true fish design? Finally, on a larger scale, why would ID design the fossil record to look like descent with modification was the result of hundreds of millions of years of evolution, rather than sprinkling geological strata willy-nilly with, say, trilobites in Cretaceous strata, and a T-Rex or two alongside some Neanderthal fossils? The fossil record screams out evolution, not creation.

Finally, the bacterial flagellum, although a remarkable structure, comes in many varieties of complexity and functions. In fact, bacteria in general may be subdivided into eubacteria and archaebacteria; the former are more complex and have more complicated flagella, while the latter are simpler and have correspondingly simpler flagella. Eubacterial flagellum, consisting of a three-part motor, shaft, and propeller system, are actually a more complicated version of the archaebacterial flagellum, which has a motor and a combined shaft-propeller system. So, when IDers describe the three-part flagellum as being irreducibly complex, they are wrong. It can be reduced to

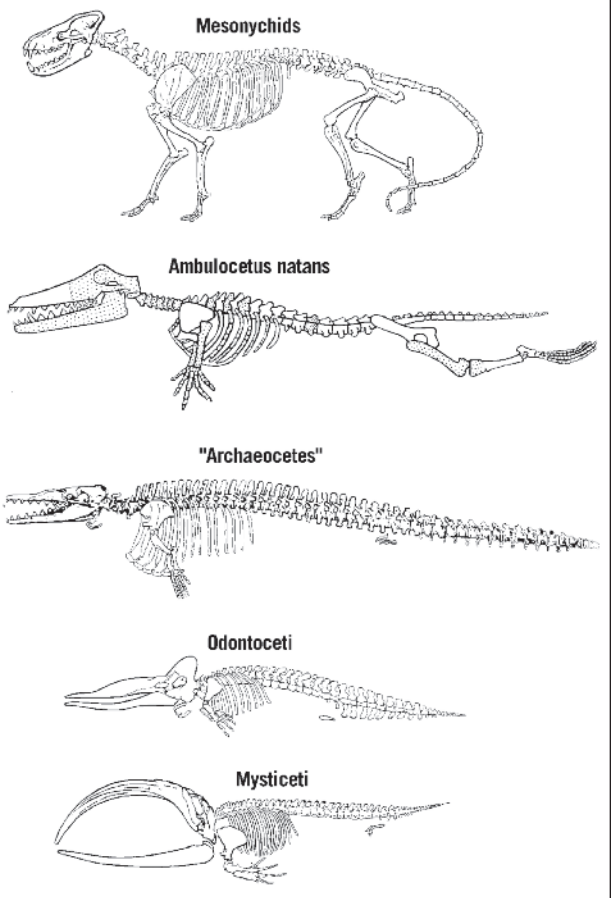


Figure 4. A Transitional Fossil Between Land and Marine Mammals. The discovery of *Ambulocetus natans*, a transitional fossil between the land-based *Mesoynchids* and the marine mammal *Archaeocetes*, the direct ancestor to modern whales, answers the creationists' demand for "just one transitional fossil." The fossil record has all the earmarks of an evolutionary process of Darwinian "descent with modification," not of creationist "abrupt appearance." *Ambulocetus natans*, with skeletal features midway between land and marine mammals, appears to be the creation of a long, historical process.

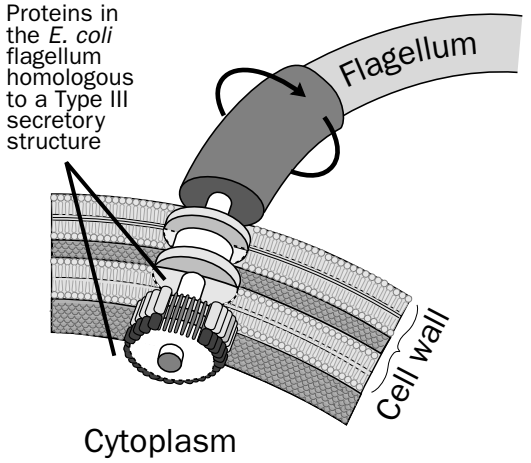


Figure 5. The Bacterial Flagellum: Evolution at Work. Long a favorite among IDers as an example of irreducible complexity and intelligent design, it turns out that there are a number of different types of bacterial flagella, ranging in complexity, as well as serving a number of different functions, not just propulsion. Evolution well explains how, for example, the flagellum may have originally evolved as a mechanism for secretion, which was later co-opted for propulsion.

two parts. Additionally, the eubacterial flagellum turns out to be one of a variety of ways that bacteria move about their environment. Finally, the flagellum has functions other than just for propulsion. For example, for many types of bacteria the primary function of the flagellum is secretion, not propulsion. For others, the flagellum is used for attaching to surfaces and other cells. As for the evolution of the flagellum, we know that 18-20 genes are involved in the development of the simpler two-part flagellum, 27 genes make up the slightly more complex *Campylobacter jejuni* flagellum, and 44 genes in the still more complicated *E-coli* flagellum, a smooth genetic rise in complexity corresponding to the end product. And phylogenetic studies on flagella indicate that the more modern and complex systems share common ancestors with the simpler forms. So here an evolutionary scenario presents itself—archaebacteria flagella were primarily used for secretion, although come forms were co-opted for adhesion or propulsion. With the evolution of more complicated eubacteria, flagellum grew more complex, refining, for example, the two-part motor and shaft-propeller system into a three part motor, shaft, and propeller system, that was then co-opted for more efficient propulsion.

5 ***Inference to Design***. *In a special issue of the Christian magazine* Touchstone*, dedicated to Intelligent Design, Whitworth College philosopher Stephen Meyer argues that ID is not simply a "God of the gaps" argument to fill in where science has yet to give us a satisfactory answer—it is not just a matter of "we don't understand this so God must have done it." ID theorists like Meyer and Phillip Johnson, William Dembski, Michael Behe, and Paul Nelson (all leading IDers and contributors to this issue) say they believe in ID because the universe really does appear to be designed. "Design theorists infer a prior intelligent cause based upon present knowledge of cause-and-effect relationships," Meyer writes. "Inferences to design thus employ the standard uniformitarian method of reasoning used in all historical sciences, many of which routinely detect intelligent causes. Intelligent agents have unique causal powers that nature does not. When we observe effects that we know only agents can produce, we rightly infer the presence of a prior intelligence even if we did not observe the action of the particular agent responsible."*

Indeed, Psalms 19:1 declares: "The heavens declare the glory of God; and the firmament showeth his handiwork." The design inference is not confined to the ancient Hebrews. In fact, in 1999 social scientist Frank J. Sulloway and I conducted a national survey, asking Americans why they believe in God. The most common reason offered was the good design, natural beauty, and complexity of the world. One subject wrote: "To say that the universe was created by the Big Bang theory is to say that you can create *Webster's Dictionary* by throwing a bomb in a printing shop and the resulting explosion results in the dictionary."

The reason people think that a designer created the world is because, well, it looks designed, and some evolutionary theorists, such as the philosopher of science Michael Ruse, think that it's high time we quit tiptoeing around this inference. In his book *Darwin and Design*, Ruse says we should admit from the start that life looks designed because it was…from the bottom up by evolution. Purpose follows functional adaptation: "At the heart of modern evolutionary biology is the metaphor of design, and for this reason function-talk is appropriate. Organisms give the appearance of being designed, and thanks to Charles Darwin's discovery of natural selection we know why this is true. Natural selection produces artifact-like features, not by chance but because if they were not artifact-like they would not work and serve their possessors' needs." More cautious evolutionary theorists such as Ernst Mayr worry that "the use of terms like *purposive* or *goal-directed* seemed to imply the transfer of human qualities, such as intent, purpose, planning, deliberation, or consciousness, to organic structures and to subhuman forms of life." To which Ruse replies: "Well, yes it does!" So what? At the heart of science is metaphor—Ruse notes that physicists talk of force, pressure, attraction, repulsion, work, charm, and resistance, all quite useful metaphors—

and the metaphors of design and purpose work well as long as we stick to natural explanations for nature and understand that natural selection (another metaphor) is the primary mechanism for generating design and purpose, from the bottom up.

What role, then, is there for a top-down designer? If you are one of those 37% in the 2001 Gallup poll who believe that God guided the process of evolution then, on one level, you are in good company. In his 1996 Encyclical *Truth Cannot Contradict Truth*, Pope John Paul II told a billion Catholics that, in essence, evolution happened—deal with it: "It is indeed remarkable that this theory has been progressively accepted by researchers, 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 the theory." Since both the Bible and the theory of evolution are true (and "truth cannot contradict truth"), John Paul II reconciled theological dualism with scientific monism by arguing that evolution produced our bodies while God granted us our souls.

This conciliatory position is fine as far as it goes, but many thinkers are not content to keep the magisteria of science and religion (per Gould) separate. They want empirical data to prove faith tenets, and it is here where the New New Creationism becomes William Paley redux. Paley was the 18th century natural theologian whose "watchmaker" argument became the foundation of all modern design arguments. IDers recast Paley in modern jargon with new and more sophisticated biological examples (such as bacterial flagellum and blood clotting agents). But as Darwin showed—and a century and a half of research has proven—the designer is a blind watchmaker (in Richard Dawkins' apposite phrase). Complex structures can and do arise out of simple systems through blind variation, selection, and adaptation. This is an inevitable outcome of Darwinism which, says Ruse, "Whether we like it or not, we are stuck with it. The Darwinian revolution is over, and Darwin won." As pattern-seeking, storytelling primates who need origin myths, the theory of evolution now fulfills that need for us and has the added advantage that, unlike most origin myths, it is very probably true.

6 *The Universe and Life are Fine-Tuned*. *Physicist Freeman Dyson won the Templeton Foundation prize valued at $964,000, for example, for such works as* Disturbing the Universe*, one passage of which is very revealing: "As we look out into the universe and identify the many accidents of physics and astronomy that have worked to our benefit, it almost seems as if the universe must in some sense have known that we were coming." Mathematical physicist Paul Davies also won the Templeton prize, and we can understand why in such passages as this from his 1999 book* The Fifth Miracle*:*

> *In claiming that water means life, NASA scientists are…making—tacitly—a huge and profound assumption about the nature of nature. They are saying, in effect, that the laws of the universe are cunningly contrived to coax life into being against the raw odds; that the mathematical principles of physics, in their elegant simplicity, somehow know in advance about life and its vast complexity. If life follows from [primordial] soup with causal dependability, the laws of nature encode a hidden subtext, a cosmic imperative, which tells them: "Make life!" And, through life, its by-products: mind, knowledge, understanding. It means that the laws of the universe have engineered their own comprehension. This is a breathtaking vision of nature, magnificent and uplifting in its majestic sweep. I hope it is correct. It would be wonderful if it were correct.*

Such statements are powerful indeed, especially when uttered by prominent scientists not affiliated with the ID movement in any way. Even an atheist like Stephen Hawking occasionally makes statements seemingly supportive of scientistic arguments for God's existence:

> Why is the universe so close to the dividing line between collapsing again and expanding indefinitely? In order to be as close as we are now, the rate of expansion early on had to be chosen fantastically accurately. If the rate of expansion one second after the big bang had been less by one part in 10^{10}, the universe would have collapsed after a few million years. If it had been greater by one part in 10^{10}, the universe would have been essentially empty after a few million years. In neither case would it have lasted long enough for life to develop. Thus one either has to appeal to the anthropic principle or find some physical explanation of why the universe is the way it is.

That explanation, at the moment, is a combination of a number of different concepts revolutionizing our understanding of evolution, life, and cosmos, including the possibility that our universe is not the only one. We may live in a multiverse in which our universe is just one of many bubble universes all with different laws of nature. Those with physical parameters like ours are more likely to generate life than others. But why should any universe generate life at all, and how could any universe do so without an intelligent designer?

The answer can be found in the properties of *self-organization* and *emergence* that arise out of what are known as complex adaptive systems, or complex systems that grow and learn as they change. Water is an emergent property of a particular arrangement of hydrogen and oxygen molecules, just as consciousness is a self-organized emergent property of billions of neurons. The entire evolution of life can be explained through these principles.

Complex life, for example, is an emergent property of simple life: simple prokaryote cells self-organized to become more complex units called eukaryote cells (those little organelles inside cells you had to memorize in beginning biology were once self-contained independent cells); some of these eukaryote cells self-organized into multi-cellular organisms; some of these multi-cellular organisms self-organized into such cooperative ventures as colonies and social units. And so forth. We can even think of self-organization as an emergent property, and emergence as a form of self-organization. How recursive. No Intelligent Designer made these things happen. They happened on their own.

As a complex adaptive system the cosmos intelligently designs itself. It is one giant autocatalytic (self-driving) feedback loop that generates emergent properties, one of which is life. There may even be a type of natural selection at work among the many bubble universes, with those whose parameters are most like ours most likely to survive. Those bubble universes whose parameters are most likely to give rise to life occasionally generate complex life with brains big enough to achieve consciousness and to conceive of such concepts as God and cosmology, and to ask such questions as Why?

7 ***Explanatory Gaps***. *Intelligent Design theory fills in an explanatory gap that science cannot or has not filled. It is legitimate to identify the shortcomings of evolutionary theory, and show how scientists have not, and perhaps cannot, provide examples of evolution at work. It is one thing to infer in the fossil record a speciation event or the creation of a new structure, it is quite another to witness it in the laboratory. It is fair and reasonable to argue that students should be made aware of these explanatory shortcomings on the part of science.*

Not only does science have an incredibly rich fossil record, the process of evolution can be seen at work at a number of different levels. We know from genetics that every dog on the planet descended from a single population of wolves in China about 15,000 years ago. Granted, this was a combination of natural selection and artificial selection (breeding), but it also now appears from both genetics and paleontology that every human on the planet descended from a single population of *Homo sapiens* in Africa about 150,000 years ago. That's a lot of evolution in a relatively short period of time. And, of course, diseases are prime examples of natural selection and evolution at work, and on time scales we can witness, all too painfully. The AIDS virus, for example, continues to evolve in response to the drugs used to combat it—the few surviving strains of the virus continue to multiply, passing on their drug-resistant genes.

This is evolution in action, which was even caught in a laboratory experiment published in the February 20, 2004 edition of *Science*, in which an *E. coli* bacteria that was forced to adopt or perish improvised a novel molecular tool. According to the experimenter, University of Michigan biologist James Bardwell, "The bacteria reached for a tool that they had, and made it do something it doesn't normally do. We caught evolution in the act of making a big step." The big step was a new way of making molecular bolts called disulfide bonds, which are stiffening struts in proteins that also help the proteins fold into their proper, functional, three-dimensional shapes. This new method restarted the bacteria's motor and enabled it to move toward food before it starved to death.

This is an important experiment because Bardwell had developed a strain of mutant bacteria unable to make disulfide bonds, which are critical for the ability of the bacteria's propeller-like swimming motor, the flagellum, to work. This is the same flagellum that creationists are so fond of displaying as an example of irreducible complexity. The researchers put these non-swimming bacteria to the test by placing them on a dish of food where, once they had exhausted the food they could reach, they either had to repair the broken motor or starve to death. The bacteria used in the experiment were forced to use a protein called thioredoxin, which normally destroys disulfide bonds, to make the bonds instead. In a process similar to natural selection, one researcher made random alterations in the DNA encoding thioredoxin, and then subjected thousands of bacteria to the swim-or-starve test. He wanted to see if an altered version of thioredoxin could be coerced to make disulfides for other proteins in the bacteria. Remarkably, a mutant carrying only two amino acid changes, amounting to less than 2% of the total number of amino acids in thioredoxin, restored the ability of the bacteria to move. The altered thioredoxin was able to carry out disulfide bond formation in numerous other bacterial proteins all by itself, without relying on any of the components of the natural disulfide bond pathway. The mutant bacteria managed to solve the problem in time and swim away from starvation and multiply.

Bardwell concluded: "The naturally occurring enzymes involved in disulfide bond formation are a biological pathway whose main features are the same from bacteria to man. People often speak of Computer Assisted Design (CAD), where you try things out on a computer screen before you manufacture them. We put the bacteria we were working on under a strong genetic selection, like what can happen in evolution, and the bacteria came up with a completely new answer to the problem of how to form disulfide bonds. I think we can now talk about Genetic Assisted Design (GAD)."

Perhaps we should now talk about GAD instead of GOD.

8 ***The Conservation of Information and the Explanatory Filter****. According to William Dembski, information cannot be created by either natural processes or chance, so there is a law of conservation of information, which indicates design. Further, design can be inferred through what Dembski calls an explanatory filter in the following way:*

1. If an event E has high probability, accept Regularity as an explanation; otherwise move to the next step.

2. If the Chance hypothesis assigns E a high probability or E is not specified, then accept Chance; otherwise move down the list.

3. Having eliminated Regularity and Chance, accept Design.

First, Dembski's "Law of the Conservation of Information" is purposefully constructed to resemble such physical laws as the conservation of momentum or the laws of thermodynamics. But these laws were based on copious empirical data and experimental results, not inferred from logical argument as Dembski's law is. Second, no other recognized theory of information—such as those by Shannon, Kolmogorov, or Chaitin—includes a law or principle of conservation, and no one working in the information sciences uses or recognizes Dembski's law as legitimate, regardless of its design inference. Third, even if the law of the conservation of information were validated, it is irrelevant to the theory of evolution, because it is abundantly clear that information in the natural world—through DNA for example—is transferred by natural processes. Fourth, the most common form of biological information transfer, DNA, in fact, has all the elements of historical contingency and evolutionary history, not design, as pointed out by evolutionary biologist Kenneth Miller:

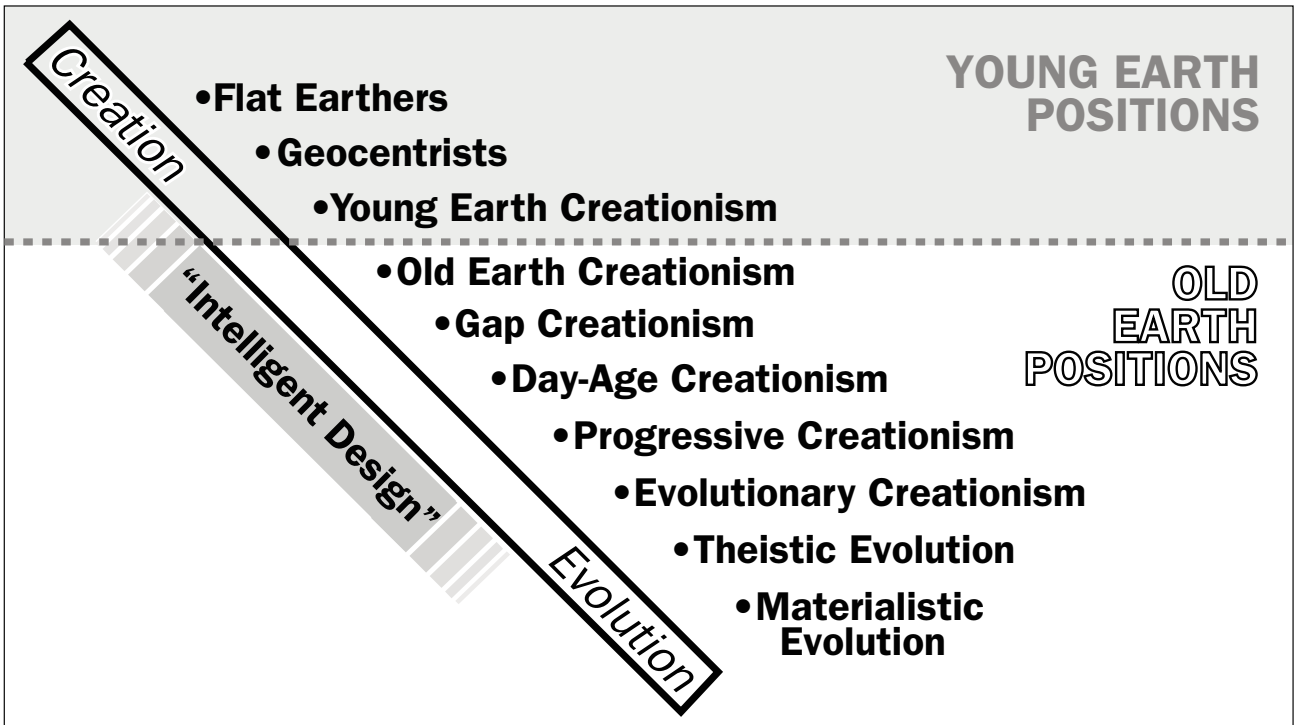
> In fact, the human genome is littered with pseudogenes, gene fragments, "orphaned" genes, "junk" DNA, and so many repeated copies of pointless DNA sequences that it cannot be attributed to anything that resembles intelligent design. If the DNA of a human being or any other organism resembled a carefully constructed computer program, with neatly arranged and logically structured modules, each written to fulfill a specific function, the evidence of intelligent design would be overwhelming. In fact, the genome resembles nothing so much as a hodgepodge of borrowed, copied, mutated, and discarded sequences and commands that has been cobbled together by millions of years of trial and error against the relentless test of survival. It works, and it works brilliantly; not because of intelligent design, but because of the great blind power of natural selection to innovate, to test, and to discard what fails in favor of what succeeds.

As for Dembski's explanatory filter, because it assumes probabilities that cannot be determined in practice, this is nothing more than a thought experiment, not something that can be used practically in science. Further, rejecting all regulatory hypotheses and chance events (in steps one and two) assumes that we know them all, which, of course, we do not. But even if we did, and rejected them all, the design inference does not follow. Design, as it is commonly defined even by IDers, means purposeful and intelligent creation, not simply the elimination of regularity and chance. In other words, design is not simply a default conclusion when all else fails to explain. Design requires positive evidence, not simply the rejection of negative evidence. Finally, even if positive evidence for design were presented, by the logic of the explanatory filter, it is reasonable to apply the filter to the design claim. Assuming regularity and chance are rejected for the design claim, the logical conclusion would be that the design was designed, and that design was designed, ad infinitum, including and especially the Intelligent Designer himself!

9 ***Science Education and Debating Evolution****. Creation theory, especially Intelligent Design Theory, provides an alternative to evolution theory, and science education involves hearing both sides of a debate. Science textbooks should carry disclaimers, such as this one now posted inside every biology textbook used in Georgia public schools: "This textbook contains material on evolution. Evolution is a theory, not a fact, regarding the origin of living things. This material should be approached with an open mind, studied carefully and critically considered."*

As innocuous as this argument sounds, it is easily seen through, even by evangelical Christians such as former U.S. President and Georgia resident, Jimmy Carter: "As a Christian, a trained engineer and scientist, and a professor at Emory University, I am embarrassed by Superintendent Kathy Cox's attempt to censor and distort the education of Georgia's students. The existing and long-standing use of the word 'evolution' in our state's textbooks has not adversely affected Georgians' belief in the omnipotence of God as creator of the universe. There can be no incompatibility between Christian faith and proven facts concerning geology, biology, and astronomy. There is no need to teach that stars can fall out of the sky and land on a flat Earth in order to defend our religious faith."

There is another, deeper flaw in this argument from "debate," and that is, which creation theory is to be debated with evolution theory? The world's foremost expert on creationism, Eugenie Scott, Executive Director of the National Center for Science Education, explains, "I encourage people to reject the creation/evolution dichotomy and recognize the creation/evolution continuum. It is clear that creationism comes in many forms. If a student tells a teacher, 'I'm a creationist,' the teacher needs to ask, 'What kind?'" To get our minds around this concept, Scott has developed a powerful visual heuristic in the Creation/Evolution Continuum (for a fuller explication go to http://www.natcenscied.org/). Scott summarizes the various positions in the following manner:



Creation/Evolution Continuum.
A continuum with creationism at one end and evolution at the other. The strictest creationists are the Flat Earthers.

Flat Earthers—believe that the shape of the earth is flat because a literal reading of the Bible demands it. The earth is shaped like a coin, not a ball. Scientific views are of secondary importance.

Geocentrists—geocentrists accept that the earth is spherical, but deny that the sun is the center of the solar system. Like flat earthers, they reject virtually all of modern physics and chemistry as well as biology.

Young-Earth Creationism—few classical YECs interpret the flat-earth and geocentric passages of the Bible literally, but they reject modern physics, chemistry, and geology concerning the age of the earth, and they deny biological descent with modification. In their view, the earth is from six to ten thousand years old.

Old Earth Creationism—from the mid-1700s on, the theology of Special Creationism has been harmonized with scientific data and theory showing that the earth is ancient. Theologically, the most critical element of Special Creationism is God's personal involvement in Creation; precise details of how God created are considered secondary.

Gap Creationism—one of the better-known accommodations of religion to science is Gap or Restitution Creationism, which claims that there was a large temporal gap between Genesis chapter I:1 and chapter I:2. Articulated from about the late 18th century on, Gap Creationism assumes a pre-Adamic creation that was destroyed before Genesis I:2, when God recreated the world in six days, and created Adam and Eve. A time gap between two separate creations allows for an accommodation of the proof of the ancient age of the earth with Special Creationism.

Day-Age Creationism—accommodates science and religion by rendering each of the six days of creation as long periods of time—even thousands or millions of years instead of merely 24 hours long. Many literalists have found comfort in what they think is a rough parallel between organic evolution and Genesis, in which plants appear before animals, and human beings appear last.

Progressive Creationism (PC)—blends Special Creationism with a fair amount of modern science. Although modern physical science is accepted, only parts of modern biological science are incorporated into PC. PCs generally believe that God created "kinds" of animals sequentially; the fossil record is thus an accurate representation of history because different animals and plants appeared at different times rather than having been created all at once.

Intelligent Design Creationism (IDC)—is a lineal descendent of William Paley's argument from design, which asserted that God's existence could be proved by examining his works. The finding of order, purpose, and design in the world is proof of an omniscient designer.

Evolutionary Creationism (EC)—God the Creator uses evolution to bring about the universe according to his plan. From a scientific point of view, evolutionary creationism is hardly distinguishable from Theistic Evolution, which follows it on the continuum.

Theistic Evolution (TE)—God creates through evolution. Astronomical, geological and biological evolution are acceptable to most TEs. They vary in whether and how much God is allowed to intervene. Other TEs see God as intervening at critical intervals during the history of life (especially in the origin of humans), and they in turn come closer to PCs. Variations of TE are the views of creation taught at mainline Protestant seminaries, and it is the official position of the Catholic Church.

Materialist Evolutionism (ME)—goes beyond the methodological materialism of science to propose that the laws of nature are all there is: the supernatural does not exist. This is a form of philosophical materialism (naturalism or scientism), which is distinct from the practical rules of how to do science. Antievolutionists such as Phillip Johnson criticize evolution and science in general as being philosophically materialistic. This is a logical error. There are many scientists who use methodological materialism in their work, but who are theists and therefore not philosophical materialists.

This continuum diffuses the debate and forces the uninitiated into thinking through which of the many positions most appeals to them based on their religious beliefs. With so many mutually-exclusive creationist doctrines all claiming infallibility and final Truth, a logical default position to fall to is science because it never makes such absolutist truth claims. In science, all conclusions are provisional, subject to new evidence and better arguments, the very antithesis of religious faith.

10 *Non-Religious Commitments*. *According to William Dembski, mathematician, philosopher, theologian, and author of* Intelligent Design, No Free Lunch, Design Inference, *and other works that form the canon of the New New Creationism: "Scientific creationism has prior religious commitments whereas intelligent design has not."*

Baloney. In the same book Dembski also wrote: "Christ is never an addendum to a scientific theory but always a completion." This is what I call the farce of Intelligent Design. The primary reason we are experiencing this peculiarly American phenomenon of *evolution denial* (the doppelganger of *Holocaust denial*), is that a small but vocal minority of religious fundamentalists misread the theory of evolution as a challenge to their deeply held religious convictions. Make no mistake about it. Creationists do not want equal time. They want all the time. Theirs is a war on evolution in particular and science in general, and they are as fanatical in their zeal as any religious movement of the past millennia. Listen to the voice of Phillip Johnson, the fountainhead of the modern ID movement, at a February 6, 2000 meeting of the National Religious Broadcasters in Anaheim, California: "Christians in the 20th century have been playing defense. They've been fighting a defensive war to defend what they have, to defend as much of it as they can. It never turns the tide. What we're trying to do is something entirely different. We're trying to go into enemy territory, their very center, and blow up the ammunition dump. What is their ammunition dump in this metaphor? It is their version of creation."

Johnson uses another metaphor: a wedge. In his 2000 book *The Wedge of Truth*, he writes: "The Wedge of my title is an informal movement of like-minded thinkers in which I have taken a leading role. Our strategy is to drive the thin end of our Wedge into the cracks in the log of naturalism by bringing long-neglected questions to the surface and introducing them to public debate." This is not just an attack on naturalism, it is a religious war against all of science. "It is time to set out more fully how the Wedge program fits into the specific Christian gospel (as distinguished from generic theism), and how and where questions of biblical authority enter the picture. As Christians develop a more thorough understanding of these questions, they will begin to see more clearly how ordinary people—specifically people who are not scientists or professional scholars—can more effectively engage the secular world on behalf of the gospel."

Finally, in a sermon to the Unification Church Jonathan Wells, author of *The Icons of Evolution*, revealed his true motives for studying evolutionary theory: "Father's [the Reverend Sun Myung Moon's] words, my studies, and my prayers convinced me that I should devote my life to destroying Darwinism, just as many of my fellow Unificationists had already devoted their lives to destroying Marxism. When Father chose me (along with about a dozen other seminary graduates) to enter a Ph.D. program in 1978, I welcomed the opportunity to prepare myself for battle."

Let me be blunt (as if I could be even more). It is not coincidental that ID supporters are almost all Christians. It is inevitable. *ID arguments are reasons to believe if you already believe*. If you do not, the ID arguments are untenable. But I would go further. If you believe in God, you believe for personal and emotional reasons, not out of logical deductions. IDers, like the creationists of old, are not only Christians, they are mostly male and educated. In the study on why people believe in God conducted by myself and Frank Sulloway, when we asked why people think *other* people believe in God, the number one reason offered was emotional need and comfort, with the good design of the world dropping to sixth place. Further, we found that educated men who already believed in God were far more likely to give rational reasons for their belief than were women and uneducated believers. One explanation for these results is that although, in general, education leads to a decrease in religious faith, for those people who are educated and still believe in God there appears to be a need to justify their beliefs with rational arguments.

What is really going on in the ID movement is that highly educated religious men are justifying their faith with sophisticated scientistic arguments. This is old time religion dressed up in new fangled language. The words change but the arguments remain the same. As Karl Marx once noted: "Hegel remarks somewhere that all great, world-historical facts and personages occur, as it were, twice. He has forgotten to add: the first time as tragedy, the second as farce." The creationism of William Jennings Bryan and the Scopes trial was a tragedy. The creationism of the Intelligent Design theorists is a farce. t

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