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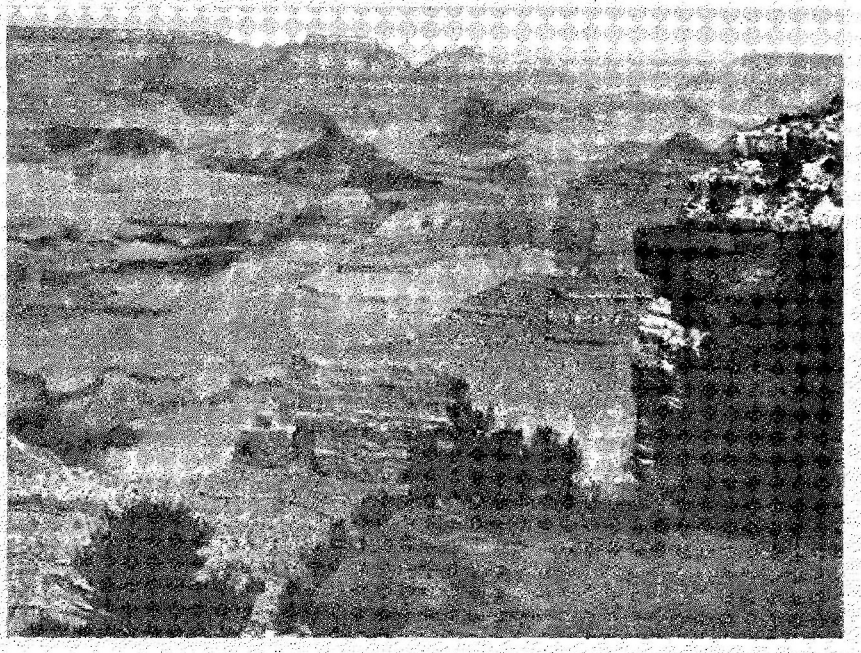

A Creationist Walk Through the Grand Canyon

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For years, the Institute for Creation Research has made much of its frequent student expeditions to the Grand Canyon. Since we have so often published investigations of other creationist "field research," we began to feel that it was about time we reported on one of these. Tom McIver, a cultural anthropologist who had gained the confidence of the ICR, felt the same way and, in June 1985, went down into the Grand Canyon with a creationist study group. His recently completed and quite detailed report on the actual nature of that expedition, this issue's lead article, is an eye-opener. If you had thought that creationist "field research" on Mount Ararat and along the Paluxy River was short on scientific merit and objectivity, you will be amazed at how much less there is of it in these regular ICR treks. According to Henry Morris's cover letter accompanying the April 1987 *Acts & Facts*, creationist students will once again enjoy "the inspiration and excitement of the ICR Grand Canyon Tour, climaxed by a glorious Easter morning service on the Canyon rim." From Tom McIver's article, you will see how Morris's statement sums up the actual purpose of these trips so nicely.

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A Creationist Walk Through the Grand Canyon

Thomas McIver

In June 1985, I participated in the Institute for Creation Research's Grand Canyon Field Study Course, offered for graduate credit at ICR as "Biology/Geology 537." I had been doing some "participant observation" at ICR as part of my research on creation "science" as an anthropology graduate student at the University of California at Los Angeles; this trip provided both a firsthand look at ICR education and training, plus intensive contact with active creationists.

The ICR offered three other hiking trips in April 1985 for graduate students and auditors (a total of forty participated) and received camping permits for sixty-four hikers for the season. ICR is not the first to offer creation-science tours of the canyon; Bible-Science Association groups, usually led by Ed Nafziger or Clifford Burdick, have been hiking to the bottom since 1969 (Lang and Lang, 1984; Bible-Science Association, n.d.).

That creation "scientists"—especially young-Earth creationists—are so fond of the Grand Canyon may seem surprising, since its awesome mile-deep exposure of rock strata is compelling evidence of millions of years of deposition and fossilization. There are, however, several factors which attract creationists to the Grand Canyon. One is that many practitioners of creation science today, like the classical (pre-Darwinian) creation scientists in the era of "natural theology," still try to look to nature for confirmation of God's word and revelation (though fundamentalists also insist that the Bible is God's sole revelation). Nature-watching field trips and amateur geology and biology outings are very much a part of this venerable tradition. Belief that sturdy common sense, uncontaminated by worldly philosophies, theories, and speculations, will lead inevitably to truth, which can be comprehended by earnest laypersons as easily as by specialists, is also part of this heritage (Marsden, 1980; Cavanaugh, 1985). And there is increasing distrust (not limited to creationists) of the supposedly materialistic, atheistic, scientific elite. The

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canyon also provides a prime opportunity for "witnessing" to fellow visitors about creation and Christ.

Because I had previously taken an ICR graduate school course (on the two-model approach to origins), had attended ICR summer institutes and done a lot of research at the ICR library, and was enrolled as a graduate student at UCLA, I was told I could join the June 1985 Grand Canyon trip by paying the ICR graduate student rate of $125, as compared to the regular $350 for auditors. On my application I repeated what I had told many people at ICR in the past: that I was interested in learning about creation science, that I was studying evolution and creation science as competing belief systems, that I hoped to pick up some knowledge of geology, and that I wanted to see how the Grand Canyon could be used as an argument for creation science. I avoided stating my own beliefs regarding creation science, and I did not make any claims about my religious beliefs. Apparently, this was adequate, though other applications contained "amazing testimonies of God's work in people's lives" and told of "ICR's strategic ministry" to Christians.

ICR faculty members on the 1985 trips were geologists Steven Austin, John Morris, and David McQueen, biologists Gary Parker and Kenneth Cumming, and meteorologist Larry Vardiman. Our group was led by Morris and McQueen. David McQueen is the only ICR member who testified in the 1981 Arkansas creation science trial (he gave a pretrial deposition but was not called as a witness during the trial itself; at the time he had not yet joined ICR as a regular member). John Morris is the son of ICR founder and president, Henry Morris. Before becoming involved with creationism through participation in the Ararat expeditions, Morris tried to distance himself from his father's religion. He notes a certain irony in the fact that, as if in response to a taunt, he was struck by lightning on Ararat in 1972 and was blinded (in one eye, at least) a few years later from multiple sclerosis. Morris seems to have drawn strength and further inspiration from these troubles. At the canyon, he remained cheerful and generous throughout and appeared to be in excellent physical condition.

Our group met at dawn at ICR, near San Diego, for the all-day bus ride to the canyon. During the ride, Morris and McQueen presented some introductory remarks on the geology of the canyon, and we familiarized ourselves with the course handbook. Mostly compiled and written by Steven Austin, this handbook (Institute for Creation Research, 1985) is a forty-eight-page collection of reprints, with some original material, attractively arranged and containing much useful information. It includes many maps of the canyon and geological diagrams from various sources, plus articles from creationist and noncreationist publications. The title page warns: "Many of the interpretations expressed here represent research in progress and are therefore tentative."

Morris and McQueen asked us to note a sand dune area we passed as illustration of the weakness of the evolutionist explanation for the formation of the

Coconino Sandstone layer in the Grand Canyon. The angles of the dunes were supposedly inconsistent with the bedded layers in the canyon, thus refuting the theory that they were formed from similar desert dunes. In the creation model, the Coconino Sandstone was formed under Flood waters. McQueen also pointed out a region of rounded boulders, many of them perched atop steep hills. He hoped that some graduate student at ICR would do a thesis on these, since their precarious perch seemed to indicate recent formation.

But the major activity on the bus ride was for each of us in turn to take the microphone and tell about ourselves—our interest in the trip, in ICR, about our family, how we came to know the Lord, our work, and other interests. Most participants talked at considerable length, primarily about the importance of Christ in their lives and how they came to accept him—often illustrated with quotes or references from the Scriptures. Mine was the shortest speech. I explained that I had only become interested in Christianity following my recent interest in creation science, which began a few years ago at UCLA as a consequence of studying scientific theories—evolution in particular—as belief systems; that pursuing external critiques of evolution led to my discovery of creation science and ICR. I mentioned that I was now studying creation science as a belief system as well and wanted to learn as much as possible about it and that I had attended several ICR courses.

The longest speech was by Harry (pseudonyms are used throughout this article for group members, except for ICR faculty), who related many incidents proving that God was providentially watching over him and helping him avert many harrowing and imminent disasters. Harry was a last-minute addition to the roster, persuaded to come along only the day before when visiting ICR, and he did not intend to hike all the way to the bottom of the canyon with the main group. Harry was an amiable and enthusiastic witnesser, but he soon let it be known, as he was telling us some of his wartime stories, that he did not believe that the Nazis had actually tried to exterminate Jews. He was in World War II, he assured us, and he knew that tales of German atrocities were just propaganda.

Richard, an Illinois schoolteacher, was a runner and health food enthusiast. He had attended seminary, liked to read theology (he was reading Rushdoony's *Institutes of Biblical Law* on the bus), and frequently quoted or discussed Scripture. His speech included a discussion of his educational philosophy and was full of references to God's will.

Charlie was a mining warehouse manager, recently a grandfather, vigorous, and extremely friendly. He was interested, like many other participants, in promoting creationism locally. Though he did not have a college education, he was very eager to learn as much as he could about geology and proved to be a highly motivated and earnest student. Charlie was one of the most genuinely nice people I have met. He was as surprised as I was when Harry announced that the Nazi extermination of Jews was a hoax and politely argued with Harry about it.

Marvin had worked in computer software, creative writing, and other jobs and planned to attend the Simon Greenleaf School of Law, a Christian institution, the next year. He loved to discuss the need for a Christian legal counterattack against humanists and evolutionists. A former Mennonite, he also enjoyed discussing theology, politics, economics, history, and philosophy. He seemed to have read a lot about creation science but knew little basic science. Marvin was attracted to conspiracy theories; it was often difficult to converse with him because he frequently launched into a recitation about organizations such as the Brookings Institution and the Trilateral Commission, which are pumping propaganda to our universities and funding humanist organizations, and the origins of this conspiracy in the Illuminati and other sinister anti-Christian plots. He held the Rutherford Institute, a legal group defending Christian rights, in highest regard and also recommended the Committee to Restore the Constitution, a rightist political and economic organization.

Jacques was an ICR graduate student in science education—the only one in our group taking the course for credit (most participating ICR students went on the earlier trips). Polite and low-key, he was an admirer of the John Birch Society and like to discuss conspiracy theories with Marvin.

There were two women in our group. Sue, an outgoing Montana schoolteacher, was an avid birdwatcher and camping and hiking enthusiast who sometimes entertained us with coyote yelps on the trail. Pat was an emergency room nurse from Arizona and was involved with Bible study groups. Always cheerful and animated, Pat managed to wear earrings and nice clothing on the trail in spite of fearful heat. Pat and Sue both seemed highly appreciative of and somewhat awed by the opportunity to learn creation science from Morris and McQueen of ICR in person.

We arrived at the Grand Canyon late in the evening and went directly to our campsite. There we met two other members of our group who had driven to the canyon separately. Roger was a high-energy physicist—a "flash-and-boom" physicist, as he put it—at Sandia National Laboratories in New Mexico. He had worked in geophysics, as well as fusion research and other fields, and has published in technical journals. Since becoming a creationist, Roger has written several articles for *Creation Research Society Quarterly* on planetary magnetic fields. His conversion to creationism has apparently taken a toll on his family life and relations at work, and he expressed genuine, heartfelt gratitude for the fellowship he received in our company. Roger had offered to discuss creation science at company seminars, but he said proposals had been quashed by upper management despite the interest of many of his colleagues. He presented a paper on Earth's magnetic field during the Flood at the 1986 International Creation Conference. Roger was also the only person in the group who fully realized that, as a cultural anthropologist, I was actually apt to be studying them—that although inside the group I was also apart from it and that though I sympathized with much of their worldview and was participating in their activities, this did not necessarily mean

that I had converted to all their beliefs. The others tended to assume, more or less, that I believed in creationism and a fundamentalist view of Christianity, and I did not try to correct this assumption. Every once in a while, as we were hiking along, Roger would ask me what my impressions and conclusions about creationists were.

Steve was a graduate student in Colorado. He had previously been a fireman, during which time he had gotten into the habit of writing letters to local papers defending creationism and other religious topics. He began graduate studies in parasitology on the advice of biologist Gary Parker of ICR, who had spoken about this as being a field most in need of creationist study. Steve was gregarious and outgoing, and his outspokenness had resulted in much friction in his graduate studies since he is openly contemptuous of evolution ("*evil*-ution," as he usually referred to it) and does not shirk chances to challenge it in class. Steve is active in a local fundamentalist organization, Christian Research Associates, as their creation science specialist and gives presentations of creationism sponsored by CRA. He made good use of the ICR expertise at hand on this trip, often asking McQueen and Morris questions concerning various aspects of creation science in order to better and more effectively present creationism himself to others. A navy veteran, he often expressed a militant superpatriotic attitude which seemed at odds with his sincerely friendly personality.

Bob, the final member of our group, met up with us the next day. He had driven from Maine with his wife (she did not hike down into the canyon with us). Bob was very quiet and polite, and I did not find out much about his background except that he had been a missionary in Alaska and planned to return there after this trip.

Though a small sample—there were ten of us who went into the canyon plus the two ICR leaders—my impression was that our group was fairly representative of active supporters and followers of creation science. These were all people interested and committed enough to spend the time and money for a tour led by ICR (though, of course, being in the Grand Canyon is itself quite rewarding), and several had come considerable distances. Most had advanced training in science or technology or worked in fields in which knowledge of science or technology is important: one professional physicist, one with computer experience, one in the mining industry, one graduate student in science education (albeit at ICR), one graduate student in a biological field, and two teachers. The remaining two, like all the others, were both active in religious activities—Bible study and missionary work.

The participants' philosophical and theological viewpoints varied somewhat from each other and from ICR's but not to a degree that I would consider surprising. All were solidly and actively creationist; no doubt they would not have applied if they had not been—or would not have been accepted if they seemed skeptical. All seemed to accept the ICR young-Earth Flood geology brand of creationism

without question. Significantly, all were born-again Christians who believed in biblical inerrancy and the importance of resisting the teaching of evolution. There were some mild differences in doctrinal matters but nothing anybody got upset over (Calvinist interpretations were favored by some; the ICR leadership is Baptist); rather, this merely led to some spirited but friendly theological discussions.

We spent the first full day at the canyon rim, glorying in the view. Morris and McQueen gave a series of lectures on the canyon's geology and formation by the great worldwide flood. We learned to identify the major rock strata spread out in full view beneath us. Most of the descriptive geology taught to us was the same as anything we would have learned from orthodox geologists. Few creationists object to using the standard names of the geological column in classifying strata but insist that these descriptive names be decoupled from assumptions of vast ages.

The ICR position is that the canyon was formed during and immediately after the Flood—a few years after, not the hundreds of millions of years proposed by "uniformitarian" geologists. We were taught to distinguish original "creation" rock from rock resulting from sediments deposited by the Flood. This turns out to be fairly simple, especially at the Grand Canyon, where the mostly horizontal strata are so neatly exposed. All Precambrian rock is considered pre-Flood—that is, original created rock. Creationists say that fossil evidence indicates an "explosion" of complex metazoan forms in the Cambrian, including representatives of all animal phyla. Precambrian rocks (at least in the Grand Canyon) appear to contain no fossils. The Precambrian layers in the canyon are tilted and faulted, in marked contrast to the neat horizontal layers overlying them. These contorted Precambrian layers were pointed out to us with no trace of embarrassment; after all, there was a day of tremendous violence in creation week, when God separated the land from the water; also, there was incredible violence when the waters of the deep were opened up during the Flood. The "Grand Canyon Supergroup" is a sequence of late Precambrian strata visible in some parts of the canyon lying at a very sharp angle; most of the visible Precambrian rock, however, is vastly older—millions of years were eroded away before the Cambrian depositions. A "Great Unconformity" separates the Precambrian from the Paleozoic strata—evidence, to the noncreationist, of this enormously long period of erosion and a gap in the geologic column. To the creationist, however, it is evidence of the violence of the Flood.

All rock above the Precambrian levels, we were told, is Flood rock. To the noncreationist, this is bizarre, since the neat horizontal strata—nearly a mile high—are so different and clearly demarcated. If formed within a year as a result of a single flood of unimaginable violence, why isn't everything just jumbled together? Here is where clever, ad hoc creationist hypothesizing comes into play. Both hydrodynamic sorting of sediments (including animal remains) and series of changing currents are involved. They explain that the layers of sediment were not dumped all at once but that great currents swept across the area from all directions as the

waters receded. Thus, sediments picked up from the north would be dumped one day; later, an entirely different set of sediments originating in the south would precipitate out on top of these and so forth. Several of the layers might be deposited in each of these series: gravels and coarse material precipitating out first, then sand on top of this, and, finally, silts and clays. Henry Morris, in fact, claims that the neat and extensive horizontal layering of the canyon argues against an ancient Earth: "The strata simply could *not* have remained so nearly uniform and horizontal over such great areas and great periods of time" while undergoing all the geological activity attributed to it by evolutionists (Morris, 1974:153).

These explanations are not new. In *The Deluge Story in Stone*, first published in 1931, creationist Byron Nelson presents the theories of the older Flood geologists, many of which have been resurrected by today's creation scientists. John Williams, for instance, wrote in 1789 about the formation of British coal seams, sometimes as many as sixty strata at one site. Williams thought that these were laid by successive tides or currents during the Flood. These tides, produced by the sun and the moon, "perhaps *several miles in perpendicular depth*," coursed back and forth over the land, depositing new layers of sediment at each pass (quoted in Nelson, 1968:78–79).

Morris and McQueen explained that the Grand Canyon itself was carved out very soon after the Flood. All the layers of newly deposited sediments were still fairly soft and unconsolidated, so this entire process took but a few years at most. The source for this sudden and monumental erosion was the retreating waters of the Flood, perhaps trapped upriver temporarily, then bursting through with enormous force. (Nafziger [n.d.:160] says that this sudden rush of water may have been released as late as two hundred to three hundred years after the Noahic Flood, but most creationists assume it occurred immediately following the Flood.)

No one in our group betrayed the slightest bit of doubt concerning this explanation of the canyon's origin. Indeed, many expressed amazement that anyone could be so foolish and perverse as to believe otherwise. How could this whole enormous canyon have been formed by such a small river, as the evolutionists claim? Where is the necessary downstream deposition of eroded canyon sediment? What about all the alleged missing layers? We shook our heads in wonder and genuine pity at the ability of evolutionists to accept such utter absurdity. Several people agreed that it would have been enlightening to have included an evolutionist in our group so that we could hear firsthand how these incredible beliefs could possibly be explained and rationalized. We agreed, however, that, though it would be entertaining, it would have resulted in too much disturbance and argument.

That evening on the rim we had supper at our campsite. The featured dish was McQueen's tasty "igneous-metamorphic-sedimentary chili" with hot dogs. We were up by 4:30 the next morning and began our hike down into the canyon on the Bright Angel Trail shortly thereafter. Everyone carried Bibles (item number one on our ICR pre-trip equipment checklist), although several people carried

only compact New Testaments. Morris had some tents, camp stoves, and other equipment from his Ararat expeditions. Because of the heat, most of the tents were left up at the rim. The two women shared one tent, and I carried my little borrowed one, though I did not use it every night.

The hike down was tiring, as it was already very hot and we had heavy packs. We made several long stops along the way, during which McQueen and Morris lectured on geological features we were passing through. Morris also gave us hiking tips from his mountaineering experience. Passing through the Coconino Sandstone, one of the upper strata, McQueen explained how the abundant fossils of this layer could be accounted for within the Flood model. Steven Austin of ICR has developed a "floating mat" hypothesis of coal formation: huge masses of trees and vegetation were torn loose during the Flood and rafted by the strong currents. Deposits—especially tree bark—from these floating mats of vegetation settled to the sea bottom to become coal. McQueen hopes to extend this hypothesis to argue that animals survived early stages of the Flood on these floating mats, only to be entombed later in various deposition layers. Some survived long enough to make footprints underwater across the newly laid sediments. Leonard Brand of Loma Linda's Geoscience Research Institute, in experiments cited in our course guidebook, used live animals in his lab to make footprints in dry, wet, and underwater sand. He concluded that the Coconino Sandstone fossil footprints were consistent with underwater—not eolian—sand dunes.

When we reached Indian Garden Campsite later that morning, the heat was ferocious. Our group's designated camping area had no shade, so we sat by the stream cooling our feet and discussing the ubiquitous and many-tentacled New Age movement. Roger entertained us with gruesome parasite stories. One ranger said that the temperature was 118 degrees; another thought the thermometer had been pushed beyond its reliability.

In the afternoon, we looked for trilobites in the blazing heat. Then most of the group went to Plateau Point overlooking the Inner Gorge. After admiring the Colorado River directly below us, hundreds of feet deep in the Precambrian Vishnu Schist, we scoured the locality for animal tracks. Plateau Point is in the Tapeats Sandstone, the lowest Cambrian layer. Fossils of trilobites and worm burrows are common, but we were particularly concerned with "out-of-order" fossils. Australian John Mackay had recently discovered some marks at Plateau Point and reported on them in *Ex Nihilo* (1985; also reprinted in our course guidebook). He thought that these could be footprints of vertebrates—amphibians or reptiles—though these were not supposed to have evolved until much later, according to evolutionists.

We now reexamined these alleged vertebrate tracks. Our opinions were solicited, although most of us had no previous geological training. This is consistent with the creation-science tradition of amateur nature-watching. Creation science relies upon a naive empiricist philosophy of science: science is thought to be built up

of common-sense observations; nature (like Scripture) is perspicuous; ordinary folk, if not blinded by theoretical speculations and materialist, evolutionist idols, can participate in this enterprise of understanding God's creation. Local creation-science groups often include astronomy buffs, rock hounds, bird-watchers, and other enthusiastic scientific amateurs interested in observing, collecting, and seeing the glory of God in nature—although not familiar with modern understanding of science as a controlled hypothesis-testing enterprise. In this case, we remained skeptical. When I was asked, I ventured that the sediment pushed up by the tracks suggested motion or weight inconsistent with the supposed "claw" marks in the center. McQueen and others also felt that these "vertebrate" footprints did not constitute reliable evidence for creationism.

Yet, despite this tradition of obsolete common-sense empiricism, with its harsh criticism of evolution and other modern scientific theories for being nothing but biased, abstract speculations, creationists indulge in hypothesis-spinning of the most reckless sort. We were encouraged in this: what scenarios could we devise which would account for the observed data—fossil footprints, various strata, faults and unconformities, or whatever—and still preserve the absolutely required literal interpretation of Genesis? No discrepancy is perceived, because creationists know that the Bible is totally inerrant. Empirical scientific data must be reconcilable with Scripture interpreted in its plainest, most literal sense (except where "obviously" symbolic!); thus, the wildest hypotheses are proposed to force nature to agree with the revealed word of God. No matter how unlikely the fit with the data, these creation-science speculations are considered plausible precisely because they preserve the fundamentalist interpretation of the Bible.

We got back to our campsite at dusk and broke camp very early the next morning to reach the next campground, Phantom Ranch, before the midday heat. We took a long and extremely refreshing break when we hit the river; the water was numbingly cold. There was no afternoon group hike as planned due to the heat. It was hot all night; a ranger said that the previous evening it didn't drop to 100 degrees until 9:30. Pat stayed up late assisting a ranger with a hiker suffering from heat exhaustion. Sleeping without tents, we were awakened frequently by various animals, especially lizards scurrying over our bodies. Deer and squirrels shamelessly inspected our backpacks.

The next morning, we returned to Indian Garden, arriving by 8:00. Richard, the runner, left his pack to jog up to the rim and back. The rest of us spent most of the day under a big shade tree telling jokes and stories and dozing a little. I told McQueen that I had spent several years as a counselor in a psychiatric hospital, and he asked me whether I thought acute mental illness was due to demonic possession. Like others at ICR, the power and influence of satan and his demons is very real to him. McQueen believes that Hitler's uncanny military genius was due to satanic possession. He was proud that in his Arkansas pretrial deposition he deflected the inquisitorial questions of the evolutionist lawyer intended to get him

to admit (as Geisler did during the trial) that he believed that UFOs were satanic deceptions. McQueen parried this hostile line of questioning by replying that his professor's brother, Dean Rusk, as secretary of state, knew that there were many secret flights by military craft flown by our own red-blooded American boys.

That evening, we had a meeting, ostensibly to review and ask questions about canyon geology, as well as the usual devotional. We had invited two other couples to join us. While we waited to get started, the ranger on duty came by. She stayed to chat for a while and ended up hearing about the Flood geology interpretation of the canyon. A Jewish woman from Massachusetts, she didn't seem to be familiar with creationism and appeared bewildered by the gentle but persistent witnessing. We left her with some surplus camping food and a Bible. (Creationists find government-sponsored "evolutionist indoctrination" by park rangers highly annoying and want a more "balanced" approach. At a local creationist meeting I attended, we were told that one park ranger at Mammoth Caves, since having been introduced to the *Bible-Science Newsletter*, now presents both the "evolutionist" and the Flood geology interpretation of the caves' origin.)

The meeting proper began with a discussion of the Grand Canyon as evidence of God's awesome powers of destruction. Beautiful as it is, it is a reminder and a warning of the destruction of the entire world because of sin. Eventually we got around to geology, but the conversation reverted almost immediately to religion. The older couple inquired about the Flood theory of the canyon's origin. Morris called upon me to respond by giving a summary of the creationist explanation we had learned. I demurred and mumbled something to the effect that I was still trying to absorb these lessions and it might be better if someone more confident answered. In truth, I couldn't bring myself to present the creationist explanation as if I believed it, especially to strangers (though it turned out that our guests were sympathetic to creationism). Later, when someone in our group asked me why I declined to answer, I said that I have great difficulty speaking in public, which is also true.

So, it was left to others to describe Flood geology. Talk then turned to the biblical implications of the Flood. The younger couple, both English, asked several polite but pointed questions. The young man, it turned out, was in general agreement with the fact of the Flood and knew his Bible well but did not agree with other theological conclusions of our group. In particular, he disputed the central claim that personal acceptance of Jesus as savior led to certain and eternal salvation. Any good Christian might backslide, he argued, so being born again or "saved" could not be any guarantee of salvation. This led to a very serious theological argument, with our English visitor raising objections which were energetically responded to by most members of our group. Eventually our visitor claimed that Jesus was not the same as God, since Christ himself prayed to God. At this point, it became clear to us that he had been influenced by Jehovah's Witnesses, which was confirmed when he stated that there would be a heavenly

kingdom on Earth and not a rapture of the faithful. Questioned, he admitted that he had studied their literature. Both sides were adamant, and it was well after dark before our group gave up trying to convince him of the error of his cultic interpretation. This theological discussion preempted any further geology, but no one minded. Most of us were quite excited by it, though frustrated at the stubborn persistence of error.

It was clear that the main emphasis of this "geology field course" was religious: seeing in the Grand Canyon a warning to heed God's word and accept Christ before the coming destruction of the world, communicating this to fellow hikers, and fellowship with our own group of believers. Whatever geology we learned was secondary to this overwhelming concern—a means to an end—though we were actually interested in the canyon's geology as well. But even this scientific interest was motivated by desire to be able to defend the faith against skeptics—apologetics—and to present creationism more effectively to others. We had daily devotionals and Bible study sessions, during which our leaders would ask one or two of us to offer prayer. McQueen brought along wafers and wine for Sunday communion. I was asked to lead the group in prayer on this occasion, but once again I demurred. No one seemed to resent my shyness and my admitted unfamiliarity with doctrine, but everyone else offered prayer freely, easily, and often. Once I was asked to which church I belonged. I replied that my wife still attended Catholic church. My questioners muttered condolences and did not press the matter.

Much of the excitement on the trip concerned witnessing attempts. People who were witnessed to were enthusiastically discussed and prayed over afterward. There was a definite consensus that such encounters were by far the most important aspect of the trip and that our witnessing was quite successful. Roger, our physicist, met a German graduate student who did not know anything about creation science but expressed real interest in it. He met up with us later, and the witnessing was pursued. Morris ran into a couple of Turkish exchange students, and some of us spoke with a young Afghan, also.

Not that all of this was imposed upon reluctant passers-by. On the contrary, many who were witnessed to were sincerely interested, though some seemed totally unaware of what creation "science" was. On several occasions, someone would overhear Morris or McQueen lecturing to us on creationist geology and come up to us afterward to introduce themselves. They were Christians, they would say, and were interested in what they had heard. Where did we come from and how might they learn more about creation science? Thus were some people introduced to ICR.

The Turkish students with whom Morris spoke were part of a school group. Their teacher, who considered himself a Christian and something of a Bible scholar, disagreed with Morris about creationism and the age of Earth. Morris wanted to discuss this with him, but he had to return to his students. A little later, Roger heard the teacher talking to his students about the creationists he had just met (that

is, us) and telling them that creationism was mistaken. This kind of response infuriated many in our group, and some unflattering things were said about that teacher. Here was somebody calling himself a "Christian" who nonetheless denied essential (according to ICR) doctrine: the historicity of Genesis, including the Flood and the literal six-day creation.

We hiked back up to the rim the following morning. At supper, we talked about other creationist groups and interpretations. Depending upon the audience, creationists may attack rival creationist interpretations as much as they do evolution itself. There were some very funny anecdotes. Some complained about John Clayton, an Indiana old-Earth creationist. Morris offered some witty impressions of Carl Baugh, the Paluxy investigator who sees "manprints" everywhere. Morris and others at ICR think Baugh does creationism a great disservice with his scientifically naive and ill-founded claims. The Loma Linda University scientists of the Geoscience Research Center, another well-known and influential creationist organization, on the other hand, are seen as too cautious and overly critical in evaluating creationist claims. Their creation science is too conservative for ICR's taste. Morris also criticized Navarra's alleged discoveries of wood from Noah's ark on Ararat as almost certainly fraudulent and Navarra's film as probably a hoax.

After supper we sat around the campfire telling stories and fellowshipping. After an hour or two of this banter, everybody in the group began offering prayers and giving testimony—some of it quite long-winded and repetitious—about what this Grand Canyon experience has meant to us. Everyone agreed that the spiritual aspects and the fellowship were most important. This went on for quite a while. Eventually, McQueen announced that he was exhausted and wanted to retire. But someone popped up and suggested that we all hold hands around the campfire and pray. Such suggestions are hard to refuse for zealous believers who feel that their faith must be constantly and publicly affirmed. Every so often, someone would chime in with a spoken prayer. Silence seemed to be abhorred and would be filled as soon as somebody thought of another suitable prayer. Finally, we hugged and said our goodbyes.

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Fossil Insects: Pests of Creation

Gene Kritsky

Insects have often been pests of the creationists' attempts to discredit evolution. The bombardier beetle is a familiar example to the readers of *Creation/Evolution* (Schadewald, 1986). Peppered moths and insect resistance to pesticides have also drawn creationists' ire. However, these entomological examples of adaptation and natural selection are not the most damaging insect pests for creationists, since fossil insects and the transitions they document provide some of the best examples of evolution.

Fossil insects have received little attention in the creation-evolution controversy. Morris discusses the fossil record of insects and claims that there were "giant dragonflies, giant roaches, giant ants and so on. But their form is no different in essence from that of modern insects" (1974). But when the fossil remains of insects are examined, differences from the insects of today are apparent. The "giant dragonflies" were similar dragonflies in that they had large eyes, slender bodies, and could not fold their wings, but they still were very primitive compared to modern dragonflies. These giants belonged to the extinct order Protodonata and had wing spans of between twelve and seventy-five centimeters. Their wing venation (FIGURE 1) was very primitive when compared to modern dragonflies (Riek, 1970). As another example, fossil roaches included forms that possessed large ovipositors which extant roaches do not possess (Riek, 1970). Finally, there were no giant ants. The oldest fossil ant is from the Cretaceous period and had a head

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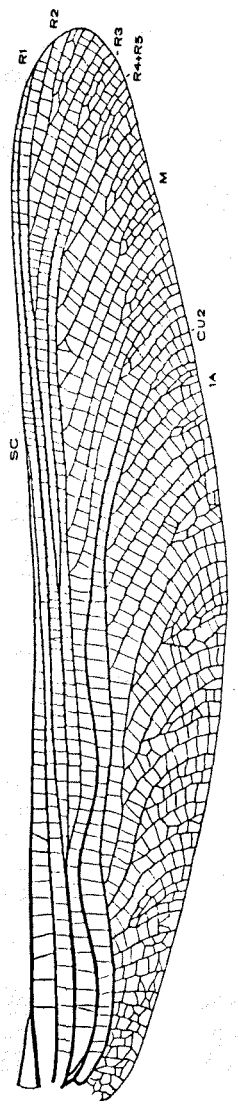

Figure 1. The forewing of the Protodonata species *Typus permianus* with the major wing veins marked (Carpenter, 1931). Reproduced with permission of F. M. Carpenter.

that was just one millimeter in length (Wilson, 1971).

Insects have been preserved as fossils in concretions, amber, shales, and the LaBrea tar pits. The oldest fossil insect dates back to the Upper Carboniferous period. However, six-legged arthropods, such as the springtails (*Collembola*), have been found in Devonian rocks (Wooton, 1981).

In order to appreciate the significance of the important fossil insects, an understanding of the features used to define the insect orders, suborders, and families is necessary. Unfortunately, an adequate understanding of the various insect groups would require several hundred pages and that is well beyond the purpose of this article. Simply stated, however, the class Insecta contains twenty-seven living and twelve extinct orders (Gillott, 1980; Riek, 1970). The features which define an order include type of mouthparts, form of development, whether or not the insect could fold its wings, and wing venation. Wing venation is very important in classification of the insect orders and families. This is fortunate for our understanding of insect evolution because wings are often the only parts of insects preserved as fossils. Although early entomologists used wing venation to create several extinct orders and families that were not valid, recent work is much more critical. Not only both pairs of wings but also the head and details of the type of mouthparts are required before new ordinal and family designations will be accepted (Carpenter, 1977).

The recent attempt to question the validity of the *Archaeopteryx* fossil has brought the importance of transition fossils to the forefront of the creation-evolution controversy (Charig et al., 1986). Although *Archaeopteryx* is possibly the most famous transition fossil, it is by no means the only known transition. There are many fossil insects which fit the criteria of being transitional

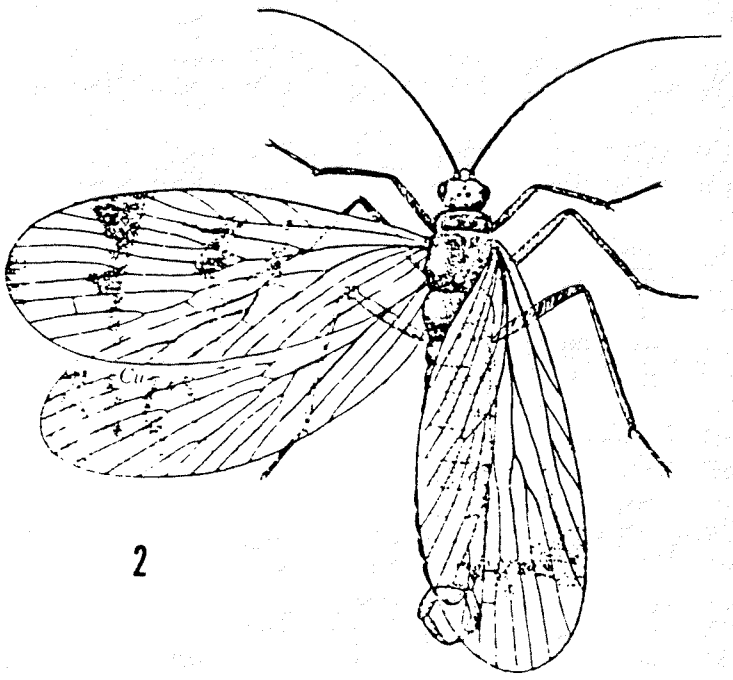

Figure 2. The Permian Mecopteran *Agetochorista tillyardi*. From Ross et al., 1982, reproduced with permission.

between higher taxa; that is, they possess features that define two distinct taxa and are found in the appropriate geological period. The transition between the Mecoptera (scorpionflies) and the Diptera (true flies) is one of the most impressive insect examples. The Mecoptera today is a small order of nine families with only about four hundred described species. They were, however, much more diverse in the Permian period and in the Mesozoic era with twelve now-extinct families (Ross et al., 1982). Scorpionflies (Figure 2) are small to medium-sized insects with chewing mouthparts often at the end of an elongated head. They also have a characteristic wing venation. The Diptera, on the other hand, are defined as insects possessing one pair of wings, the hind wings having been reduced to small balancing structures called *halteres*. The wing venation of the Diptera includes a characteristic "kink" near the base of one of the veins. This difference allows for the identification of Mecoptera and Diptera wings. Comparative studies have long suggested that the Diptera evolved from the Mecoptera. The most primitive flies, Tipulidae

(crane flies), have features which are suggestive of scorpionflies (Ross et al., 1982; Riek, 1970; Gillott, 1980).

In 1953, E. F. Riek described a Permian fossil wing that had the characteristic kink in the wing vein that is diagnostic of the Diptera. But the wing also had venation that was similar to Permian scorpionflies, so he placed the wing into a Mecopteran suborder he named Protodiptera. The similarity led him to predict that a four-winged fossil fly might be found, and in 1976 he described a more complete fossil of a four-winged insect which possessed the characteristic venation of the Diptera with some of the Mecopteran similarities. Moreover, the hind wings were smaller than the forewings, suggesting that the move toward diptery was on its way. Also, the third segment of the thorax was reduced, another intermediate characteristic between the Mecoptera and the Diptera. The fossil insect, called *Choristotanyderus*, was used by Riek to define a new suborder of Diptera to include those fossil forms with four wings (Riek, 1976).

The Mecoptera were also apparently ancestral to the order Trichoptera, or caddisflies, mothlike insects which have aquatic larvae and pupae. Like the Mecoptera and Diptera, the Trichoptera have a characteristic wing venation which includes a complete set of longitudinal veins with few cross veins. The Permian fossil *Belmontia*, which is classified within the Mecoptera, has wing venation which is intermediate between the primitive Mecoptera and the early Trichoptera (Gillott, 1980; Ross et al., 1982). Jurassic fossils show modern trichopteran venation.

These examples are just *two* of the transitions between orders seen in fossil insects. There are several other fossil insects that yield important information on evolution within the orders. For example, beetles, order Coleoptera, have hardened forewings called *elytra*. The oldest fossil beetles possess elytra which still retain remnants of wing veins typical of insects without elytra. These first beetles are similar to a group that survives today, the Cupedidae (Riek, 1970). This is an interesting point because these beetles have long been regarded as primitive. The family today consists of only twenty-five species worldwide and is rarely collected, yet it is the first definite beetle to be found in the fossil record and is even found in the early Cretaceous Wealden beds of southern England, suggesting that they were much more common in the past (Jarzembowski, 1984).

Another example is provided by dragonflies, order Odonata. Dragonflies today have a series of wing veins that create a triangular-shaped cell appropriately called the triangle. Harvard's Frank M. Carpenter, using Permian fossils, showed how the wing evolved from those of primitive dragonflies, which did not possess the triangle, to the typical contemporary dragonfly wing with the triangle (1931). This fossil series has important implications for the evolution of dragonfly suborders.

Another case of evolution within an order of insects involves the mayflies, order Ephemeroptera. These delicate insects have membranous wings with many veins. The front wings are large and somewhat triangular-shaped, whereas the hind wings, if present, are small. The mouthparts of living mayflies are vestigial.

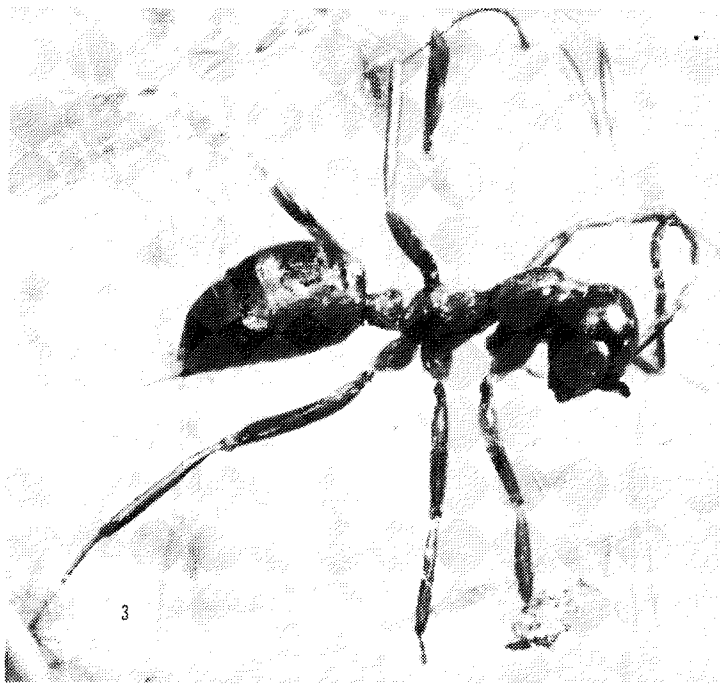

Figure 3. *Sphecomyrma freyi*, the Cretaceous fossil which forms a near-perfect link between the nonsocial wasps and the ants. Reproduced with permission from F. M. Carpenter

The mayflies of the past were very different compared to those of today; Paleozoic mayflies possessed forewings and hind wings which were large and equal in size. Moreover, some Paleozoic mayflies had well-developed mandibles (Wooton, 1981).

An excellent example of a family-level transition involves the origin of the family Formicidae, or the ants. The oldest "ant" (Figure 3) is from the Cretaceous amber of New Jersey. It is considered an ant because it has a modified first segment of the abdomen, called the petiole, which is characteristic of ants. E. O. Wilson and his colleagues who described this fossil were surprised by its wasplike mandibles. In fact, this ant, as they described it in the original paper, "forms a near-perfect link between non-social tiphiid wasps and the most primitive myrmecioid ants" (Wilson et al., 1967).

The Cretaceous amber, as seen with the ant-wasp example, is especially important in providing details of family-level transitions. Another example is the extinct family Jacopidae, which is defined from a Cretaceous amber nymph that is transitional between the families Cercopidae, the spittlebugs, and the Cicadelli

the leafhoppers (Ross et al., 1982). As more work is completed on the Cretaceous amber, it is likely that even more family transitions will be discovered.

As we examine younger amber deposits, such as the Baltic amber from Europe, we find different kinds of transitions. The insects of the Late Eocene show evolutionary transitions below the family level of classification. Many of the genera found in the Baltic amber are still living today, but only one species found in the Baltic amber still survives (Stanley, 1979). These extinct species from the Eocene are providing important details on the evolution of tribes and genera. For example, the ant *Agroecomyrmex duisburgi* is the "apparent connecting link" between two tribes of ants (Wilson et al., 1967). Moreover, the bumblebees, which belong to the modern genus *Bombus*, are not found in the Baltic amber or other Tertiary deposits, while the genus *Protobombus*, thought to be ancestral to the bumblebees, is found in the Baltic amber (Wilson et al., 1967).

It is obvious that there is a trend in the type of transitions that are seen in the fossil record of insects. Clearly, the orders were evolving in the Paleozoic. The evolution of families can be seen in the Cretaceous with the subsequent evolution of tribes, genera, and species occurring during the Tertiary. The finding of transitions within different taxa of insects at different geological periods is not surprising from an evolutionary perspective. Indeed, the value of these insect fossils is best appreciated in the light of a quotation by Duane Gish: "The discovery of only five or six of the transitional forms scattered through time would be sufficient to document evolution" (1978).

Acknowledgements

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Design, Created Kinds, and Engineering

Francis J. Arduini

Introduction

Although rarely used today by most philosophers, certain conservative theologians and, of course, creationists continue to utilize the "argument from design" as a cornerstone of their personal world views (Geisler, 1983; Gordon, 1984; Jnana Dasa, n.d.; Sadaputa Dasa, 1984; Watchtower Bible and Tract Society of New York, 1967). Strictly from the logical perspective, such arguments are often unsatisfying to those who have not already committed themselves, consciously or otherwise, to an a priori belief in the intelligent design of the universe. But anti-creationist contentions that such arguments are made from an incomplete, and therefore invalid, analogy (Edwords, 1983; Thwaites, 1983) have rarely been developed in any real detail.

Stephen Jay Gould has contributed major steps in this direction by pointing out

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that many adaptations in living organisms have apparently been developed by the opportunistic utilization of previously existing parts—that is, tinkering, as opposed to real "design" (1980). The fact that living organisms would be limited in their adaptational options by prior phylogenetic history is a critical point in this analysis. Living organisms must evolve by modification of existing organs. Evolutionary innovation cannot come about by the sudden appearance of new, functioning organ systems. Instead, they result from the "exaptation" of preexisting structures for new functions. Thus, a wrist bone can become the Panda's thumb and ordinary flower parts can become the elaborate insect-luring mechanisms of orchids.

But Gould's analysis only goes so far. It is not enough to demonstrate that *bricolage* has apparently occurred; for once a design is demonstrated as functionally adequate in its new role, the determination as to whether or not it constitutes "good" design is largely subjective. It comes as no surprise that some creationists have already responded to this argument with the contention that, in their opinion, the Panda's thumb is not a clumsy, "jury-rigged" affair but, in fact, is an interesting, effective, and original design (Gordon, 1984).

The purpose of this article, then, is to take a look at the same issue from a slightly different perspective: instead of looking at organisms to evaluate the "goodness" of their design (by whatever subjective criteria we may choose to impose), we shall examine how designed machines as a group differ objectively from living organisms, regardless of the subjective quality of those designs. It is the contention of this article that, from an engineering perspective, living organisms fail to demonstrate the clear signs of artifice that characterize "created kinds."

The Process of Intelligent Design

The "created kinds" of modern technology have indeed evolved but in a manner quite different from living organisms. Where living organisms are constrained in their development by their evolutionary histories, machines are constrained only by the level of technology available to their designers. Design selection is based upon the unique design criteria of each individual creative act. Previous designs can be used, modified, or completely abandoned. Changes over time reflect technological advances, and such advances often manifest themselves in distinct ways.

1. The Quantum Leap. The achievement of a new technology will show up in machines with a previous design history as completely new systems or subsystems that only minimally affect the other independent systems in the machine. For example, when the technology of turbine engines became available, aeronautic engineers began designing aircraft using jet engines, while most of the other aircraft systems were unaffected. Control systems, building materials, even most of the aerodynamic design of our first jets were almost unchanged from their cylinder-

propeller-driven predecessors. These other systems did change later but only with the development of other new technologies.

The point is not that this type of mosaic evolution is unlike that of living organisms. One need only look at *Archaeopteryx* to see that this is actually quite *like* a living organism. The point is that the design of a turbine engine is so radically different from that of a cylinder engine that one cannot possibly construct a "Darwinian history" that could evolve one from the other. Unlike the fusing of two clavicles to form a wishbone or the fraying of a keeled scale to form a feather, the turbine engine is a completely original design with complex parts and subsystems that have no homologs and often no analogs in the other design.

Innovations in design are often unrestrained by whatever designs existed prior to them. They are therefore often revolutionary changes. Innovations in living organisms, however, do not show this type of wholesale replacement of systems. The very fact that it is possible to construct plausible Darwinian histories for living organisms, while at the same time it is impossible to do the same for our own "created kinds," is a crucial point of comparison.

2. Contagious Technology. Living systems evolving from different directions to fill the same ecological niche often develop strikingly similar adaptations. But again, constrained by their evolutionary histories, these adaptations are formed out of the parts available, and different parts are used for similar purposes. Dolphins do look remarkably like large fish and even more like icthyosaurs. But no competent zoologist would ever confuse the three. Past the most superficial level, the differences are dramatic.

Machines, constrained only by the level of technology of their creators, need not be so dissimilar when designed for similar functions. Grumman, Northrop, and McDonnel Douglas may be designing three individual air superiority fighters, but, if the specific design criteria so dictate, they can use the identical Pratt and Whitney engines for all three aircraft. This is not convergent evolution, but it *is* a fact of contemporary design.

And once turbine engines became available for aircraft, they need not be limited to the aircraft "clade." Engineers have placed turbines into boats, automobiles, motorcyles, and the M-1 main battle tank. The organic equivalent to this would be for feathers, once evolved in birds, also to appear suddenly on bats and flying squirrels or for whales, dolphins, and icthyosaurs to have gills. Needless to say, we do not see this.

An innovation in a "created kind" is contagious *between* "created kinds." Physical traits (systems, technologies) are not confined within specific clades by the limiiations of genetic transfer through phylogenetic descent.

3. Extrafunctional Homology. Design engineers do tend to specialize and develop their own unique design styles. A bridge designer will often use similar

designs for different bridges. A common designer should be expected to use similar designs *for similar functional purposes*. But what about *different* functional purposes?

What engineer in his or her right mind would use the same design only slightly modified to build an aircraft and a submarine? The different functions and design criteria mandate drastically different designs for these purposes. An aircraft requires a specially designed hull to hold air pressure *in;* a submarine requires an equally special hull to hold water pressure *out*. An aircraft will normally utilize internal combustion engines, even at high altitude; a submerged submarine requires electric or nuclear power. An aircraft requires airfoils for lift; a submarine requires ballast tanks for buoyancy. The list of profound differences could go on for pages.

But whales and bats are *both* air-breathing, warm-blooded, milk-giving mammals. Their design differences are quantitative, not qualitative. This cross clade similarity of design is completely unheard of in "created kinds," whether the design team consists of fifty engineers or only one.

Implications

If living organisms did in fact display the characteristics of "created kinds" that we witness around us, then the premiere prediction of evolutionary biology would be easily falsified. That prediction is the existence of a hierarchical, nested pattern of similarities in living organisms with which to construct a taxonomic system. If traits (technologies) were distributed among living things in the same way that they are distributed among machines, there would simply be no perceivable basis for a pattern that is *so* tangible that it was first perceived and formalized by creationists.

How would one go about establishing a Linnean taxonomy for machines? One could choose to sort machines by function—for example, "flying machines." But at the organic level, that would group bats with the birds (a mistake which can, incidentally, be found in Leviticus). One could attempt to sort by the organic criteria of homology versus analogy, but then where would one put Evel Kneival's rocket motorcycle? In the Harley Davidson clade or the Saturn V clade? It rapidly becomes evident that the selection of taxonomic criteria for machines would be entirely arbitrary and that drastically different "cladograms" would result depending upon which traits were being used to determine taxonomic affinity.

Even with these problems, at least one creationist, David Johannsen, *has* made a token effort at suggesting such a taxonomy for machines (1984). It was largely the spectacular failure of his system to result in the nested, hierarchical pattern he was explicitly attempting to construct that inspired this article.

Furthermore, even the limited evolutionary pattern given by advancing tech-

nology changing through time would be missing from the creationist scenario. The genuine evolution of humankind's technology has at least resulted in machines that increase in complexity over time. From a strictly directional (as opposed to anatomical) perspective, aircraft *have* evolved since Orville and Wilbur Wright took their first flights at Kittyhawk—but not in a manner that would allow construction of a phylogenetic tree.

But creationists don't even have this much of an explanation going for them. Creationists maintain that the creative act took place essentially instantaneously by a creator with no technological limitations.What possible reason could there be for God to impose an evolutionary pattern of change over time on living organisms when he allegedly had the unlimited technology available to make the appropriate design decisions at the first moment of design?

As already pointed out, if living things were created, there would simply be no engineering rationale to not create feathered, milk-giving fish and thus completely frustrate any attempts to establish taxa higher than the species. But instead we find penguins (firmly members of the class Aves, yet, a marine niche) and seals (unambiguously mammalian, yet also in a marine niche).

A common design stretched so far across different functional requirements speaks unambiguously of a severe lack of options, not an omnipotent designer. It speaks of a near total lack of originality, not omniscience. It speaks of opportunism, not intelligent design.

When observed from the point of view of engineering, and particularly from the perspective of the design process, it becomes quite clear that, if living organisms are the result of intelligent design, it is a type of design completely alien to engineering *as we know it.* The design decisions creationists attribute to God are not the same type of design decisions that are made by human engineers—the only intelligent designers with whom we are reasonably familiar.

And therein lies a fundamental flaw in the argument for design. The entire analogy rests upon the comparison of living organisms to the products of *human* design. And as we can clearly see, such a comparison presents us with glaring inconsistencies that argue against the validity of that analogy. If the creationist chooses to take the position that God is not limited to design in the same manner as humans, fine. But doing so forfeits the entire argument. If God has not designed the natural world in the same manner that humans design, then the analogy fails *even before* we get to the level of discussing the similarities between the universe and a watch found on a desert beach.

One arrives at this conclusion without even bothering to ask why the mammalian retina is inside-out or why I had to get those extra teeth extracted. At this point it may be interesting to discuss "good" versus "bad" design, but it is no longer necessary. Even if I were to grant (and I will not so grant) that all living designs are good, they still appear to be the best that nature could do with what it had on hand—not forward thinking, intelligent design.

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Postscript

Several of this nation's finest engineering schools have annual competitions for which students are given small packages of machine parts and construction materials. *Using only these parts* the students are to design, build, and demonstrate machines that can accomplish specific tasks, such as: traverse a three-foot table, capture a ping-pong ball, and return it to home base while simultaneously defending from someone else's machine trying to capture the same ping-pong ball from the other end of the table. Although these are talented young engineers, they are "historically constrained" in their design options by the parts with which they are provided. The results invariably are that almost all of the competitors come up with variations on a very few basic designs, none of them as effective as they could have been in an unconstrained design environment.

The competition is invariably won not by some novel, original design but by the best use of a basic design that simply did not work as well for several of the other participants. The competition and the results are an analog of Darwinian natural selection at its purest.

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The Origin of Species by Punctuated Equilibria

Frank J. Sonleitner

If you have been reading the recent creationist literature, you might come to the conclusion that the biologists have completely overturned Darwin. Thus, we have Duane Gish saying:

> Asimov seems unaware of the current uproar in evolutionary circles incited by those paleontologists who are suggesting radical new evolutionary mechanisms ("punctuated equilibria," Goldschmidt's "hopeful monster" mechanism). . . . [Gish, 1981:85]

Or this news item in the September 22, 1981, issue of *Awake!:*

> New Debate Among Evolutionists
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> For decades, evolutionists have been explaining their theory by the process of natural selection. Now a new breed of evolutionists says that this is all wrong. Natural selection can only account for changes within a single species, they concede, and to use this process to explain the formation of new species "is an imaginative leap that cannot be tested by experiment," reports the *Sunday Times* of London.
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> The new theorists favor evolutionary "jumps" as the explanation. However, they "have not explained how they [the jumps] occur—although there is no shortage of speculation," says the report. Regarding the debate, the report adds: "There is vast scope for argument and little hope of agreement in the foreseeable future." Sounds familiar, does it not?

Even science reporters seem to lend credence to these views. A November 1981 "Nova" television program, entitled "Did Darwin Get It Wrong?" concludes that,

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yes, Darwin was wrong and modern biologists and paleontologists believe that evolution occurs in *instantaneous* steps. Francis Hitching does the same thing at greater length in an article, "Was Darwin Wrong?" in the April 1982 issue of *Life* magazine and in a book, *The Neck of the Giraffe: Where Darwin Went Wrong.* The Eldredge and Gould (1977) hypothesis of punctuated equilibria figures prominently in such reports. The very name itself, an unfortunate choice of words, implies instant changes or jumps followed by constancy. Does punctuated equilibria deny Darwin?

First of all, what does the punctuated equilibria hypothesis really state? Certainly the account by Eldredge and Gould must be considered authoritative:

> The model . . . is based on the allopatric model of speciation. The essence of this model is simply that most morphological change is effected (*via* normal selection processes) through geographic variation within a species, and that most morphological differences between sister species arose either prior to, during, or right after (e.g., character displacement during initial sympatry) the onset of full genetic isolation. The model does not assert that "large" morphological changes occur in jumps—most morphological parameters are perceived as continuous variables and evolutionary modification of such variables will necessarily be gradual—but rather that evolutionary change takes place more rapidly at certain times during the history of a species than at others. [Eldredge, 1974]

The fossil record at the species level of detail in a local stratigraphic section will show a species in morphological stasis during most of its existence, perhaps showing minor directional changes, and perhaps followed by ". . . a break with essentially sudden replacement of ancestors with descendents; this break may record the extinction or emigration of a parental species and the immigration of a successful descendent rapidly evolved elsewhere in a small, peripherally isolated population (Gould and Eldredge, 1977). Gould essentially says the same in his article, "Evolution's Erratic Pace" (1977).

How long does speciation take? In other words, how "instantaneous" are the "punctuations"? Gould says hundreds, even thousands of years (1977; 1979). Lewin quotes Gould as saying, "I'd be happy to see speciation taking place over, say, 50,000 years . . ." (1980). Fifty thousand years may be an "instant" in the geological record, but in human terms it is a *very long* time. In creationist terms, it is *five times* the age of the universe!

What are the implications for macroevolution? According to Gould and Eldredge:

> The model of punctuated equilibria does not maintain that nothing

> occurs gradually at any level of evolution. It is a theory about speciation and its deployment in the fossil record. It claims that an important pattern, *continuous at higher levels*—the "classic" macroevolutionary trend—is a consequence of punctuation in the evolution of species. It does not deny that allopatric speciation *occurs gradually* in ecological time . . . but only asserts that this scale is a geological microsecond. [1977; emphasis added]

Thus, for example, mammals evolved gradually from reptiles during the length of the Permian and Triassic periods as the small morphological changes from hundreds of successive speciations accumulated. There is abundant fossil evidence for this kind of slow, gradual change. It is a far cry from the reptile-egg-hatching-a-bird idea of Schindewolf (*not* Goldschmidt) that the creationists use to describe the punctuated equilibria hypothesis.

This doesn't sound like a radical revision of evolutionary theory. As Gould and Eldredge [1977] further state:

> For all the hubbub it engendered, the model of punctuated equilibria is scarcely a revolutionary proposal. As Simpson (1976, p. 5), with his unfailing insight, recognized in three lines (where others have misunderstood in entire papers), our model tries to "clarify and emphasize ideas nascent in previous studies of the synthetic theory."

And it certainly does not discard or contradict Darwinism! Gould also says:

> The modern theory of evolution—little more than a contemporary restatement of basic Darwinism—does not require gradual change. In fact, the operation of Darwinian processes should yield exactly what we see in the fossil record. . . . Our model is fully consistent with Darwin's central postulate that natural selection controls evolutionary change. Natural selection requires continuity and intermediacy, for selection must create the fit by steadily increasing the frequency of favorable variants. It does not require exceedingly slow and gradual transformation of entire populations. [1977]

The above considerations show that the creationists' depiction of punctuated equilibria is *totally inaccurate*. Gould complains, "It's so utterly infuriating to find oneself quoted, consciously incorrectly, by creationists. . . . None of this controversy within evolutionary theory should give any comfort, not the slightest iota, to any creationist" (Godfrey, 1981). But perhaps he and Eldredge are partly responsible for these misunderstandings because of the way in which they presented their hypothesis. They contrasted it with *phyletic gradualism*—a model of "a slow steady

shift in the mean phenotypic expression'' of entire populations over millions of years'' (Eldredge, 1974). They assert that this model was the accepted view among most paleontologists and proponents of the modern synthetic theory of evolution. They also claim that this view is implied in Darwin's writings, although they quickly point out that it is not a necessary consequence of Darwinian theory.

Perhaps many of their paleontological predecessors and colleagues did subscribe to that model, but I don't think it would be correct to say it characterized the views of the leading proponents of the synthetic theory. Templeton and Giddings, in a letter to *Science* (February 20, 1981, p. 770), assembled the following three exerpts:

> . . . and we should expect that the more extraordinary developments of sexual plumage were not due like most characters to a long and even course of evolutionary progress, but to sudden spurts of change. (Fisher, 1958).
>
> Now Haldane (1924) showed that a dominant character causing an increase of 0.1 per cent. in the fitness of its carriers would increase from a frequency of .001 per cent. to one of 99 per cent. in a random mating population in 23,490 generations, and somewhat more rapidly in an inbred population; in fact on a geological time scale, almost explosively. (Haldane, 1937).
>
> A species ordinarily tends to persist for very long periods in a state of equilibrium or at best, very gradual advance under ecological pressures that leave only one restriced niche in which there can be successful competition with other species. Yet such species may all the time, especially if population structure is favorable, carry a head of steam in the form of a store of potential variability that permits very rapid change (the tachytely of Simpson (1944) whenever any major ecologic opportunity offers. . . . (Wright, 1949).

In addition, Simpson wrote: ''Some groups have been changed rapidly while others were remaining practically unchanged. The same group is commonly seen to have changed rapidly at some time in its history and slowly or not at all in others'' (1950).

In another work, Simpson presents the terms *horotely, bradytely, tachytely,* and *quantum evolution* to describe and categorize the wide variation in evolutionary rates (1953). In this same work, he presents a diagram illustrating the patterns of evolutionary change of some characters of the horse lineage (p. 265). Some of the cheek tooth characters show a ''phyletic gradualism'' pattern, but the foot mechanism shows a decidely ''punctuated equilibria'' pattern, while size shows a mixture of the two types. Finally, the punctuated equilibria hypothesis itself was first proposed (*sans* name) by Ernst Mayr (1954; 1963; 1970). Mayr considered it a part of modern neo-Darwinism (Mayr, 1967). Eldredge and Gould contributed

the provocative name and thrust it upon the paleontological world. (For Mayr's comments on this, *see* Goldberg, 1985).

All the scientists cited above are considered strong proponents of the "classic" synthetic theory of evolution, yet none of them was "hung up" on "phyletic gradualism." But what about the author of the following?

> But I must here remark that I do not suppose that the process ever goes on so regularly as is represented in the diagram, though in itself made somewhat irregular, nor that it goes on continuously; it is far more probable that each form remains for long periods unaltered, and then again undergoes modification.
>
> Many species when once formed never undergo any further change but become extinct without leaving modified descendents and the periods, during which species have undergone modification, though long as measured by years, have probably been short in comparison with the periods during which they retain the same form. It is the dominant and widely ranging species which vary most frequently and vary most, and varieties are often at first local—both causes rendering the discovery of intermediate links in any one formation less likely. Local varieties will not spread into other and distant regions until they are considerably modified and improved; and when they have spread, and are discovered in a geological formation, they appear as if suddenly created there, and will be simply classed as new species.

The above excerpts describe almost all the elements of the punctuated equilibria hypothesis and even speculate about species selection, a related hypothesis. The only element missing is the explicit identification of the short periods of modification with the periods of speciation or phyletic branching! These excerpts, taken from Charles Darwin's *Origin of Species* (Modern Library Edition, pp. 89 and 357, respectively), are amazingly parallel to the passages from Gould and Eldredge quoted previously.

Punctuated equilibria is not new or revolutionary; it simply shifts the emphasis among a number of classic evolutionary mechanisms. And it strengthens Darwinism insofar as it better reconciles the synthetic theory with the fossil record. Because variation within species is geographically rather than temporally distributed, one will not be likely to see it in stratigraphic sections which represent only one or a few points in the spatial range of a species (Gould and Eldredge, 1977). The work of Williamson (1981; and summarized in *Science*, November 6, 1981, p. 645, and *Newsweek*, December 7, 1981, p. 114), who studied an instance of a fossil record continuous over several million years, appears to be a case of punctuated equilibria in which the short-lived transition forms in the speciation process *have* been preserved as fossils.

Afterword

Since this article was written, Eldredge has published a book-length account of the theory of punctuated equilibria entitled *Time Frames* (Simon and Schuster, 1985).

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Reviews

The Problems of Evolution by Mark Ridley (Oxford University Press, 1985), pp. 159.

reviewed by Niles Eldredge

Problems in biology, in sharp distinction to those of philosophy, are solvable—or so writes Mark Ridley in the preface of *The Problems of Evolution*. Ridley has organized his book around a series of ten great problems currently (albeit, he says, timelessly) besetting evolutionary biology—problems which curiously decrease in their apparent solvability quotient as one ascends the scale of biological organizational complexity and, at the same time, approaches the end of the book. Ridley's preoccupation with the answers to questions imparts an eerie quality to his narrative. On the one hand, he is often quite sure of having *the* answer to a particular problem (namely, the gene is the unit of selection)—a sort of certainty that I had thought was no longer fashionable in science in general (and particularly in the domain of evolutionary studies, justly known for its authoritative imaginary tales). Yet, I must admit to some frustration when Ridley throws up his hands and announces that a problem still defies solution and that, in fact, our understanding remains at the same low level attained in earlier days. It seems to me that rather more progress has been made toward resolving some of the confusion in evolutionary biology than Ridley seems willing to concede.

Whence this collision between certitude and confusion? Ridley's book accurately reflects the generally unsettled state of evolutionary biology—and I think David Hull is right in laying the blame on a pervasive "common sense" ontology that lies at the very core of evolutionary biology. Thus, certitude stems from unexamined convictions on the very nature of such entities as genes, organisms, demes, species, and taxa of higher categorical rank. And confusion ensues if we have our ontology wrong. Ridley's discussion of what species are—a stunning rerun of the Dobzhansky-Mayr position enunciated nearly fifty years ago—forms the crucial case in point. In this view, species are seen to be simultaneously reproductive communities and at least fairly coherent groupings of similar organisms, recognizably distinct from other such groups. Ridley thus is forced to repeat the standard claim that species are "real" at any one time (especially well demarcated in sympatry with close relatives) but, through time, of necessity will disappear, evolving themselves out of existence as they transform into descendants. Species exist only in a single time plane—a conceptualization that understandably

outraged George Gaylord Simpson.

Thus, in our received ontology, species are real, individualized entitites when construed as reproductive communities at any one time; they are also classes of similar organisms. Moreover, the economic adaptations of organisms (the main source of that similarity) are imagined to be in a constant state of overhaul, and so the properties of the members of the class change, and a species evolves itself out of existence. Ridley simply does not report that Ghiselin and Hull over a decade ago pointed out that entities are either classes or individuals and that there is no real trick to seeing species, if construed as reproductive communities, as individuals in time as well as in space. Species emerge as spatiotemporally bounded historical entities, regardless of how much or little adaptive modification may accrue in the phenotypes of their component organisms. Much of the doubt and confusion permeating the second half of Ridley's book stems directly from his certitude over the basic nature of species, based, as it is, on a rather garbled ontology.

Indeed, Ridley's book is an excellent statement of mainstream evolutionary biology today. If it does not expose the *real* problem in evolutionary theory—the ontological issues—it does paint an accurate picture of the teleological-ridden "who or what benefits" approach that selectionists seem ever more locked into as a source of explanation for all manner of biological phenomena. Nor is Ridley utterly conventional: indeed, within the overall matrix of neo-Darwinian theory, he follows the Williams-Dawkins reductionism that sees the gene as the locus of evolutionary action. And, in an amusing and effective gambit that coincides well with my own prejudices, Ridley discusses systematics by contrasting phenetics and cladistics, claiming that the latter is evolutionary and the former not—and allowing him to brush aside the vast middle ground of "evolutionary systematics" as an uninteresting muddle of the two extremes. Moreover, while Ridley is clear that cladistics does not depend upon any prior theory of how evolution actually works, in several places he makes a link between nested patterns of resemblance linking up all elements of the biota and the simple notion of descent with modification. Those nested patterns of similarity have always been the strongest evidence that life must have had an evolutionary history, and it is refreshing to see it acknowledged once again, just as a creation-minded journalist in the United States, in a feat of literary legerdemain, has recently tried to show how cladistics somehow throws doubt on the very idea of evolution.

Ridley's book is not a "fun" read. Indeed, it is difficult to determine to whom this book is addressed. The style, superficially zesty ("And the prediction is this. . . . Here is the final result"), is actually rather flat and utterly matter-of-fact. There seems, for Ridley, to be no *joy* in these rather marvelous mysteries. The level is decidely elementary—as if the intended audience were beginning students or the ever-elusive "intelligent layman." Yet, the tone is so unrelentingly serious and the pace so brisk that all but the most dedicated will surely flag.

Nor does the book get at what I think is *really* the matter with evolutionary theory. But as a quick yet pretty accurate summary of most of the current topics under debate, and as a source of insight into how the majority of evolutionists still approach their topic, the book should prove useful indeed.

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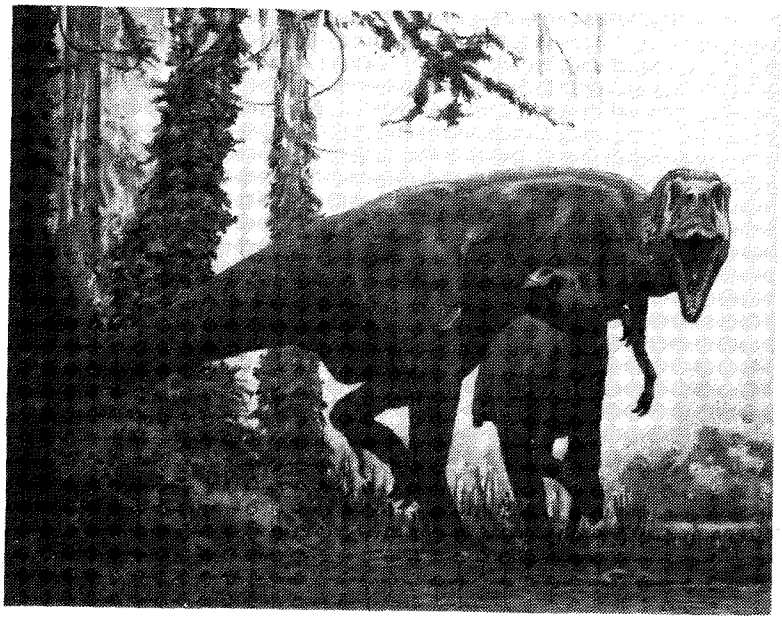
The Riddle of the Dinosaur by John Noble Wilford (New York: Alfred A. Knopf, 1986), 304 pp. (includes: index, bibliography, 7 color plates), $22.95.

The New Dinosaur Dictionary by Donald F. Glut (Secaucus, NJ: Citadel Press, 1984), 288 pp. (includes: index, brief bibliography, over 600 illustrations), $12.95 paperback.

Dinosaurs of North America by Helen Roney Sattler (New York: Lothrop, Lee, and Shepard Books, 1981), 157 pp. (includes: index, site location index, brief bibliography, ca. 100 figures).

reviewed by John R. Cole

These may be the best three recent books about dinosaurs written for the general reader. Sattler's *Dinosaurs of North America* won the Golden Kite Award from the Society of Children's Book Writers and is the least technical, designed for younger readers and school libraries. It consists of an alphabetical listing of known dinosaurs from the Triassic, Jurassic, and Cretaceous plus a chapter on extinction theories. Glut's work, *The New Dinosaur Dictionary*, is worldwide in scope and thus includes vastly more genus names and illustrations. There is also an introductory explanation or definition of dinosaurian orders, families, and subfamilies. It is invaluable as a reference to dinosaur nomenclature, alternative names, discoverer, date of discovery or naming, and morphology. Drawings and photographs illustrate specific animal reconstructions, bones, teeth, and footprints. There is even an appendix listing now-discarded names. As a taxonomic guide, the book is unequaled. No library or dinosaur fanatic should be without it, but it is strictly a reference book on names—not theory or interpretation. It does not dwell on phyletic relationships except in a Linnaean taxonomic sense, let alone upon evolu-



Maiasaura peeblesorum, a species of dinosaur that roamed the earth until 65 million years ago. One of the seven full-color lithographs and thirty-four black-and-white illustrations from *The Riddle of the Dinosaur* by John Noble Wilford, published by A. A. Knopf. ARTWORK by Douglas Henderson.

tionary theory.

Wilford's *The Riddle of the Dinosaur* is entirely different. Its very readable, narrative style brings together virtually everything the nonspecialist wants to know about dinosaurs—including the surprising fact that there are rather few dinosaur specialists. The fossils which probably inspired every child who later became a paleontologist to choose that career were, for a long time, the preserve of explorers and collectors rather than evolutionary biologists or anatomists. Wilford traces the early days of dinosaur-hunting, especially the fierce, nearly murderous nineteenth-century competition between Othniel Charles Marsh of Yale and Edward Drinker Cope, a wealthy Philadelphia amateur scientist. Wilford records both earlier and later quests and discoveries, culminating in Roy Chapman Andrews' 1922 Central Asiatic expedition which led forty scientists and explorers to the Gobi Desert at the apogee of romantic, pith-helmeted Western explorations of remote Eastern and African lands. Movie archaeologists and paleontologists even today follow the stereotype; Andrews would have approved of Indiana Jones. Andrews was searching for the origins of humans, hoping to show that Darwin was wrong about Africa being the likely human hearth, but he had to settle for some of the most

extensive fossil nonhumans ever found.

Wilford notes the beginnings of more modern interests by other explorers, such as Barnum Brown of the American Museum of Natural History and Brown's assistant, Roland T. Bird, who discovered the Glen Rose, Texas, trackways in the late 1930s (not the 1940s, as the author writes). These tracks became creationists' happy human footprint hunting ground in later years. (Wilford notes this, and its baselessness, in a footnote about the "Palaxy" [*sic*] tracks, quoting Steven Schafersman's 1983 letter to *Geotimes*. Such footnotes appear repeatedly, apparently last-minute additions to a manuscript largely finished between 1983 and 1984, despite the 1986 copyright.) By World War II, dinosaur behavior, not just bones, was being seriously studied. Bird showed that *Brontosaurus* (now called *Apatosaurus*) walked on land rather than floated in shallow water and that adults left tracks on either side of an infant, seemingly to protect it from the approach of a carnivore whose tracks run into the quadrupeds' trail. (Actually, Bird was dealing with a much more recent creature, probably *Pleuroceolus*, not *Apatosaurus*; this series of minor errors within a few pages on a topic I know well is disturbing, but the general discussion of issues is not affected.)

The balance of the book discusses the controversies and theories generated in recent years as dinosaur-collecting has yielded to studies of locomotion, anatomy, social life, diet, adaptation, evolution, and extinction. Bakker's warm-blooded dinosaur hypothesis and its critics, the relationship between birds and dinosaurs, and "the great dying" are among the topics. Gradual extinction theories, the Alvarezes' asteroid impact theory, Sepkoski and Raup's alleged 26-million-year cycle of such impacts blamed by R. Muller, Hut, and others upon a postulated "death star" solar companion are discussed in detail, although recent challenges to Raup's calculations did not meet the book's deadline. Also discussed are the implications for mammal and human evolution and the potentials for extinction via global "winter" caused by nuclear war or asteroid.

Wilford, a Pulizter Prize-winning science writer for the *New York Times*, has produced an outstanding survey of what we do and do not know about dinosaurs—and how we are learning more. Some petty errors bother me, but the author succeeds very well in relaying the issues and information across the invisible boundary usually separating scientists and their public constituents. He shows the drama and humanness of science, from the excitement of discovery and ideas to the pettiness and errors and arguments and personal accomplishments.

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Evolution (from the series *Time, Space, and Spirit—Twelve Keys to Scientific Literacy*). Bill Stonebarger, writer/photographer. Hawkhill Associates, Inc., 1984. (38½-minute film, available on two filmstrips with two audio cassettes or on one video cassette.)

reviewed by Frederick Edwords

The catalog description of this audio-visual program states that it "teaches the basic science of modern evolution theory, while at the same time fostering respect for the religious search for ultimate meaning in life and the universe." It is intended for use in biology, humanities, and history courses.

All items in the *Time, Space, and Spirit* series, of which this is a part, are designed to begin "where your textbook leaves off." That is, while the textbook deals with the "what" and "how" of science, items in this series concentrate on the "when," "where," and "why." Each program is divided into two parts: the first tracing the history, "the fascinating human story," behind the discoveries covered; the second presenting "the clear cut outlines of present day state-of-the-science knowledge of the concept in question." This series was developed in consultation with the History of Science Department at the University of Wisconsin-Madison.

The two parts of the program *Evolution* are called "Anaximander to Darwin and Beyond" and "Evolution by Natural Selection Today." Let's begin with part one. The program opens with some nostalgic old photographs of the Scopes Trial and recent shots of the famous Rhea County Court House where the trial was held. The narrator gives the outcome of the trial in broad outline and then jumps to ancient history and the evolutionary ideas of Anaximander. From Anaximander, the history of science in general is briefly traced up to the eighteenth century. Then material is provided on Carolus Linnaeas, Georges Buffon, Jean Baptiste Lamarck, Georges Cuvier, James Hutton, and Charles Lyell. Finally, Charles Darwin, Alfred Russell Wallace, and T. H. Huxley are covered in some detail.

This serves as a nice beginner's history of the leading characters in the development of evolutionary science, but it misses its opportunity to demonstrate *why* these different thinkers came to the conclusions they did. The student gets hardly a taste of the evidence and discoveries that made the contributions of these men so important. Instead, trivia on the personal lives of each are provided (for example: Buffon started work at six o'clock every morning and took only two breaks each day to have his hair dressed and powdered; while Linnaeas started out as a poor boy "plagued with gout, headache, scurvy, and toothache"). And when information on the discoveries and theories *are* provided, it is oversimplified and somewhat misleading. For example, we learn that Cuvier concluded that fossils had been formed in "great catastrophes of the past. Catastrophes like the Biblical flood," when Cuvier actually rejected the worldwide flood idea and argued

instead for numerous regional floods.

But the worst mistakes the program makes come at the end. The recent court suits of fundamentalist Christians are mentioned, along with the creationist belief in a worldwide flood. The narrator then says, "Who is right? Who is wrong? Some say it is hopeless, we will never know these things. Some say we already do know, and it is this way." Fortunately, a good quote from Darwin against dogmatic hostility to science closes the presentation. Yet, this bit of confusion is minor compared to the seeming attack on evolution that appears with frame seventy-seven. The viewer is here told that evolution has

> spawned the most varied social and political spin-offs. Dog-eat-dog capitalism, socialism, communism, fascism, racism, manifest destiny, progressive education,—one and all claim descent from, and support from the evolution by natural selection theory of Charles Darwin.

With nothing more said on this subject, the student could easily conclude that evolution is a socially dangerous idea or that all the ideas in the list are equally distasteful.

The photography in the program is excellent and of high quality, but often the images are there just to provide something pretty to look at rather than to instruct. And, in one case, an improper picture is used. When talking about Cuvier, a fossil of *Archaeopteryx* is shown. *Archaeopteryx* wasn't discovered until a half century after Cuvier's death!

If one is not supposed to be too critical of the lack of scientific content in part one, given that its purpose is historical, that caution does not apply to part two. The intent there is to explain evolution in an up-to-date way.

A Jesuit priest's poem about the glories of God's creation opens this part. This is compared to Darwin's five basic principles of evolution by natural selection. These principles are well explained, along with an important remark that science looks for explanations that use "a bare minimum of general principles." The history of life on the planet is then covered, and the student is given a clear idea of how old Earth is and how small a part of Earth history human civilization represents. This is all good material. But, in the choice of photographs used, great opportunities are lost for graphically demonstrating the evidence for evolution. Most of the photography is excellent but often consists simply of nice pictures of interesting fossils which seem to have no obvious relationship to one another. There are no tree-of-life diagrams, no cladograms, no comparisons of fossil forms, few transitional fossils, and no graphic illustrations of the mechanisms of evolution. Such tools would have been very useful in supporting statements made in the narration, but it seems the images used were selected for their photographic artistry rather than for their value as illustrations of scientific concepts.

There is also an air of "corniness" created by the use of an obvious model of *Icthyostega* walking up a modern beach and another model of a flying reptile

in the air with some modern hillside in the background. The real plants in the pictures don't match the reconstructed animals—either in size or nature.

Very little is said about human evolution, and what is said is disjointed. Human ancestors are simply listed. *Homo erectus* is mentioned under the name *Pithecanthropus*, and its importance or connection to modern humans is not detailed.

The present controversies over evolutionary mechanisms are only briefly dealt with, and only Stephen Jay Gould—not Eldredge or any others—is mentioned. And no case is made for how microevolutionary changes make macroevolution inevitable. Fortunately, the narrator calls the occurrence of evolution a fact and the mechanism of evolution a theory and then adds that the consensus of scientists today is against creationism. But in the absence of a convincing case, these statements acquire a hollow ring.

The program concludes with a discussion of possible "deeper spiritual meaning expressing itself through the evolutionary process." The last seven frames accompany stanzas of a poem by Kathleen Raine. This inspirational close will probably be lost on most students, though they will enjoy the photographs of sunsets, redwood trees, and reeds swaying in the breeze.

Overall, high school students will prefer viewing this audio-visual presentation to taking a test or hearing a lecture, but they will learn little and remember less. Some of the message they won't hear at all, since the narrator is unskilled and key words are lost as his voice trails off now and again. So, if a little educational entertainment is needed in the science, history, or humanities classroom, this program is suitable. But if solid learning is desired in order to promote a clear understanding of science and the case for evolution, one is advised to look elsewhere.

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SELF-CORRECTION CORNER

Contrary to a report in issue XVIII, Galileo has not been "pardoned" by the pope; rather, his views have been more or less pardoned or condoned a bit apologetically without opening the case to full legalistic and awkward review. Among other details, his "conviction" was a muddy affair which did not challenge heliocentrism, as such, although that was the ostensible issue. It has been suggested that his conviction was in fact a plea bargain which got a modernizing pope off the hook along with Galileo who spent the rest of his life under house arrest rather than executed for heresy.

Letters to the Editor

I have often insisted that there is no one argument that by itself makes the case for evolution. Rather, it is the consilience of many diverse arguments all leading to the same conclusion that makes the case.

But the article by E. E. Max, "Plagiarized Errors and Molecular Genetics" in *Creation/Evolution* XIX, comes closer than any to making the case all by itself. It is especially nifty for two reasons: (1) the evidence establishes the common ancestry of humans and apes, which is the anti-evolutionists' biggest stumbling block, and (2) the article establishes parallels with legal cases in which plagiarizers were convicted. This is nice because lawyer Norman Macbeth, in "Darwin Retried," suggests that the case for evolution would not stand up in court.

The article did have a few loose ends which I wonder if Dr. Max would tie up: (1) For the reason indicated, it would be nice to have citations to the two legal cases he describes. (2) It would be nice to have a *quantitative* comparison of nitrogen base pairs shared by the epsilon gene and its classical pseudogene, which establishes their common origin, and the same for various other appropriate comparisons. Calculations of the probability of such similarity arising by chance would be useful and could be compared with typewriting monkeys and hurricanes going through junkyards. (3) The test proposed by Frank Awbrey (?) should be performed: if pseudogenes are functionless, and if they've existed long enough, the rate of occurrence of substitution mutations should be as great for the first two nitrogen bases of each codon as for the "wobbling" third one. (4) Finally, several other kinds of evidence, all of which point to humans and chimps having shared a common ancestor more recently than either shared one with gorillas, lead me to conclude that there must be some other explanation for chimps not having the epsilon classical pseudogene. Is loss of it through a deletion mutation a plausible explanation?

Karl D. Fezer

While reading Dr. Max's article, "Plagiarized Errors and Molecular Genetics," I found myself thinking, "Of course! Why didn't I realize that?" It seemed to me to be of that kind of information that lies around under your nose for long periods of time and seems retrospectively obvious once someone points it out.

I want to share with you the pathway of my thoughts concerning a creationist response.

For decades, young-earth cre-

ationists have rejected all the evidences of an ancient Earth yet have retained (contradictorily enough) the apparent age argument: "None of the so-called evidences of an ancient Earth really prove that the Earth is more than several thousands of years old; but even if they did, the only reason for this would be that when God created the world several thousand years ago he created it with the *appearance* of having been around much longer." So, if the evidences of an ancient Earth are mistakes, the Earth is young. If the evidences of an ancient Earth are real, the Earth is young. You just cannot beat the simple (il)logic of creationists.

I believe that this is probably the form of argumentation that will be used against the evidence for evolution that is implied by genetic errors. In fact, ancient-Earth creationists have already argued in such a manner concerning evidences of organic evolution. "As God created each new animal kind over the ages, he could have created each one in such a way that it possessed the appearance of having evolved from some previous kind." And in this specific case, genetic errors are one of those "created appearances" and thus do not constitute a real evidence of evolution.

I will now (sigh) leave this realm of theological fantasy and enter reasonable discussion.

Dr. Max states very briefly (and shows in FIGURE 3 of the article) an observation that I found intriguing. He says that the processed pseudogene is found in humans, gorillas, and chimpanzees (and also several monkey species). Then he states, "[The classical] pseudogene is . . . shared by man and gorilla but is not found in other apes or monkeys." I see two possible indications from this: (1) humans and gorillas are more closely related than humans and chimpanzees or (2) humans and chimpanzees are the more closely related species, but the classical pseudogene under scrutiny has suffered deletion in chimpanzees' genetic material. I have two related questions: is the second situation that I have just stated really a possibility, and, if it is, how is it possible to determine that such is the case?

Finally, since anthropological thinking has for a long time considered chimpanzees to be, of all the apes, the most closely related to humans, would Dr. Max please elaborate on this point?

I want to thank Dr. Max and you for this article. I enjoyed it much.

Todd Greene

Martin Nickels' article "Creationists and the Australopithecines" (*Creation/Evolution* XIX) very astutely points out the dishonesty of creationists such as Gish, Kofahl, and Morris. Nickels did an excellent job showing how these individuals distorted Oxnard's work on the locomotor functions and evolution of the australopithecines. It should be reiterated that, in Nickels' article, Oxnard's position on the evolutionary lineage of the australopithecines applied only to the forms *Australopithecus africanus* and *Australopithecus*

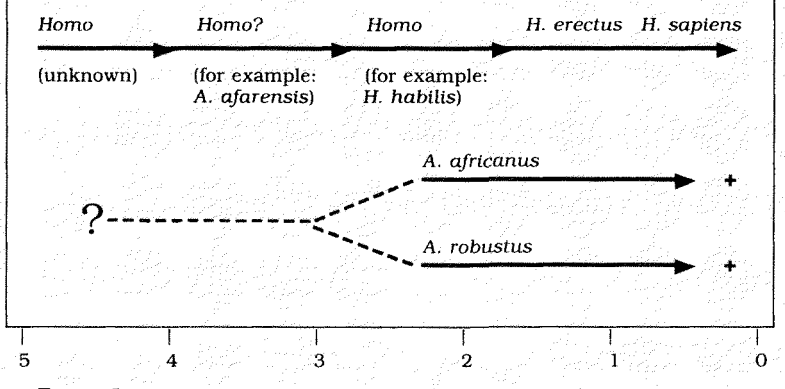

Figure 1. From C. E. Oxnard, "Human Fossils: New Views of Old Bones," *American Biology Teacher* (1979), 41:264–276

robustus and not to *Australopithecus afarensis*. In his 1979 paper, however, Oxnard explicitly refers to the "new fossil finds" (*A. afarensis*) of Johanson and others. He identified this material as humanlike and placed it on the ancestral line of humans, assuming an intermediate status. While he classified *afarensis* as *Homo*, he stated that it will probably remain classified among the australopithecines (*see* Figure 1). So, while Oxnard still maintains a separate line of hominid evolution for *A. africanus* and *A. robustus*, he quite clearly places *A. afarensis* ancestral to *Homo sapiens*.

Despite it all, however, I'm sure the next time I read or hear a creationist talk about human evolution, Dr. Charles Oxnard will have established that the australopithecines did not walk upright and were not intermediate between ape and man.

Michael L. Bagby

My understanding of professor Geisler's design argument (*Creation/Evolution* XVIII) is as follows:

1. Certain objects (the faces on Mount Rushmore, books, watches) possess a complex structure which is obviously the product of intelligent manufacture. Intelligent action is necessary for their existence but needs not be a direct cause (consider an automated assembly line). Call these artifacts class "A" objects.

2. The structure of DNA is mathematically similar to class "A" objects. The two have the same type of complexity.

3. Therefore, it is reasonable to believe that the information content of DNA originated by intelligent action (by God, gods, genetic engineers from planet X, superrobot from a deceased civilization, and so forth). As DNA is identical to an "A" class object (with the exception that it lacks the signs of

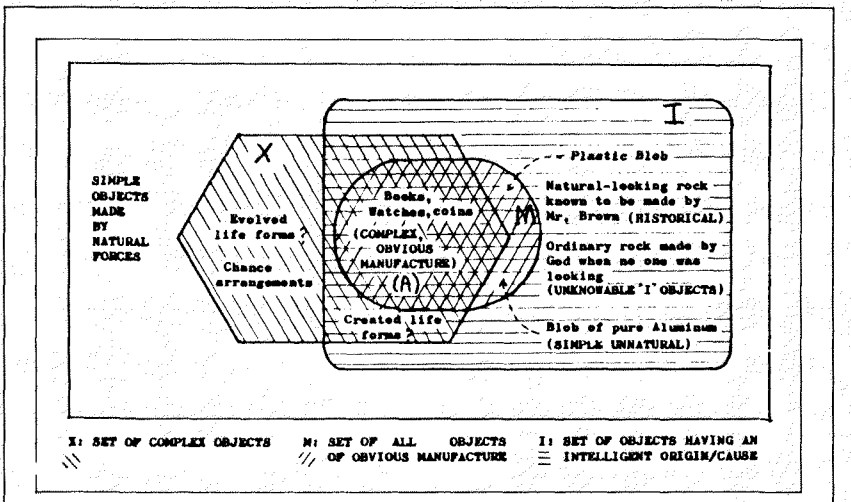

Figure 2. The "Design Argument" asserts that set "X" is a subject of "I." But, the fact that all "A" objects are complex does not imply that all "X" objects are in "I."

manufacture as we understand it), it should be included in the class of objects which have an intelligent origin, class "I" objects.

I trust I have not unduly oversimplified the argument, but the above does seem to capture the crux of it. I am skeptical for several reasons:

(*a*) It is not clear that class "I" objects (of which "A" objects are a subset) include DNA. A distinction is to be made between the capabilities of primitive natural forces and the effects of what we call "intelligent cause." This distinction cannot be made without fully understanding the limits of nature. (Wind, ice, and rain may carve many patterns on a mountain, but it is unlikely that the faces of Mount Rushmore would be so produced. Therefore, those faces must have an intelligent origin. On the other hand, if watches were produced within the sands of certain beaches, then we would be hard pressed to say whether or not an unknown watch had an intelligent origin.) Without knowing its history, we cannot place an object in class "I" without first showing that its structure is beyond the range of natural forces. (There is some uncertainty, for example, in assigning an intelligent origin to some of the most primitive "stone tools.") Class "A" objects have all passed the test, but DNA is not a member of that class. The fact that the information content of DNA may be mathematically similar to class "A" objects is irrelevant. We may, however, discuss a class of objects which are defined by complex information content—say class "X." But it does not follow that class "X" is a subset of class "I." (Class "X"

is clearly not a subset of class "A," though the reverse is true.) Can nature produce DNA? The only hope of settling such arguments is to dig into the scientific details. I see no easy philosophical shortcut.

(*b*) Objects with similar structure do not necessarily have similar origins. A nugget of gold may well be natural, whereas an exact duplicate of pure aluminum clearly indicates an intelligent origin. We are dealing with more than abstract information content.

(*c*) It is not altogether clear to me that the information content of DNA is comparable to a book. I'm under the impression that DNA contains a lot of "junk" or "clutter" which suggests that evolution has played a role. The design hypothesis does not fit well with such evidence.

(*d*) The term *intelligent origin* (intelligent cause, nonnatural origin) is not well defined. Are we implying that nature could not create an "intelligent" object in a few million years, or are we saying that a natural creation is flatly impossible? The evolutionist might well claim that even intelligent design (the faces on Mount Rushmore, the works of Shakespeare) is ultimately the product of natural forces—humans being an evolutionary tool of nature. It is not clear to me that "intelligent cause" is exclusive of natural forces. Even if we found a group of stars out in the middle of nowhere spelling "Guess who?" there is no guarantee that its creator or creators must be the first link in the chain of cause and effect.

Dave E. Matson

I feel I have to make one last effort regarding the Geisler articles. Hopefully the following will be of some use to you.

I think all of us who have followed the scientific-theological-philosophical interchanges between Professor Geisler and his antagonists in the past few issues of *Creation/Evolution* are indebted to him for his efforts and especially for his last letter (*Creation/Evolution* XVIII) in which he clearly summarizes his position. It is sometimes difficult, however, to understand how people of roughly equal good intentions and intelligence can come to such different conclusions regarding the origin of life on this planet.

After reading and rereading the relevant discussions of those who participated in this important interchange of ideas, I have tried to isolate the fundamental argument Geisler uses to show there was a supernatural, intelligent cause of the origin of life. The argument (briefly summarized) seems to be as follows. Only an intelligence of divine proportions could be the cause of the first DNA since DNA (or similarly complex information systems) are like the intelligence displayed by humans in such things as language, computer design, and so forth. More precisely, since DNA and human information systems are similar in important ways (which we learn from observation), and since language (and computer systems) came about from intelligent design, so the first DNA must also have come about from intelligent design. It seems clear to me, though, that the weight of this conclu-

sion simply cannot be borne by the premises and for several reasons. First, we have nothing to compare human, complex information systems with *other* than DNA (or RNA, and so forth). One comparison is simply *not* adequate for such a weighty conclusion. Such analogical arguments require much more data within the premises to be at all convincing. If we could contact beings on another planet who knew how to make complex replicating systems similar to those life forms here on Earth, Geisler's argument would be much stronger. Unfortunately, we know of no such creatures or their works; we only know what humans have done.

Second, Geisler avoids a key point made by Edwords in one of his rejoinders (*Creation/Evolution* XVII, p. 41), viz., DNA was not always so complex; there were simpler life forms that used a simpler DNA structure such as in one-celled organisms and viruses. There also exists some rather complex molecular structures that involve complex information systems but are inorganic, such as certain crystals. Where do Geisler and other creationists draw the line between necessary intelligent design of such complex molecules and their information systems and other less sophisticated systems, such as crystals? It seems to me Geisler must argue either that *all* information systems (complex or simple, living or nonliving) have an intelligent design or that even the most complex of systems have a naturalistic origin. I do not see how he, or anyone else, can convincingly argue that only the most complex, living, replicating systems have an intelligent design but no others. This is not only arbitrary but begs the question of why one must draw the line at *A* rather than *B*. (This reminds me of the same kind of question begging point at which many religionists draw the line between humans and nonhumans—that is, at the moment of fertilization of the human ova.)

To claim, as Geisler does, that there is no similar scientific plausibility between information systems of lesser complexity and DNA or Mount Rushmore is to ignore the enormous amount of work done by scientists in the past fifty years or so in uncovering such plausible similarities. As pointed out earlier, there are not a few information systems quite similar to human DNA though not quite as complex as found in lesser creatures or even in the DNA of viruses and one-celled organisms. To complain that this is still DNA is not legitimate criticism, since the DNA structure found in humans is about as different from the DNA in a virus as is the DNA in a virus from the complexity of a snowflake (although, at present, little is known about the information system of a snowflake). That the former are living things and the latter nonliving makes no difference to the argument either, since degrees of complexity (and inherent information systems) are all that is needed to indicate the required similarities. Thus, we have indirect inductive evidence (the term *constant conjunction* is pretty well outmoded now, despite Hume's reputa-

tion in philosophy) of lesser complex systems leading to more complexity through time. We have no such similar evidence of complex systems somewhat like DNA having been created *ex nihilo* by intelligent design.

A last criticism—and perhaps the strongest—of Geisler's argument is that the conclusion can state no more than what is already in the premise. That is, one cannot have any characteristics in the conclusion of an analogy which are not already found in the premises of the argument. Logic isn't magic. Geisler wants to conclude that the designer of "first life" is infinite in intelligence and supernatural. But neither of these characteristics can be found in human information systems no matter how complex. As a matter of fact, in one of Geisler's quotes from Yockey (*Creation/Evolution* XVII, p. 39), it is claimed that the information conveyed in human language is "mathematically identical" to that of DNA. If this were so, this would make human mathematical powers identical to the divine intelligence (perhaps this makes humans divine?)—a conclusion which, I think, would be unwelcome by Geisler and other creationists. By the same token, it would follow that this intelligent cause of life had a material body just as humans do (though, of course, not necessarily *like* our bodies)—a point Geisler seemed to have ignored in my letter in *Creation/Evolution* XVI (p. 47).

Now, if Geisler would grant me these last two points as concessions, perhaps we would not really be so far apart after all. If he would want to maintain that this intelligent cause of life was some very clever material being with only a bit more intelligence that we humans (after all, DNA is a bit more complex than anything *we* have created, though not infinitely so) and who *probably* created life on this planet, then the only difference between our beliefs is that I would claim we do not yet have enough inductive evidence to conclude any such probability. Since we have seen some of the things nature can and has done on its own, I would say the probability is that nature itself "caused" DNA over countless millions of years; it needed no help from divinity. I would, though, allow the *possibility* of intelligent design somewhere near the beginning of the development of life.

The other claims made by Geisler in his letter are much less plausible than his claim for an intelligent design of life, so only a few relevant comments will be made here.

Geisler claims that we have a clue for the existence of a supernatural originator of life from the results of science itself. He claims that science has shown that the universe "came into existence" some (fifteen) billions of years ago. He quotes Jastrow's claim that the univese "began abruptly in an act of creation" and that "supernatural forces at work . . . [is] a scientifically proven fact." Science, of course, has proved no such thing, not even that the universe was created. That science could ever prove the existence of supernatural forces is as absurd a statement as I have ever read from a supposedly reputable scientist. The phrase

supernatural forces in itself is self-contradictory (if something is supernatural, it is not a force in the scientific sense of "force," and, if it's a force, it can't be supernatural since all known forces are natural) and certainly could never be verified scientifically.

Scientists do not yet know what happened in the fraction of time after the presumed "big bang," so how could they know the universe was created or even that it "came into existence"? This last phrase implies that there was *no* existence prior to the "big bang." No one yet knows what the situation was at time T_0 (or before), so how can it be said that the world "came into existence"?

Furthermore, the fact that most early scientists believed in an intelligent design of the universe in no way proves that their authority as scientists proves them correct in theology or philosophy. Besides, majority of expert opinion has been shown to be wrong in many cases in past history—for example, the belief in Earth's flatness, the geocentric hypothesis, the belief in blood-letting in medicine, and so forth. I am utterly surprised at Geisler resorting to such fallacious appeals to authority.

But he continues in this vein by claiming that many modern scientists also believe in a supernatural cause of origin of life here. Perhaps this is so, although I know of no recent surveys which attest to this claim. But it proves nothing for the same reasons suggested above: large numbers prove nothing (beyond what scientists believe) and these scientists are outside of their area of expertise.

But beyond these purely philosophical-scientific criticisms of Geisler's position, I am quite dismayed at the effect this position, and that of creationists generally, can have on the appreciation of science itself. To claim an intelligent design of life *ex nihilo* is to cool the appetite for a scientific understanding of our complex and fascinating world, especially among youth. Pat religious answers to complex questions regarding life and the cosmos can only dull our creative powers and limit our aesthetic appreciation of the magnificence of our natural world (since it is now second to God, at best). Scientific claims and the method of science soon become viewed as an enemy of religion, as something to be wary of, not to be enjoyed or held as a fascinating challenge to the intellect. In short, creationist thought seems to be at least one of the causes in the apparent decline in interest in the sciences today, since it undermines the principles and method of science, causes distrust of the whole scientific enterprise, and destroys that aesthetic sense of love for the world which is nourished by scientific understanding. "To wonder is to begin to understand," it has been said. I worry that such wonder is being destroyed by the influence of creationist thought.

P. Ricci

If ex-astronaut James Irwin does find pieces of wood on the heights of

Ararat in Turkey, and if those pieces of wood show signs of having been shaped and joined together with pith or pitumen, will this be proof that the biblical story of Noah is true, that there really was an ark, that it had ridden the Flood, and that it had come to rest on that mountain range?

Another interpretation of such a find suggests itself if we consider the name *Ararat:* the meaning of the word in Semitic language is "light of lights." This would mark it as the birth location of the sun in its morning risings for the early inhabitants of the Anatolian plateau.

As mountains sacred in worship of a solar deity, they would be the site of temples erected to house the rites deemed suitable for such a deity. These rites in all probability included the sacrifice of a variety of animals.

Poet and novelist Robert Graves, in *The White Goddess*, sees certain myths as developing through a process he calls *iconotropy*, in which a rite or historic occurrence is depicted in some way but the picture is reinterpreted by another people to mean something else.

Thus a picture of a line of sacrificial animals entering a temple to be sacrificed would become a line of animals entering Noah's ark. Thus, any find of James Irwin of hewed timbers could well confirm not an ark for floating on the Flood but a temple built to honor the sun.

Irwin is not a skilled archeologist and is probably untrained in methods of preserving and recording those details necessary to establish dates and other essential data. He seems liable to have the Archimides reaction: to seize the artifact and run down the hill crying, 'I've found it!"

Let us hope that, if he does succeed in finding something to support his idea, he doesn't destroy whatever evidence there would be to test.

Kenneth H. Bonnell

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