CREATION RESEARCH SOCIETY

QUARTERLY

Volume 47 Summer 2010 Number 1

- EVALUATION OF AR/AR DATING
- VOLCANISM:

  "FOUNTAINS OF THE DEEP," AND FORTY DAYS OF RAIN
- THE ORIGIN OF GRAND CANYON--PART III
- MYSTERY OF TRILOBITE EVOLUTION

Creation Research Society Quarterly

Volume 47
Number 1
Summer 2010

Articles

Departments

Haec Credimus

For in six days the Lord made heaven and earth, the sea, and all that in them is, and rested on the seventh.—Exodus 20:11

Creation Research Society Quarterly

Volume 47
Number 1
Summer 2010

Cover design by Michael Erkel:
Michael Erkel and Associates, 1171 Carter Street,
Crozet, Virginia 22932

Design services by Cindy Blandon, cblandon@aol.com.

The *Creation Research Society Quarterly* is published by the Creation Research Society, 6801 N. Highway 89, Chino Valley, AZ 86323, and it is indexed in the *Christian Periodical Index* and the *Zoological Record*.

Send papers on all subjects to the Editor:
CRSQeditor@creationresearch.org or to
Kevin L. Anderson, Van Andel Creation Research Center, 6801 N. Highway 89, Chino Valley, AZ 86323.

Send book reviews to the Book Review Editor:
Don B. DeYoung, 200 Seminary Dr.,
Winona Lake, IN 46590.

Authors' opinions expressed in the *Quarterly* are not necessarily those of anyone else associated with the Creation Research Society.

ISSN 0092-9166

Printed in the United States of America

Editorial

It's Time for Atheists to Get Real

II. Beyond Pascal's Wager

"Men became scientific because they expected Law in Nature, and they expected Law in Nature because they believed in a Legislator." —C.S. Lewis

In the last few years there has been an unfortunate trend in American television programming. I realize this is really nothing new. However, with this particular trend, several programs (esp. murder mysteries) have been featuring characters portrayed as logical, "scientifically minded" geniuses that are decidedly atheistic. These characters calmly, but slightly condescendingly, interact with their less logical co-characters, who have not yet achieved the greater enlightenment of atheism.

There is little doubt that the intention of these characterizations is to infiltrate the public consciences (esp. younger viewers) with the idea that atheism is the logical, scientific position. Non-atheists are more emotional and traditional—nice, but a little out of touch with the twenty-first-century age of science and technology. It is a subtle but very effective means of conveying the message that atheism is the modern "enlightened" thinking. Belief in a creator is simply old-fashioned and certainly not in step with the scientific age.

Along with this hype, recent years have seen atheists attack theism with an extraordinary tone of vile and anger. While these attacks still represent a small (albeit sometimes vocal) minority of people, they are often popularized and confirmed by both the media and the education systems of many countries.

One salvo in this renewed battle was fired by Christopher Hitchens with his provocatively titled book, *God Is not Great* (Hitchens, 2009). The subtitle of the book, *How Religion Poisons Everything*, explicitly lays the blame of all the world's troubles on any and all religions. As with most atheist writings, he simply lumps Christianity into the large pot of "religion" and stirs it all together. He accuses religion of persecuting "free thinkers," saying that "all major confrontations over the right of free thought, free speech, and free inquiry have taken the same form—of a religious attempt to assert the literal and limited mind over the ironic and inquiring one" (Hitchens, 2009, p. 258). He also arrogantly declares, "Here is the point, about myself and my co-thinkers. Our belief is not a belief. Our principles are not a faith" (Hitchens, 2009, p. 5).

In other words, those illogical and irrational "religious" people are always interfering with those making an honest and sincere attempt at logical and objective thinking (i.e., atheists). Atheism is the only "true" scientific/objective position; all others require faith, superstition, irrationality, etc. etc. What is more, apparently, only atheists are truly capable of free thought and inquiry and are not restricted by some form of irrational belief. Religious people just spout their foolish nonsense, totally intimidated by scientific discoveries and skeptical inquiry.

But consider this: Based upon an evolutionary perspective, Cashmore (2010, p. 4503–4504) argues that humans are merely "mechanical forces of nature … as living systems we are nothing more than a bag of chemicals." After all, to the atheist, what else could we be? Because of this he concludes that "a belief in free will is nothing less than a continuing belief in vitalism—a concept that we like to think we discarded well over 100 years ago!" (Cashmore, 2010, p. 4504). He defines vitalism as "the belief that there are forces governing the biological world that are distinct from those that determine the physical world" (Cashmore, 2010, p. 4504).

Since we humans are merely a result of chemical reactions governed by physical laws, then our behavior is simply a result of those reactions and laws (Cashmore, 2010). Chemical and physical reactions do not have free will or make moral choices, so how can humans? The evolutionary materialism, upon which atheists rely so heavily to explain everything about humans (origin, cognition, behavior, etc.), has no ultimate means to explain how humans would be capable of either free thought or free will.

Therefore, when atheists such as Hitchens argue that they are the true "free thinkers" in society (whose minds

are unclouded by silly superstitious belief in a supernatural being), they are actually contradicting their own worldview. How does Hitchens think he acquired this ability of "free thought?" If our thoughts are merely a consequence of our genetics, environment, diet, chemical laws, etc., then we have no true capacity for "free thought." We are prisoners of natural forces. Our thoughts and decisions are strictly a chemical process. Change the chemistry, change our thoughts.

Hitchens (2009) also claims that atheists

> do not rely solely upon science and reason, because these are necessary rather than sufficient factors, but we distrust anything that contradicts science or outrages reason. We may differ on many things, but what we respect is free inquiry, openmindedness, and the pursuit of ideas for their own sake. We do not hold our convictions dogmatically" (p. 5)

So, if I were to seek a "free inquiry" of the genetic contradictions of evolutionary teachings, would Hitchens and his fellow atheists accept my inquiry with a nondogmatic "openmindedness?" If I asked for a podium at a university to present genetic evidence for creation, would they respect my "pursuit of ideas for their own sake"? Such questions are a direct challenge to Hitchens's claim. They have already been repeatedly asked, and the answer from atheists has consistently and loudly been *NO!* Free inquiry and open-mindedness? Apparently, these only apply to ideas consistent with atheism. Hitchens makes himself foolish to claim otherwise. In fact, contrary to Hitchens's claim, the recent atheist literature reveals a dogmatism rarely exceeded by any other philosophy or teaching.

I would also challenge how much "outrage" atheists actually have about anything that contradicts science or reason. Atheism requires the "belief" that life spontaneously formed from nonliving chemicals strictly as a result of chemical and physical laws. Yet, there is not a shred of scientific evidence to suggest how this could plausibly happen. In fact, all the empirical evidence suggests the opposite. Life does not spontaneously form. Life comes only from life. If Hitchens had not clarified that atheism was not a belief system, I might be inclined to think that atheists accept the "origin of life from nonlife" as a matter of faith. Because he has enlightened me about how rational and objective atheists are, I guess I now know better.

Atheism and Science

So, where does such arrogance as Hitchens's come from? Sadly, in part, it comes from the atheists' belief (oops, I said that word again) that science has disproved the existence of God and refuted the teachings of the Bible.

> Religion has run out of justifications. Thanks to the telescope and the microscope, it no longer offers an explanation of anything important (Hitchens, 2009, p. 282).
>
> Science can chip away at [any possibility of god] (Dawkins, 2008, p. 96).

While there is really nothing new in these claims, they do illustrate how atheists have hijacked science. Claiming to serve as its mouthpiece, they have actually misused science. Science is merely a tool that we use to understand the creation. Like other tools, such as a nail or a hammer, science makes no claims and has no opinion. On the other hand, scientists make many claims and have countless opinions. Scientists look at the same data (which is all that the tool of science can provide) but often interpret it differently to arrive at different opinions. But whose opinions are correct?

Not surprisingly, atheism is again inconsistent within its own claims. How does a "bag of chemicals" have an opinion? Atheists claim that their opinions and reasoning are more objective than we "religious" people. This superior objectivity allows them to arrive at interpretations (i.e., opinions) that satisfy their assertion that there is no creating God.

Yet, what is their standard for this reasoning? How do they know they are being objective? How are humans even able to reason? Do chemical reactions or physical laws have the capacity for "reason?" If humans lack a capacity for free thought (as discussed above), how do we have the capability to reason outside our own self-indulgent mentality? How do we know we can trust our own reasoning?

Christianity has a universal standard for reasoning. As Creator, Christ is the ultimate source of all wisdom and rational thought. By contrast, atheism has no source of reasoning or external standard. Atheists' standard for reasoning merely seems to be anything that leads them to atheism—a rather self-serving, but not very meaningful standard.

What is more, early scientists (such as Newton and Kepler) assumed that events within the universe could be predicted because they were not simply random and erratic actions. Why? These early scientists understood the universe as designed and orderly because it was created by the God of the Bible. In turn, the Biblical God reveals Himself as one who created with order and intelligence (Job 38–41). Thus, an orderly universe can be studied by the scientific process.

In contrast, there is no reason for an atheist to expect (or even anticipate) that the universe is orderly or predictable. Their "universe" could just as easily—and in fact, more likely—be chaotic and unpredictable. Thus, as unintentional as it may be, atheists are forced to work within a Biblical creationist framework of a predictable universe. Such order and predictability is the very premise of the scientific framework.

Nor is there any reason for the atheist to expect humans to have the mental capability to even engage in the scientific process. Scientific investigation

requires an independence of thought and the ability to draw objective conclusions—conclusions not limited to our particular genetic makeup or momentary brain chemistry.

How do "bags of chemicals" possess this capacity? Once again, atheism assumes what it cannot explain. Only a Christian worldview provides the foundation for humans to intellectually explore and understand the creation (Ps. 19; Rom. 1). Only a creationist perspective enables a creator to endow humans with clarity of thought and discernment of reason. Atheism attempts to claim "ownership" of science and the scientific process, yet science works only within a Biblical creation framework.

Atheism claims to honor the discoveries of science more than do other worldviews, but it can do so only by moving away from the ultimate conclusions of its own worldview. It must, instead, embrace the premise of the Biblical worldview. Such is the conundrum for our atheist friends.

Friend to Foe

Among some of the more vocal atheists is a group that identify themselves as "former" Christians. These people typically cite various reasons for their ultimate rejection of Christianity, but a common theme is their claim that the Bible presents an unscientific and utterly unbelievable account of creation. For many, this was the key to rejecting the Bible as God's Word.

One interesting example of this is Charles Templeton, who was instrumental in the formation of the Youth for Christ International ministry. During the 1950s he was also an integral part of the Billy Graham crusades. In his autobiography, *Farewell to God*, Templeton describes why he ultimately decided to reject God and Christian teachings. Not surprisingly, he states that he "had always doubted the Genesis account of creation" (Templeton, 1996, p. 6). It becomes clear from his memoirs that this doubt began to undermine his entire understanding of the Bible and Christianity. He relates a conversation where he explained to Billy Graham that "it's simply not possible any longer to believe, for instance, the biblical account of creation" (Templeton, 1996, p. 7). By the time of this conversation, Templeton was so indoctrinated with evolutionary teaching that he told Graham, "The world wasn't created over a period of days a few thousand years ago; it has evolved over millions of years. It is not a matter of speculation; it is demonstrable fact" (Templeton, 1996, p. 7).

As part of this "demonstrable fact," Templeton states that "fully formed human beings did not suddenly appear on the earth a few thousand years ago; humankind has evolved to its present state from subhuman progenitors who lived in Africa as long ago as 4.4 million years (Templeton, 1996, p. 48). Templeton then offers *Lucy* as part of the fossil evidence supporting this claim. As is often the case with such types of popularized "fossil evidence," *Lucy* was never the wonderful fossil demonstration of human evolutionary history that she was claimed to have been (e.g., Anderson, 2009). It is sad to think that Templeton (and untold millions of others) allowed such flimsy and ultimately poorly interpreted "evidence" to so strongly influence them.

Once he abandoned Biblical creation, it was only a matter of time before Templeton abandoned other Biblical teachings and ultimately belief in God. In fact, such a progression is typical for this group of atheists. They usually feel that scientific discovery and critical analysis have successfully exposed the errors and inconsistencies in the Bible. Once these are exposed, the fictitious nature of Christianity is clearly revealed, and they are intellectually compelled to denounce their Christian faith. Or, so they think.

It has been my observation that such "critical analysis" is really not very critical or analytical. So-called skeptic groups (generally a euphemism for atheists) are rarely skeptical about much of anything except Christianity, which they approach with a very narrow and shallow perspective.

Defending his anti-Bible position, Templeton (1996) invokes allegations about Biblical teachings that can only be called amateurish and superficial. For example, he scoffs at the Biblical account of God directly speaking to Abraham and promising to make his descendants into a great nation. Templeton assumes that because God apparently did not speak directly to "fathers" of other nations, such as George Washington or Otto van Bismarck, then there is no reason to believe he spoke to Abraham either.

Templeton's reasoning in this question lacks any theological or philosophical sophistication and certainly seems to present only a very simplistic view of God. (But such a god is always easier to criticize and dismiss.) While others may be viewed as "fathers" of various nations, God did not specifically make a covenant with them. Nations come and go, and "fathers of nations" come and go. However, God's promise to Abraham involved far more than merely being the father of a single nation (Gal. 3:8, 16).

Certainly such arguments are far beneath what should have been Templeton's level of reasoning and knowledge. Yet, all too often, once a person decides that the creation account of Genesis cannot be accepted as historically accurate, other claims in the Bible are also more easily dismissed. In fact, it becomes inevitable. If Genesis is not historical truth, are any portions of the Bible historical? How do we know? Why should we believe the accounts of Christ's resurrection? If only portions of the Bible reveal physical truth about the creation, which portions?

Intellectual Criticism?

A similar level of superficiality can be found in Bill Maher's movie *Religulous*.

At one point in the movie, Maher claims that there is a strong parallel between the life of Christ and that of Horace. I suppose this was an attempt to diminish the unique significance of Christ's life and teachings. However, any parallel in the lives of Christ and Horace is strictly superficial and based almost exclusively on inaccurate comparisons. Presumably, the movie assumes that the viewers are as ignorant of history as Maher. In fact, ignorance seems to be a key requirement for most atheists' arguments.

Templeton (1996), and others, also challenge that the God of the Bible always needs attention, worship, fawning, and praise. If we fail to do this, then He becomes angry and vindictive. They argue that such a "god"' is childish and immature and was just invented as a means for religious extortion of the gullible.

What these critics fail to understand is that God does not "need" anything from us (not to be confused with "desiring" something from us). He existed for an eternity without the praise or worship of humans. What He *desires* is for us to take our focus away from our own insecurities and selfish desires and focus upon Him. In focusing upon Him, we become more humble; we seek less self-indulgence and more service to others. We also become more mature and loving. In fact, I think it is impossible for someone who is truly focusing on praise and service to Christ to also be consumed with self-gratification. Could atheists say this is a bad thing? Who knows; I find they are rarely consistent within any philosophy.

What is more, to whom else could we turn our attention? Who else is worthy of our praise and adoration? Who else can accept such attention without becoming arrogant or perverted? Movie stars? Athletes? Politicians? Yet, when we fail to turn our focus onto others, we inevitably turn our attention toward ourselves, seeking to satisfy our own desires. How much of the daily tragedy in this world can be directly attributed to selfishness and greed?

Critics also frequently charge that Christian prayer provides no correlative response (Stenger, 2007). When is the last time that prayer moved God to restore a severed arm or leg? One so-called scientific study "tested" prayer on the recovery of heart patients and found no effect (Benson et al., 2006). Thus, critics conclude either that there is no God or that He does not answer prayers. Either way, they argue that prayers go unanswered and it is a foolish waste of time.

Again, these arguments fail to acknowledge that as the sovereign ruler of the universe, God has no obligation to answer our prayers in the manner we desire or can predict. Prayers are answered in ways that bring glory to God and often far exceed our limited view. Also, such "studies" of prayer possess the underlying assumption that prayers are answered in an automatic-type response, such as a chemical reaction or computer program.

As an independent, cognitive being, God cannot be tested in the same manner as a lab rat or Pavlov's dogs. In fact, God may simply choose to not participate in such so-called tests. Even Dawkins (2008, p. 151) admits that if there was a God, "the one thing we can be sure of is that he would have to be very very complex." Such complexity would hardly reduce itself to laboratory studies or sociological assessments or, for that matter, any form of human evaluation.

Plus, like worship, prayer serves to move our thoughts and desires from ourselves. In so doing, our focus is drawn away from our own pain and stress. The very act of prayer provides a comfort that unbelievers have little understanding or appreciation.

Biblical Authority

The Bible declares itself as God's inspired word to His creation (2 Tim. 3:16). As such, it is above any human teaching, any human philosophy, and any human reasoning (Col. 2:8). So it is not trivial that the Bible strongly declares that atheism is foolishness (Ps. 14:1) and that anyone unable to see God revealed through His creation is merely choosing to deny the obvious (Rom. 1:18–25). These are harsh words for unbelievers. No wonder criticism of the Bible is so vital to an atheistic worldview.

Of course, from God's perspective, how foolish it is of these small, created beings to deny their Creator. We cannot even create a single atom. We cannot explain why or where anything came from. We cannot solve even the most basic human problems. Who are we to make such arrogant claims?

God considers the very existence of the universe as more than enough proof of His existence (Rom. 1:20). Thus, atheism is not about being open-minded. It is not about "respecting free inquiry." It is not about objective pursuit of the truth. It is not about scientific inquiry or analytical reasoning. Rather, it is about making an intentional decision to deny God. It is about ignoring all the physical evidence God has given of His own existence. It is about replacing God with our self. It is about attempting to justify human sin.

Kevin Anderson, Ph.D.
Editor
Creation Research Society Quarterly

References

Anderson, K. 2009. What is new is old again. *Creation Research Society Quarterly* 45:241–244.

Benson, H., J.A. Dusek, J.B. Sherwood, P. Lam, C.F. Bethea, W. Carpenter, S. Levitsky, P.C. Hill, D.W. Clem, M.K. Jain, D. Drumel, S.L. Kopecky, P.S. Mueller, D. Marek, S. Rollins, and P.L. Hibberd. 2006. Study of the Therapeutic Effects of Intercessory Prayer (STEP) in cardiac bypass patients: A multicenter random-

ized trial of uncertainty and certainty of receiving intercessory prayer. *American Heart Journal* 151:934–942.

Cashmore, A.R. 2010. The Lucretian swerve: the biological basis of human behavior and the criminal justice system. *Proceedings of the National Academy of Sciences* 107:4499–4504.

Dawkins, R. 2008. *The God Delusion*. A Mariner Book. Houghton Mifflin Co., New York, NY.

Hitchens, C. 2009. *God Is Not Great: How Religion Poisons Everything*. Hachette Book Group, Inc., New York, NY.

Stenger, V.J. 2007. *God: The Failed Hypothesis*. Prometheus Books, Amherst, NY.

Templeton, C. 1996. *Farewell to God*. McClelland & Stewart, Toronto, Canada.

Book Review

Redeeming Science

by Vern Poythress

Crossway Books, Wheaton, IL, 2006, 381 pages, $20.00.

Author Poythress holds doctorates from Harvard (mathematics, 1970) and the University of Stellenbosch, South Africa (New Testament, 1981). He is a teaching elder in the Reformed Presbyterian Church and for decades has been a professor at Westminster Theological Seminary in Philadelphia. This book summarizes much of his classroom content. Broad insights cover science history, mathematics, music, creation, and intelligent design.

Poythress presents a conservative, Calvinist worldview: "The Bible is the word of God…competing claims for revelatory authority are counterfeit" (p. 79). Regarding Genesis, the author strongly promotes a literal creation week. Clear discussion is given for young earth, framework, gap, and day-age views of Genesis 1–2. Preference is expressed for a consistent, mature creation in a young-earth setting. This is carried to the extent of a virtual history built into the original creation. This is called ideal or *prochronic* time, the latter term suggested by Bernard Ramm in 1954 (p. 82). The virtual history concept does not suggest fossils made in rocks but does include starlight details streaming toward us today (p. 123).

Poythress challenges several popular creationist ideas. For example, he concludes that the "waters above" in Genesis 1:7 are neither a vapor canopy nor water in space but simply clouds and rain: "The Bible is describing what an ordinary person could observe about the sky overhead and the rain coming down" (p. 96). As a second example, questions are raised about current efforts to use relativistic cosmology to explain our observation of distant starlight: "Relativity would not significantly affect the time estimates to nearby galaxies like the Andromeda galaxy" [2.5 million light-years distant] (p. 103). Poythress agrees with Paul Nelson and John Mark Reynolds, representing the young-earth view, that we "should humbly agree that [the] view is, at the moment, implausible on purely scientific grounds" (p. 104). This does not mean that young-earth creation is wrong; every origins position has its full share of unanswered questions.

Many pages describe the fundamental laws of nature. Poythress suggests that their discovery amounts to "thinking God's thoughts after Him" (p. 27). This phrase was Johann Kepler's original definition of science. The author explains that physical laws are universal and cannot be broken. They are in some sense omnipresent and omnipotent. Thus the law of gravity reveals several attributes of God, as stated in Romans 1:20.

Poythress explores the question of whether the majority of members of the National Academy of Sciences, university science divisions, and Nobel honors can be wrong in their understanding and pronouncements on nature. The answer is a humble but firm "yes." (1) All are wrong who claim that God does not exist or is irrelevant. (2) Evolution has cast up the human race to either evolve further or go extinct. (3) Our goal has been reduced to propagating the species with ultimate purposelessness in the cosmic setting (pp. 79–80). How refreshing is our worldview with a personal, caring Creator. This writing by Vern Poythress is clear and original. Full subject and Scripture indexes are provided.

Don B. DeYoung
DBDeYoung@Grace.edu

Volcanism, "Fountains of the Great Deep," and Forty Days of Rain

Hamilton Duncan*

Abstract

The Bible references the fountains of the deep and forty days of rain as contributors to the global Flood. Magmas are ideal candidates for fountains of the deep since water is the primary gas released during virtually all volcanic eruptions. The geologic record preserves volcanism on a level not observed today, especially with the existence of large igneous provinces. Gravimetric analysis of large igneous provinces indicates the liberation of water from their magmas could have contributed at least 58 cm of rain worldwide every day for forty days. Diatremes could be signature structures for volatiles launched into suborbital trajectories. The possible cause of the volcanism, Flood, and forty days of rain could have been concentrated, global decompression due to multiple bolide impacts. Under the scenario of global decompression from bolide impacts, the forty days of rain came from four potential sources: (1) liberation from volcanism, (2) destruction of vapor canopy, (3) vaporization of existing liquid water upon bolide impact, and (4) vaporization of bolides.

Introduction

The phrase "fountains of the great deep" is frequently used by creation scientists to refer to the source for water within the earth used to flood its surface. The phrase originates in the Bible, where it or a similar phrase appears three times: once in Genesis 7:11, once in Genesis 8:2, and once in Proverbs 8:28.

> In the six hundredth year of Noah's life, in the second month, the seventeenth day of the month, the same day were all the *fountains of the great deep* broken up, and the windows of heaven were opened. And the rain was upon the earth forty days and forty nights (Gen. 7:11–12 KJV, emphasis added).

> The *fountains also of the deep* and the windows of heaven were stopped, and the rain from heaven was restrained (Gen. 8:2 KJV, emphasis added).

> When he established the clouds above: when he strengthened the *fountains of the deep* (Prov. 8:28 KJV, emphasis added).

These verses share a common theme. All three associate moisture in the air with the fountains in the earth. Genesis specifically associates the fountains of the great deep with rain. Genesis 7:11–12 reads "…were all the fountains… broken up,…And the rain was upon the earth forty days and forty nights" (KJV). In the next chapter, in Genesis 8:2, the

* Hamilton Duncan, P.E., P.G., Charleston, WV 25324, heduncan16@yahoo.com
Accepted for publication November 24, 2009

same order is repeated; the fountains were "stopped" and then the rain was "restrained." If so, the Bible could be describing a cause-and-effect relationship observed today. The Hebrew text historically has been interpreted as indicating a causal relationship between the "windows" and "fountains" (Brown, 2008, p. 120; Dillow, 1981; Fouts and Wise, 1998; Whitcomb and Morris, 1961). Moreover, the atmospheric effects of volcanism (ozone depletion, tropospheric cooling, acidification, and cirrus modification) are well documented (Buchwald, 2007; Dasch, 1996a; Fischer, 1994; Gerlach et al., 1989; McGee et al., 1997; Rampino and Self, 1982; Self, 2006; Sigurdsson, 1982; Sigurdsson, 2000a; Sutton et al., 1997; Whitcomb and Morris, 1961). Volcanism is one example of how swiftly and severely geologic episodes can affect climate. The "cause" of the Flood may have been the eruption of crustal and subcrustal magmas, which the Bible calls "fountains of the deep" (Dickens and Snelling, 2008; Dillow, 1981; Hunter, 1996; Rehwinkel, 1951; Whitcomb and Morris, 1961). The "effect" would have been large releases of lava onto Earth's surface, as well as volatiles and ash into the atmosphere.

Volatiles are an element or compound that forms a gas at relatively low pressure and magmatic temperature (Wallace and Anderson, 2000). Carbon dioxide, sulfur, chlorine, and fluorine are common, but water vapor is the most abundant volatile (Johnson et al., 1994). If water vapor released during an eruption is forced high into the atmosphere, it will cool and condense. The liquid water can precipitate or revaporize (Fetter, 1988). Therefore, rainfall can be sustained indefinitely by sufficient volcanism.

Volcanism and the Flood Waters

Although the Bible does not specify the exact amount of rainfall for forty days and forty nights (Gen. 7:12), past investigators have traditionally interpreted the "violent shower" meaning of the word "rain" used in Genesis 7:12 and 8:2 as referring to a "torrential downpour" (Brown, 2008, p. 120; Rehwinkel, 1951; Strong, 2001; Whitcomb and Morris, 1961). Presently there is approximately 1.27×10^{19} grams of water in the atmosphere (Trenberth and Smith, 2005), which is enough to provide approximately 2.5 cm of rain simultaneously across the entire Earth's surface (Dillow, 1981; Fox, 1952; Whitcomb and Morris, 1961; Appendix A). This modest amount of water would be insufficient to generate either global torrential rainfall or a global flood. Therefore, magmas would have had to liberate considerably more than the 10^{19} grams of water in order to sustain forty days of rain.

Experiments have shown that magmas can conceivably liberate vast amounts of water because the solubility of water in magmas increases with pressure. Snelling (2008) quoted previous investigators who determined granites could dissolve 24 weight percent water (wt % H_20) at 100 km. Rhyolite melts can contain up to 21 wt % H_20 at 1,000°–1,200° C at 10 kbars (Sood, 1981), which is the pressure at approximately 36 km depth (Blatt et al., 2006). Andesitic melts can dissolve 10 wt % H_20, and basaltic melts can dissolve 14 wt % H_20 under similar conditions (Middlemost, 1985; Annen et al., 2006). Mitchell (1986) discusses but discounts how kimberlites could have contained about 40% H_20 at a depth of 200 km. Magmas degassing these large volumes of water vapor at Earth's surface could have contributed significant amounts of precipitation for the Flood.

Rainfall during the Flood

There has been much debate as to exactly how much rainfall occurred during the forty days of rain. Determining the precise amount of precipitation during the Flood is a formidable task, but could begin with a quantification of water liberated from magmas erupted during the Flood.

Basalt is the most common type of igneous rock (Smith, 1999a), and more than half of all volcanoes consist wholly or largely of basalt (Walker, 2000). The largest known volcanic emplacements on Earth consist almost exclusively of basalt and are called *large igneous provinces* (LIPs) (Figure 1). LIPs are defined by Coffin and Eldholm (1994) as a continuum of voluminous iron and magnesium rock emplacements that include continental and ocean basin flood basalts, volcanic passive margins, oceanic (submarine) plateaus, submarine ridges, and seamount groups. The largest known LIP is the Ontong Java LIP, a submarine emplacement located in the western Pacific Ocean (ONTO in Figure 1) with an area and volume estimated at 1,900,000 km^2 and 44,000,000 km^3 respectively (Large Igneous Provinces Commission, 1993).

The immense size of LIPs suggests their magmas may have contributed significant amounts of water to the Flood (Froede, 2007). The volume of some LIPs are known, and six are considered and included in Table I. The original water contents by mass for six LIPs also have been calculated and included in Table I. The density and original water contents of many continental LIPs are difficult to quantify due to alterations after initial emplacement (metamorphism, weathering, etc.). Furthermore, the actual volume of the Siberian Traps in Table I is much larger, but only the portion with a volume and water content available for estimation are considered in this study.

Using a gravimetric analysis procedure (Chang, 1984) for each LIP in Table I, where

mass H_20 in LIP = (mass of total LIP) x (% H_20 by mass in LIP)

and assuming the density for basalt is 2.9 g/cc (Best, 2003), it can be determined that the magmas from these six LIPs

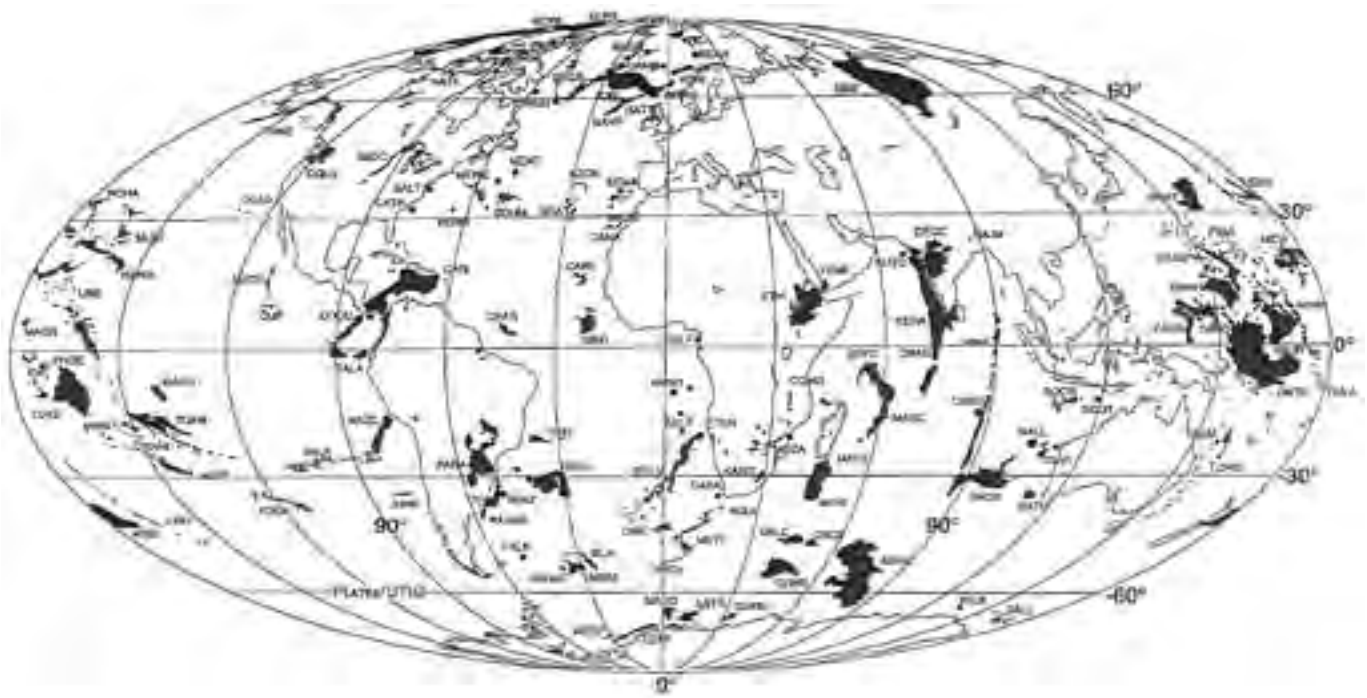


Figure 1. Distribution of known large igneous provinces (after *Reviews of Geophysics*, by Coffin and Eldholm, 1994)

alone could have liberated a volume of water equivalent to approximately 4.4 cm of rain across Earth's surface every day for forty days.

Note that the calculated water contents from direct sampling in Table I are much lower than the empirical values referenced earlier for previous investigators. Since the Bible makes it clear that Earth was made out of water (Genesis 1, 2 Peter 3), the empirical values indicating high water contents should align with the water contents calculated from sampling. Why are calculated values lower than the empirical values? One possible reason could be the magmas from LIPs originated from shallow sources, where the lower pressures allow only limited amounts of dissolved water within magmas. However, most investigators suspect magmas for

Table I. Name and volume of LIPs along with the reported original water content.

LIP name	Vol. km^3	Reference	H_20 wt %	Reference	Mass H_20 g
Deccan	8,600,000	LIPC, 1994*	0.6	Sano et al., 2001	1.496×10^{20}
Iceland	6,600,000	Hooper, 2000	0.15	Nichols et al., 2002	2.871×10^{19}
Kerguelen-Broken Ridge	9,100,000	LIPC, 1994*	0.63	Scoates et al., 2008; Yang et al., 1998	1.666×10^{20}
Naura Plateau	900,000	LIPC, 1994*	1.17	Floyd, 2007	3.054×10^{19}
Ontong Java Plateau	44,000,000	LIPC, 1994*	0.29	Michael, 1999	3.700×10^{20}
Siberian Traps	280,000º	Carlson et al., 2006	(1.75*0.6)+(0.625*0.4)	Ivanov, 2007; Elkins-Tanton et al., 2006	$1.903 \times 10^{18} + 8.881 \times 10^{18}$
TOTAL	**69,480,000**				**7.563×10^{20}**

* LIPC — Large Igneous Provinces Commission

º Although the entire volume of the Siberian Traps exceeds 2,000,000 km^3 (LIPC, 1994) only the geologic portion as defined by Carson et al., 2006 has data sufficient for reliably estimating initial water contents using a gravimetric procedure.

LIPs as originating within the mantle (Coffin and Eldholm, 1994; Duncan and Richards, 1991; Jones et al., 2002, Klevberg, 2007; Smith, 1999b), where the higher pressures permit much higher water contents in the magmas. Another possibility is that the magmas from the LIPs underwent degassing before solidification (Carlson et al., 2006; Jambon, 1994).

Before the acronym "LIP" was coined, Schubert and Sandwell (1989) published a paper estimating the volumes of continental submarine plateaus, oceanic plateaus, and thermal swells, much of what is now known as LIPs (continental flood basalts are absent in Schubert and Sandwell's estimating). Schubert and Sandwell, using the Airy compensating model, estimated the individual volumes of continental submarine plateaus, oceanic plateaus, and thermal swells to have a combined volume of 621,820,000 km^3. This total volume calculation included Madagascar and the surface volume of the Caribbean plate, along with its compensation root. These volumes should be removed from analysis due to the abundance of non-volcanic rocks (Boast and Nairn, 1982; Donovan and Jackson, 1994). When these volumes are removed, the adjusted total volume is 605,603,000 km^3.

Another interesting paper was written by Kovalenko et al. (2007) about the analysis of melt inclusions and quenched glasses from various geodynamic settings. Quenched glasses are frequently analyzed for the original volatile contents of the parent magma, but since degassing before solidification is almost always a concern (Carlson et al., 2006; Jambon, 1994), the measured H_2O contents in quenched volcanic glasses should be interpreted as minimum values. Nevertheless, Kovalenko et al. (2007) reported mean volatile values for mid-ocean ridge basalts, oceanic islands, and continental settings that take from the analysis of quenched glasses. The classification system used by Kovalenko et al. (2007) varies from Schubert and Sandwell (1989), but Table II unifies the two classification schemes.

Table II provides the mean for the H_2O values reported by Kovalenko et al. (2007) for the corresponding volcanic setting. Kovalenko et al. (2007) used the geometric mean for the H_2O content of the continental intraplate volatile data and the arithmetic mean for the H_2O content of oceanic island and mid-ocean ridge settings. When gravimetric analysis is applied to the information in Table II, a volume of 605,603,000 km^3 of basaltic magma would have yielded a total of 1.174×10^{23} grams H_20. Additionally, the total water calculated from both the continental Deccan and Siberian Traps from Table I is 1.604×10^{20} grams H_20 and can be added to the 1.174×10^{23} grams H_20 calculated for oceanic volcanism, yielding a total value of 1.190×10^{23} grams H_20. If 1.190×10^{23} grams of water were released into the atmosphere during the forty days of rain, then approximately 58.3 cm of rain would have fallen across Earth's surface every day for forty days. Although it is more desirable to individually quantify each LIP geochemically, as done in Table I (Froede, 2007), this estimate gives a "rough idea" for a minimum value of global precipitation during the Flood. Continental LIPs and other forms of volcanism are underrepresented in this study, but future research may quantify their hydrologic contribution to the Flood.

High Velocity Volcanism

Basaltic magma is capable of spectacular eruptions. A rapid ascent (> 1m/s, Wolff and Sumner, 2000) of a low viscosity mafic (basaltic) magma would create a lava fountain comprised of a central jet of gas (Austin et al., 1994; Gonnerman and Manga, 2007; Wolff and Sumner, 2000). Degassing by this method could have sent volatiles to extraordinary heights. Morgan et al. (2004) describe volatile-driven explosions that would have fractured cratonic rock and launched jets of volatiles high into the atmosphere. Diatremes, described by Morgan et al. (2004) as "verneshots," are funnel-shaped breccia pipes formed as a result of rapidly ascending, degassing basaltic magma. Kimberlites, famous for their association with diamonds, are examples of rocks found in diatremes (Evans, 1987; Heinrich, 1966; Milashev, 1984; Mitchell, 1986; Morgan et al., 2004; Smith, 1999c) and comprise approximately 30% of all diatremes (Milashev, 1984). The formation of kimberlites, along with their ascent rates, is debated. McGetchen and Ullrich (1973) have modeled ascent rates ranging from 25 m/s at 90 km deep to 334 m/s at the surface. Best (2003) reports ascent rates of 10–30 m/s and a surface exit velocity approaching 600 m/s. Velocities up to 1,200 m/s are discussed and discounted by Milashev (1984), but he concurs with exit velocities of 500 m/s. Any of these launch velocities would have sent volatiles several kilometers high into the atmosphere.

Best (2003) estimates that there are more than 5,000 kimberlite diatremes worldwide with an estimated volume exceeding 5,000 km^3. However, the original water content and density of kimberlitic magmas is uncertain. Shkodzinskii and Zol'nikov (1995) tested kimberlite melts with water contents between 10–20 wt %. O'Brien and Tyni (1999) report the water content of several kimberlite samples averaging 9.69 wt % H_20. The density of the original kimberlitic magma varies, with Katsube et al. (1999) reporting an average of 2.4 g/cc and McCallum and Eggler (1971) reporting a range from 2.66–2.72 g/cc. Therefore, if the values of 10 wt % H_20 and a specific gravity of 2.60 g/cc are chosen, then 5,000 kimberlite diatremes with a volume of 5,000 km^3 would have contributed approximately 0.25 cm of water across the entire earth's surface for one day. This modest volume of water from diatremes may conceal a disproportionately large

Table II. Compilation of the work of Schubert and Sandwell (1989) and Kovalenko et al. (2007).

Name	Setting Schubert and Sandwell (1989)	Setting Kovalenko et al., (2007)	Volume (10^6 km^3) Schubert and Sandwell (1989)	H_20 wt % Kovalenko et al. (2007)	Mass H_20 g
Broken Ridge	Oceanic Plateau	Mid-Ocean Ridge	12.4	0.29	1.043E+20
Caribbean	Oceanic Plateau	Ocean Island	34.964	0.43	4.360E+20
Caroline	Oceanic Plateau	Ocean Island	5.595	0.43	6.978E+19
Chagos Ridge	Oceanic Plateau	Mid-Ocean Ridge	24.991	0.29	2.1024E+20
Crozet	Oceanic Plateau	Con. Intraplate	9.449	1.66	4.549E+20
Emperor	Oceanic Plateau	Mid-Ocean Ridge	13.423	0.29	1.129E+20
Hess Rise	Oceanic Plateau	Ocean Island	9.081	0.43	1.132E+20
Iceland	Oceanic Plateau	Mid-Ocean Ridge	14.151	0.29	1.190E+20
Kerguelen	Oceanic Plateau	Con. Intraplate	44.655	1.66	2.150E+21
Magellan	Oceanic Plateau	Con. Intraplate	5.335	1.66	2.568E+20
Manihiki	Oceanic Plateau	Oceanic Island	13.092	0.43	1.633E+20
Marcus Wake	Oceanic Plateau	Oceanic Island	15.427	0.43	1.924E+20
Maud Rise	Oceanic Plateau	Oceanic Island	2.353	0.43	2.934E+19
Mid Pacific	Oceanic Plateau	Oceanic Island	21.469	0.43	2.678E+20
Mozambique	Oceanic Plateau	Oceanic Island	9.819	0.43	1.224E+20
Nazca Ridge	Oceanic Plateau	Mid-Ocean Ridge	9.165	0.29	7.708E+19
Ninetyeast	Oceanic Plateau	Mid-Ocean Ridge	23.738	0.29	1.996E+20
Ontong Java	Oceanic Plateau	Oceanic Island	50.677	0.43	6.319E+20
Shasky	Oceanic Plateau	Oceanic Island	13.007	0.43	1.622E+20
Wallaby	Oceanic Plateau	Oceanic Island	4.185	0.43	5.219E+19
Walvis	Oceanic Plateau	Mid-Ocean Ridge	16.224	0.29	1.364E+20
Agulhas	Con. Plateau	Oceanic Island	6.821	0.43	8.506E+19
Artic Ridges	Con. Plateau	Mid-Ocean Ridge	22.057	0.29	1.855E+20
Campbell	Con. Plateau	Oceanic Island	24.950	0.43	3.111E+20
Chatham	Con. Plateau	Oceanic Island	18.885	0.43	2.355E+20
Cuvier	Con. Plateau	Oceanic Island	2.351	0.43	2.932E+19
Exmouth	Con. Plateau	Oceanic Island	9.273	0.43	1.156E+20

(table continues on next page)

Table II (continued). Compilation of the work of Schubert and Sandwell (1989) and Kovalenko et al. (2007).

Name	Setting Schubert and Sandwell (1989)	Setting Kovalenko et al., (2007)	Volume (10^6 km^3) Schubert and Sandwell (1989)	H_20 wt % Kovalenko et al. (2007)	Mass H_20 g
Faeroe	Con. Plateau	Mid-Ocean Ridge	6.257	0.29	5.262E+19
Falkland	Con. Plateau	Oceanic Island	47.815	0.43	5.963E+20
Flemish Cap	Con. Plateau	Oceanic Island	3.570	0.43	4.452E+19
Galicia	Con. Plateau	Oceanic Island	3.624	0.43	4.519E+19
Lord Howe	Con. Plateau	Con. Intraplate	47.163	1.66	2.270E+21
Mascarene	Con. Plateau	Con. Intraplate	19.861	1.66	9.561E+20
Naturaliste	Con. Plateau	Oceanic Island	3.230	0.43	4.028E+19
Porcupine	Con. Plateau	Oceanic Island	3.689	0.43	4.600E+19
Queensland	Con. Plateau	Oceanic Island	8.325	0.43	1.038E+20
Rockall	Con. Plateau	Oceanic Island	9.668	0.43	1.206E+20
Shirshov	Con. Plateau	Oceanic Island	1.767	0.43	2.203E+19
Voring	Con. Plateau	Oceanic Island	2.518	0.43	3.140E+19
Austral	Thermal Swell	Con. Intraplate	0.290	1.66	1.396E+19
Bermuda	Thermal Swell	Con. Intraplate	0.286	1.66	1.377E+19
Canary	Thermal Swell	Con. Intraplate	0.719	1.66	3.461E+19
Cape Verde	Thermal Swell	Con. Intraplate	0.818	1.66	3.938E+19
Conrad	Thermal Swell	Mid-Ocean Ridge	0.276	0.29	2.321E+18
Hawaiian	Thermal Swell	Con. Intraplate	2.220	1.66	1.069E+20
Line Swell	Thermal Swell	Oceanic Island	1.657	0.43	2.066E+19
Marquesas	Thermal Swell	Con. Intraplate	0.401	1.66	1.930E+19
Midway	Thermal Swell	Con. Intraplate	0.272	1.66	1.309E+19
Rio Grande	Thermal Swell	Con. Intraplate	1.427	1.66	6.870E+19
Sierra Leone	Thermal Swell	Oceanic Island	0.496	0.43	6.185E+18
S Tasman	Thermal Swell	Con. Intraplate	0.439	1.66	2.113E+19
Tahiti	Thermal Swell	Con. Intraplate	0.303	1.66	1.459E+19
Tuamotu	Thermal Swell	Oceanic Island	0.975	0.43	1.216E+19
TOTAL			**605.603**		**1.174E+22**

contribution to the Flood due to high velocity launchings into the atmosphere (Dickens and Snelling, 2008). The suborbital presence of volatiles would have collapsed any existing vapor canopy and contributed additional precipitation to the Flood (Dillow, 1981; Hunter, 1996; Jorgensen, 1990; Whitcomb and Morris, 1961).

Not all hydrological contributions to the Flood would have necessarily been explosive and terrestrial. Comparatively uneventful submarine eruptions are currently the most common form of volcanic activity on earth (Fisher and Schmincke, 1984). Water condensed directly into seawater from LIP magmas would have increased eustatic sea levels during the Flood. Moreover, the sheer volume of the LIPs, coupled with their rapid emplacement, would have raised eustatic sea levels. Coffin and Eldholm (1994) estimate the volume of displaced water from the Ontong Java LIP alone would have elevated sea level by approximately 10 m. Moreover Austin et al. (1994) noted that newly emplaced magmas would also raise sea level by increasing crustal volume and note the MOR mountain range is believed to have displaced eustatic sea levels by more than 1,000 m.

Two existing creation science theories that explain rainfall during the Flood, the hydroplate and the catastrophic plate tectonics (CPT) theories, describe a wall of high velocity linear geysers at the Mid-Oceanic Ridge (MOR) (Austin et al., 1994; Brown, 2008). Although there are geological differences between deep-rooted, volcanic diatremes and subterranean linear geysers, both provide roles for volatiles changing Earth's atmosphere during the Flood.

Cause of Concentrated, Global Volcanism

Most geologists date LIPs within their uniformitarian framework rather than that of the Bible. As noted earlier, the one great geologic catastrophe in Biblical history was the Flood. Therefore, it is reasonable to assign LIP and diatreme formations to that event. Moreover, many of the LIPs are associated with active volcanism (hot spots) and are believed to have been formed quickly (Austin et al., 1994; Best, 2003; Coffin and Eldholm, 1994; Self et al., 2005; Sigurdsson, 2000b), thereby rendering present-day eruption rates inadequate for LIP formation.

Although the Bible tells us "why" God flooded Earth, it does not provide many details about "how" God flooded Earth. One vital clue appears in Genesis 7:11 (KJV, emphasis added): "*The same day* were all the fountains of the great deep broken up, and the windows of heaven were opened." If the fountains of the deep were magmas that erupted when they were "broken up," what could cause concentrated, global volcanic eruptions on the same day?

The ultimate source of magma is the mantle, where rocks exist as mainly crystalline and partially molten (Jeanloz, 2000). Mantle rock can be further melted in three ways: increasing heat, changing chemical composition, or decreasing pressure (Asimow, 2000). Decompression melting is considered the most common form of melting in the crust and mantle, and it is believed to occur with rock upwelling at the MOR (Asimow, 2000), while Hunter (2000) has proposed that rocks were decompressed globally by a miraculous change in the gravitational constant. Another alternative is that bolide impacts could have created areas of concentrated decompression worldwide and initiated the Flood.

Bolides are meteors, meteorites, or comets (Jackson, 1997; Smith, 1999d), and they frequently strike Earth. If bolides with sufficient size and velocity were to strike Earth, the impacts would cause decompression of the upper mantle through the creation of a cavity and lithospheric updoming (Fischer, 1994; Rampino and Self, 2000). Cavity formation would quickly remove substantial amounts of material at the impact sites, thus decompressing and melting the underlying rock (Jones et al., 2002; Smith 1999e). The new buoyant, less viscous magma would rise and add stress against the lower lithosphere, generating updoming, while fractured rock near the impact zone would provide conduits for magmas to extrude onto the surface (Faulkner, 1999).

Many investigators believe Earth was bombarded by bolides in the past (Gilmour and Koeberl, 2000; Glikson, 2001; Norman et al., 1977; Oard, 2009; Spencer, 1998a; Unfred, 1984; Whitcomb and Morris, 1961). In the shorter Biblical timescale, the impact events would have been catastrophic and probably associated with the Flood (Aldaney, 1992; Froede and DeYoung, 1996; Glikson, 2001; Oard, 2009; Parks, 1990; Unfred, 1984; Whitcomb and Morris, 1961). A rapid, global bombardment could have led to extensive fracturing, segmental upper mantle decompression, LIP emplacement (Jones, 2005; Jones et al., 2002), and diatreme emplacement (Oard, 2009). The modeled ascent speeds of kimberlite and basaltic magmas attest to the accuracy of the Bible's recording how the fountains of the great deep were "broken up" on the same day.

Bolides may have contributed to the Flood in other ways. If they struck water, the impact would have vaporized water near the impact area (Ingle and Coffin, 2004; Spencer, 1998b), which could have been carried into the upper atmosphere and returned to the surface as precipitation (Spencer, 1998b). Additionally, comets are comprised mainly of water (Campins et al., 2004; Dasch, 1996b; Hartmann, 1989); and if comets struck Earth, they would have been vaporized upon impact. The vaporized water could have been dispersed, condensed, and returned to Earth's surface as precipitation during the Flood (Spencer, 1998b). Therefore, under the

scenario of global decompression from bolide impacts, the forty days of rain came from four potential sources: (1) liberation from volcanism, (2) destruction of vapor canopy, (3) vaporization of existing liquid water upon bolide impact, and (4) vaporization of bolides.

Some investigators have suggested that water vapor may not have significantly contributed to the Flood. This suggestion seems to be directed at water vapor condensing into liquid because life-threatening amounts of heat would have been released to convert enormous amounts of water vapor to liquid water (Baumgardner, 2002; Brown, 2008, p. 120; Dillow, 1981). The concentration of diatremes and LIPs in distinct regions across Earth's surface, along with the launching volatiles at various heights within the atmosphere, may have localized heat. Additionally, the global cooling effects from sulfur dioxide (Fischer, 1994; Jorgensen, 1990; Rampino and Self, 2000) and dust ejected from bolide impacts (Smith, 1999e; Spencer, 1998b) also could have helped to offset any atmospheric temperature increases from condensation (Dasch, 1996a). Dillow (1981) and Sibley (2004) reference volcanism, dust, and other cooling mechanisms.

Conclusion

The conjunction of the "fountains of the great deep" and "windows of heaven" at the beginning of the Flood suggests a causal relationship. This is reinforced by the impossibility of today's atmosphere providing sufficient rain for forty days. However, past voluminous magmatic emplacements with water contents measured today could have provided at least 58 cm of rain worldwide everyday for forty days. This calculated rainfall value is commensurate with our understanding of how diatremes, LIPs, and volcanism transformed Earth during the Flood.

Since the fountains of the deep were broken up on the same day the windows of heaven were opened, an abrupt catastrophic event must have triggered these phenomena. A global bolide impact event could have triggered tremendous crustal volcanism through decompression of the mantle and fracturing of the lithosphere. Moreover, bolide impacts may have initiated LIP emplacements and the launching of volatiles including water vapor through diatremes. LIPs and diatremes have ramifications for the hydroplate, CPT and vapor canopy models and offer a plausible explanation for globally dispersed, torrential rainfall during the Flood. Additional research is needed to more precisely quantify the water liberated from volcanic activity during the Flood.

There are over 40,000 volcanoes on Earth, with 1,500 of them active (Dasch, 1996b). If a singular global event gave rise to the Flood via global volcanism, the resulting volcanic activity would absolutely dwarf modern volcanic activity. A world where 40,000 volcanoes simultaneously erupt would be extremely dreadful and may very well be the world referred to in Genesis 7 and 8.

Acknowledgments: I would like to thank my family, Christine, Jonas, and Benjamin Duncan, for their assistance and support. A special "thank you" is also extended toward the women at the Lexington County Library, Chapin Branch in Lexington, South Carolina, and the workers at the Kanawha County Library in Charleston, West Virginia, especially Linda Lawrence, Melissa Adkins, Olivia Bravo, and Elizabeth Fraser. I am in debt to Kati Holland, Yuvonne Smith, and the Kanawha Creation Science Group for their constructive comments.

References

CRSQ: Creation Research Society Quarterly

JOC: Journal of Creation

CENTJ: Creation Ex Nihilo Technical Journal (now Journal of Creation)

EPSL: Earth and Planetary Science Letters

Aldaney, J. 1992. Asteroids and their Connection to the Flood, *The 1992 Twin-Cities Creation Conference*, Twin-Cities Creation Science Association, Northwestern College, Roseville, MN.

Annen, C., J.D. Blundy, and R.S.J. Sparks. 2006. The genesis of intermediate and silicic magmas in deep crustal hot zones. *Journal of Petrology* 47(3):526.

Asimow, P.D. 2000. Melting the Mantle. In Sigurdsson, H. (editor), *Encyclopedia of Volcanoes*, pp. 56–63. Academic Press, San Diego, CA.

Austin, S.A., J.R. Baumgardner, J.R. Humphreys, A.A. Snelling, L. Vardiman, and K.P. Wise. 1994. Catastrophic plate tectonics: a global Flood model of Earth history. In Walsh, R.E. (editor), *Proceedings of Third International Conference on Creationism*, pp. 609–621. Creation Science Fellowship, Pittsburgh, PA.

Baumgardner, J.R. 2002. Catastrophic plate tectonics: the geophysical context of the Genesis Flood. *CENTJ* 16(1):58–63.

Best, M.G. 2003. *Igneous and Metamorphic Petrology*, 2nd Edition. Blackwell Publishing, Oxford, UK.

Blatt, H., R.C. Tracy, and B.E. Owens. 2006. *Petrology: Igneous, Sedimentary, and Metamorphic*. W.H. Freeman and Company, New York, NY.

Boast, J., and A.E.M. Nairn. 1982. An outline of the geology of Madagascar. In Nairn, A.E M., M. Churkin, Jr., and F.G. Stehli (editors), *The Ocean Basins and Margins*, Volume 6, *Indian Ocean*, pp. 649–696. Plenum Press, New York, NY.

Brown, W.T., Jr. 2008. *In The Beginning: Compelling Evidence for Creation and the Flood*, 8th Edition, Center for Scientific Creation, Phoenix, AZ.

Buchwald, J. 2007. The rhythmic coherence of global volcanic activity with the development of extreme regional rainfalls and resulting floods; examples in Saxony. *Geologica Saxonica* (52–53):129–142.

Campins, H., T.D. Swindle, and D.A. Kring. 2004. Evaluating comets as a source of Earth's water. In Seckbach, J. (editor), *Origins, Evolution, and Biodiversity*

and Microbial Life in the Universe. pp. 569–591. Kluwer Academic Publishers, Dortrecht, the Netherlands.

Carroll, M.R., and J.R. Holloway (editors). 1994. *Reviews in Mineralogy*. Volume 30: *Volatiles in Magmas*, p. 321. Mineralogical Society of America, Washington, DC.

Carlson, R.W., G. Czamanske, V. Fedorenko, and I. Ilupin. 2006. A comparison of Siberian meimechites and kimberlites: implications for the source of high-Mg alkalic magmas and flood basalts. *Geochemistry, Geophysics, Geosystems* 7(11):1–21

Chang, R. 1984. *Chemistry*, 2nd Edition. Random House, New York, NY.

Coffin, M.F., and O. Eldholm. 1994. Large igneous provinces: crustal structure, dimensions, and external consequences. *Reviews of Geophysics* 32(1):1–36.

Dasch, E.J. (editor). 1996a. Global environmental changes, In *Macmillan Encyclopedia of Earth Science*, volume 1, pp. 425–432. Simon & Schuster Macmillan, New York, NY.

Dasch, E.J. (editor). 1996b. Volcanic eruptions, volcanism. In *Macmillan Encyclopedia of Earth Science*, volume 1, pp. 1139, 1144. Simon & Schuster Macmillan, New York, NY.

Dickens, H., and A.A. Snelling. 2008. Precambrian geology and the Bible: a harmony. *JOC* 22(1):65–72.

Dillow, J.C. 1981. *The Waters Above: Earth's Pre-Flood Vapor Canopy*. Moody Press, Chicago, IL.

Donovan, S.K., and T.A. Jackson. 1994. *Caribbean Geology: An Introduction*. University of West Indies Publishers' Association, Kingston, Jamaica.

Duncan, R.A., and M.A. Richards. 1991. Hotspots, mantle plumes, flood basalts, and true polar wander. *Reviews of Geophysics* 29(1):31–50.

Dutch, S.I. 2007. Earth. *The World Book Encyclopedia*, volume 6, p. 17. World Book, Inc., Chicago, IL.

Elkins-Tanton, L.T., D.S. Draper, C.B. Agee, J. Jewel, A. Thorpe, and P.C. Hess. 2006. The last lavas erupted during the main phase of the Siberian Flood Volcanic Province: results from experimental petrology. *Contributions to Mineralogy and Petrology* 153(2):191–209.

Evans, A.M. 1987. *An Introduction to Ore Geology*, 2nd Edition. Blackwell Scientific Publications, Oxford, UK.

Faulkner, D. 1999. A Biblically based cratering theory. *Technical Journal* 13(1):100–104.

Fetter, C.W. 1988. *Applied Hydrology*, 2nd Edition. Merrill Publishing Company, Columbus, OH.

Fischer, J.M. 1994. A giant meteorite impact and rapid continental drift. In Walsh, R.E. (editor), *Proceedings of Third International Conference on Creationism*, pp. 185–197. Creation Science Fellowship, Pittsburgh, PA.

Fisher, R.V., and H. Schmincke. 1984. *Pyroclastic Rocks*. Springer-Verlag, Berlin, Germany.

Floyd, P.A. 1986. Petrology and geochemistry of oceanic intraplate sheet-flow basalts, Nauru Basin, Deep Sea Drilling Project Leg 89. In Moberly, R., S.O. Schlanger et al., *Initial Reports. DSDP*, 89, pp. 471–497. U.S. Govt. Printing Office, Washington, DC.

Fouts, D.M., and K.P Wise. 1998. Blotting out and breaking up: miscellaneous Hebrew studies in Geocatastrophim. In Walsh, R.E. (editor), *Proceedings of Fourth International Conference on Creationism*, pp. 217–228. Creation Science Fellowship, Pittsburgh, PA.

Fox, C.S. 1952. *Water*. The Philosophical Library, Inc., New York, NY.

Froede, C.R., Jr. 2007. Catastrophic plate tectonics, flood basalt, and Large Igneous Provinces. *Creation Matters* 12(6):7–8.

Froede, C.R., Jr., and D.B. DeYoung. 1996. Impact events within the young-earth Flood model. *CRSQ* 33:23–34.

Gerlach, T.M., J.L. Krumhansl, R.O. Fournier, and J. Kjargaard. 1989. Acid rain from the heating and evaporation of seawater by molten lava: a new volcanic hazard [abs.]: *Transactions of the American Geophysical Union (EOS)* 70:1421–1422.

Gilmour, I., and C. Koeberl. 2000. *Impacts and the early Earth*. Springer-Verlag, Berlin, Germany.

Glikson, A.Y. 2001. The astronomical connection of terrestrial evolution: crustal effects of post-3.8 Ga mega-impact clusters and evidence for major 3.2±0.1 Ga bombardment of the Earth-Moon System. *Journal of Geodynamics* 32:205–229.

Glikson, A.Y. 2005. Asteroid/comet impact clusters, flood basalts and mass extinctions: significance of isotropic age overlaps. *EPSL* (236):933–937.

Gonnerman, H.M., and M. Manga. 2007. The fluid mechanics inside a volcano. *Annual*

Review of Fluid Mechanics 39:321–356.

Hartmann, W.H. 1989. *Astromony: The Cosmic Journey*, 4th Edition. Wadsworth Publishing Company, Belmont, CA.

Heinrich, E.W. 1966. *The Geology of Carbonatites.* Rand McNally & Company, Chicago, IL.

Hooper, P.R. 2000. Flood Basalt Provinces. In Sigurdsson, H. (editor), *Encyclopedia of Volcanoes*, p. 349. Academic Press, San Diego, CA.

Hunter, M.J. 1996. Is the pre-Flood/Flood boundary in the earth's mantle? *CENTJ* 10(3):344–357.

Hunter, M.J. 2000. The pre-Flood/Flood boundary at the base of the of the earth's transition zone? *CENTJ* 14(1):344–357.

Ingle, S., and M.F. Coffin. 2004. Impact origin for the greater Ontong Java Plateau? *EPSL* 218:123–134.

Ivanov, A.V. 2007. Evaluation of different models for the origin of the Siberian Traps. *Geological Society of America Special Papers* 430:669–691

Jackson, J.A. (editor). 1997. *Glossary of Geology*, 4th Edition. American Geological Institute, Alexandria, VA.

Jambon, A. 1994. Earth degassing and large-scale geochemical cycling of volatiles elements. In Carroll, M.R., and J.R. Holloway (editors), *Reviews in Mineralogy*. Volume 30: *Volatiles in Magmas*. p. 498–499. Mineralogical Society of America, Washington, DC.

Jeanloz, R. 2000. Mantle of the Earth. In Sigurdsson, H. (editor), *Encyclopedia of Volcanoes*, p. 42. Academic Press, San Diego, CA.

Johnson, M.C., A.T. Anderson, Jr., and M.J. Rutherford. 1994. Pre-eruptive volatile content of magmas. In Carroll, M.R., and J.R. Holloway (editors), *Reviews in Mineralogy*. Volume 30: *Volatiles in Magmas*, p. 321. Mineralogical Society of America, Washington, DC.

Jones, A.P. 2005. Meteorite impacts as triggers to large igneous provinces. *Elements* 1:277–281.

Jones, A.P., D.G. Price, J. Neville, P.S. DeCarli, R.A. Clegg. 2002. Impact induced melting and the development of Large Igneous Provinces. *EPSL* 202:551–561.

Jorgensen, G.S. 1990. A computer model of the pre-Flood atmosphere. In Walsh, R.E. (editor), *Proceedings of Third International Conference on Creationism*, pp. 185–197. Creation Science Fellowship, Pittsburgh, PA.

Katsube, T.J., N. Scromeda, and B.A. Kjarsgaard. 1999. Laboratory physical characteristics of kimberlites from Smeaton, Saskatchewan. *Current Research 1999–E; Geological Survey of Canada*, Project 870057, pp. 65–71.

Klevberg, P. 2007. Lava extrusion and the age of Iceland. *CRSQ* 44(2):119–146.

Kovalenko, V.I., V.B. Naumov, A.V. Girnis, V.A. Dorofeeva, and V.V. Yarmolyuk. 2007. Average compositions of magmas and mantle sources of mid-oceanic ridges and intraplate oceanic and continental settings estimated from the data on melt inclusions and quenched glasses of basalt. *Petrology* 15(4):361–396.

Large Igneous Provinces Commission. 1993. http://www.largeigneousprovinces.org/downloads.html (as of August 1, 2009).

Lindeburg, E. 2001. *Civil Engineering Reference Manual*, 8th Edition. Professional Publications, Inc., Belmont, CA.

Luth, R.W. 2003. Mantle volatiles – distribution and consequences. pp. 319–361. In Carlson, R.W. (editor), *The Mantle and Core*, Treatise on Geochemistry, vol 2, pp. 319–361. Elsevier-Pergammon, Oxford, UK.

McCallum, M.E., and D.H. Eggler. 1971. Mineralogy of the Sloan Diatreme, a Kimberlite Pipe in northern Larimer County, Colorado. *The American Mineralogist* 56:1735–1749.

McGee, K.A., M.P. Doukas, R. Kessler, and T. Gerlach. 1997. Impacts of volcanic gases on climate, the environment, and people. *U.S. Geological Survey Open-File Report* 97–262.

McGetchen, T.R., and G.W. Ullrich. 1973. Xenoliths in maars and diatremes with inferences for the Moon, Mars, and Venus. *Journal of Geophysical Research* 78(11):1844.

Michael, P.J. 1999. Implications for magmatic processes at Ontong Java Plateau from volatile and major element contents of Cretaceous basalt glasses. *Geochemistry, Geophysics, Geosystems* 1:1525–2027.

Middlemost, E.A.K. 1985. *Magmas and Magmatic Rocks*. Longman Group Ltd, New York, NY.

Milashev, V.A. 1984. *Explosion Pipes*. Springer-Verlag, Berlin, Germany.

Mitchell, R.H. 1986. *Kimberlites*. Plenum Press, New York, NY.

Morgan, J.P., T.J. Reston, and C.R. Ranero. 2004. Contemporaneous mass extinctions, continental flood basalts, and impact signals: are mantle plume-induced lithospheric gas explosions the casual link? *EPSL* 217:263–284.

Nichols, A.R.I., M.R. Carroll, and Á. Höskuldsson. 2002. Crustal volumes of the continents and of oceanic and continental submarine plateaus. *EPSL* 202(1):77–87.

Norman, J., N. Price, and M. Chukwu-Lke. 1977. Astrons – the earth's oldest scars? *New Scientist* 73:689–692.

Oard, M.J. 2009. How many impact craters should there be on Earth? *JOC* 23(3):61–69.

O'Brien, H.E., and M. Tyni. 1999. Mineralogy and geochemistry of kimberlites and related rocks from Finland. In Gurney, J.J., J.L. Gurney, M.D. Pascoe, and S.H. Richardson (editors), *Proceedings of the VII*th *International Kimberlite Conference, Volume 2*, pp. 625–636. Red Roof Design, Cape Town, South Africa.

Parks, W.S. 1990. The role of meteorites in a creationist cosmology. *CRSQ* 26:144–146.

Rampino, M.R., and S. Self. 1982. Historic eruptions in Tambora (1815), Krakatau (1883), and Agung (1963), their stratospheric aerosols, and climatic impact: *Quaternary Research* 18:127–143.

Rampino, M.R., and S. Self. 2000. Volcanism and biotic extinctions. In Sigurdsson, H. (editor), *Encyclopedia of Volcanoes*, pp. 1088–1090. Academic Press, San Diego, CA.

Rehwinkel, A.M. 1951. *The Flood*. Concordia Publishing House, Saint Louis, MO.

Sano, T., T. Fujii, S.S. Deshmukh, T. Fukuoka, and S. Aramaki. 2001. Differentiation process of Deccan Trap Basalts. *Journal of Petrology* 42(12):2175–2196.

Schubert, G., and D. Sandwell. 1989. Crustal volumes of the continents and of oceanic and continental submarine plateaus. *EPSL* 92:234–246.

Scoates, J.S., D. Weis, M. Franssens, N. Mattelli, H. Annell, F.A. Frey, and K. Nicolaysen. 2008. The Val Gabbro Plutonic Suite: a sub-volcanic intrusion emplaced at the end of flood basalt volcanism on the Kerguelen Archipelago. *Journal of Petrology* 49(1):79–105.

Self, S. 2006. The effects and consequences of very large explosive volcanic eruptions. *Philosophical Transactions—Royal Society, Mathematical, Physical and Engineering Sciences* 364(1845):2073–2097.

Self, S., T. Thordarson, and M. Widdowson. 2005. Gas fluxes from flood basalt eruptions. *Elements* 1:283–287.

Shkodzinskii, V.S., and G.V. Zol'nikov. 1995. Decompression solidification of kimberlite melt and genesis of kimberlite diatremes and breccias. *Russian Geology and Geophysics* 1(12):96–102.

Sibley, A. 2004. Likely causes of the Ice Age. *CENTJ* 18(2) 83–90.

Sigurdsson, H. 1982. Volcanic pollution and climate—the 1783 Laki eruption.

American Geophysical Union, EOS Transactions 601–602.

Sigurdsson, H. (editor). 2000a. Part VII, volcanic hazards. *Encyclopedia of Volcanoes*, pp. 931–943, 999–1004, 1045–1056, 1083–1091. Academic Press, San Diego, CA.

Sigurdsson, H. 2000b. Volcanic episodes and rates of volcanism. In Sigurdsson, H. (editor), *Encyclopedia of Volcanoes*, p. 274. Academic Press, San Diego, CA.

Smith, R. (editor). 1999a. Basaltic rocks. *Encyclopedia of Geology*, p. 21. Fitzroy Dearborn Publishers, Chicago, IL.

Smith, R. (editor). 1999b. Intraplate volcanism. *Encyclopedia of Geology*, pp. 222–227. Fitzroy Dearborn Publishers, Chicago, IL.

Smith, R. (editor). 1999c. Ultramafic rocks and glossary. *Encyclopedia of Geology*, pp. 450, 492. Fitzroy Dearborn Publishers, Chicago, IL.

Smith, R. (editor). 1999d. Ultramafic rocks and glossary. *Encyclopedia of Geology*, p. 488. Fitzroy Dearborn Publishers, Chicago, IL.

Smith, R. (editor). 1999e. Meteorite and comet impacts. *Encyclopedia of Geology*, pp. 281–285. Fitzroy Dearborn Publishers, Chicago, IL.

Snelling, A.A. 2008. Catastrophic granite formation: rapid melting of source rocks, and rapid magma intrusion and cooling. *Answers Research Journal* 1:11–25.

Sood, M.K. 1981. *Modern Igneous Petrology*. John Wiley & Sons, New York, NY.

Spencer, W.R. 1998a. Catastrophic impact bombardment surrounding the Genesis Flood. In Walsh, R.E. (editor), *Proceedings of Fourth International Conference on Creationism*, pp. 553–566. Creation Science Fellowship, Pittsburgh, PA.

Spencer, W.R. 1998b. Geophysical effects of impacts during the Genesis Flood. In Walsh, R.E. (editor), *Proceedings of Fourth International Conference on Creationism*, pp. 567–579. Creation Science Fellowship, Pittsburgh, PA.

Strong, J. 2001. Hebrew and Aramaic Dictionary. In *The New Strong's Expanded Exhaustive Concordance of the Bible*, p. 58, entries 1652 and 1653. Thomas Nelson Publishers, Nashville, TN.

Sutton, A.J., E.T. Hendley, W. Hendley II, and P.H. Stauffer. 1997. Volcanic air pollution—a hazard in Hawaii. *U.S. Geological Survey Fact Sheet FS169–97*.

Trenberth, K.E., and L. Smith. 2005. The mass in the atmosphere: a constraint on global analysis. *Journal of Climate* 18(6):864–875.

Unfred, D.W. 1984. Asteroidal impacts and the Flood-Judgment. *CRSQ* 21:82–87.

Walker, G.P.L. 2000. Basaltic volcanoes and volcanic systems. In Sigurdsson, H. (editor), *Encyclopedia of Volcanoes*, p. 283. Academic Press, San Diego, CA.

Wallace, P., and A.T. Anderson. 2000. Volatiles in magmas. In Sigurdsson, H. (editor), *Encyclopedia of Volcanoes*, p. 150. Academic Press, San Diego, CA.

Whitcomb, J.C., Jr., and H.M. Morris. 1961. *The Genesis Flood*. The Presbyterian and Reformed Publishing Company, Phillipsburg, NJ

Wolff, J.A., and J.M. Sumner. 2000. Lava fountains and their products. In Sigurdsson, H. (editor), *Encyclopedia of Volcanoes*, pp. 322–324. Academic Press, San Diego, CA.

Yang, H., F.A. Frey, D. Weis, A. Giret, D. Pyle, and G. Michon. 1998. Petrogenesis of the flood basalts forming in the northern Kerguelen Archipelago: implications for the Kerguelen Plume. *Journal of Petrology* 39(4):711–748.

Appendix A

Total amount of water in the atmosphere (Trenberth and Smith, 2005): 1.27×10^{16} kg

Total amount of water in the atmosphere in gm: 1.27×10^{19} g

Total surface area of Earth (Dutch, 2007): 5.1×10^{8} km^2

Total surface area in cm^2: 5.1×10^{18} cm^2

Density of water: 1 g/cm^3 (Lindeburg, 2001).

Total volume of water in atmosphere: 1.27×10^{19} cm^3

Dividing the volume of total moisture by the total surface area yields the total water height over the total surface area of the earth:

$(1.27 \times 10^{19}\ \text{cm}^3) \div (5.1 \times 10^{18}\ \text{cm}^2) = 2.49$ cm

Book Review

Galileo Goes to Jail and Other Myths about Science and Religion

edited by Ronald L. Numbers

Harvard University Press, Cambridge, MA, 2009, 302 pages, $28.00.

Galileo Goes to Jail is a collection of twenty-five essays, each by a different author, on widely believed ideas called "myths" of science and religion. In this reviewer's assessment, four of the "myths" are in fact true and not myths, and so should not be included in the volume.

Noah Efron, the author of Myth 9 (that Christianity gave birth to modern science), conflates the isolated scientific contributions of diverse cultures, such as the Chinese development of paper, with the development of a long-lasting scientific enterprise—a "culture of science." This last has happened only in the West. Efron ultimately objects to the fact that if Christianity gave birth to modern science, then this implies that Christianity is a "better" religion (pp. 88-89). Nevertheless, Efron acknowledges that "Christians, Christian beliefs, and Christian institutions played crucial roles" in the development of modern science (p. 80).

Nicolas A. Rupke, the writer of Myth 15 (that the theory of organic evolution is based on circular reasoning), attempts to falsify this statement by quoting a number of creationists, such as Henry Morris, who claimed that evolutionary dating and morphology are based on circular reasoning. Rupke then tries to cast this claim as a uniquely creationist one. He almost totally ignores evolutionists such as Michael Denton who say the same thing. Factoring in this latter fact weakens Rupke's case greatly.

Michael Ruse, Myth 23, tries to show that intelligent design (ID) has mounted no scientific case against evolution. Ruse, and creationists such as this reviewer, are actually talking in two different sets of terms. To Ruse, evolution means science and anything else, including ID, is religion. Since science and religion are two differing aspects of reality—a point with which this reviewer agrees—ID cannot challenge evolution (read *science* in Ruse's lexicon). Once it is understood that evolution is not tantamount to science, however, but to an intangible model or construct that involves science—as is creation—then Ruse's essay becomes an example of the misuse of terms. ID is certainly an alternative to the *model* of evolution.

Myth 25 is "that modern science has secularized western culture." As in the Ruse essay, the writer implicitly equates evolution with science, so the essay title ought to be "That *Evolution* Has Secularized Western Culture." The author also overlooks the fact that it is the beliefs of scientists as manifested in their interpretations of physical data that lead toward secularization—or away from it. The real issue is that secular beliefs can be propagated, and so can Biblical or God-honoring beliefs. Of course, if the writer phrased his "myth" in these terms, it would be a true statement and could not be included in this volume.

Myth 18, "that Darwin destroyed natural theology," also involves an unclear use of terms because it becomes apparent that the writer of the essay, Jon H. Roberts, really wants to show that evolution did not foster unbelief or atheism. He therefore should have titled his essay, "That Darwinism Fostered *Unbelief* and *Atheism*," but this would have been difficult if not impossible to falsify.

Several myths are satisfactory as presented but would benefit from additional clarification. Myth 2 (that the medieval Christian church suppressed the growth of science) may be confused in some readers' minds with the different claim that it promoted or encouraged the growth of a scientific enterprise (as opposed to isolated technologies), a much more difficult statement to support. A clarification of this point would have been beneficial. Myth 4 (that medieval Islamic culture was inhospitable to science) needs a follow-up on the chain of events leading to the inhospitality to science in modern Islamic culture. Surely

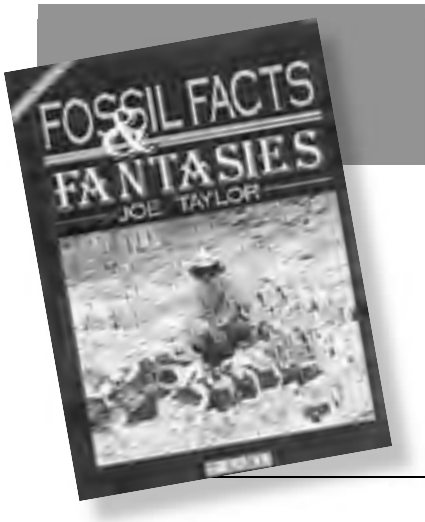
the average reader would like to know what caused such a great shift. Myth 19, "that Darwin and Haeckel were complicit in Nazi biology," is not the same as saying that Nazi ideology depended on evolution, but a reader may think it is. This point needs clarification. Perhaps the myth should be titled "that Darwin and Haeckel's ideology *contributed* to Nazism," but then this would not be a myth.

This leaves sixteen myths that this reviewer is pleased to see falsified. My favorites are Myth 3 (that medieval Christians thought the earth was flat), Myth 6 (that Copernicanism demoted humans from the center of the cosmos), Myth 9 (that Galileo was imprisoned and tortured for advocating Copernicanism), and Myth 21 (that Einstein believed in a personal God). As a college professor, I see these myths promoted endlessly, and I hope they can be put to rest. The content that all too many of my entering freshmen students think they know about science consists at least partly of these myths. Evolution is only one myth. Every creationist has a responsibility to unlearn other popular myths as well.

Interestingly, Numbers places the greatest blame for propagating these kinds of myths on two evolutionists, Andrew Dickson White, author of *A History of the Warfare of Science with Theology in Christendom* (1896); and John William Draper, author of *History of the Conflict Between Religion and Science* (1874). Of the seventeen myths predating the publication dates of these books, the individual essayists attribute eight of them mainly to White's and/or Draper's polemics.

Numbers considers himself an agnostic but once was a lecturer at one of the campuses of Loma Linda University. Perhaps this background underlies his claim in Myth 25 that the tenets of modern young-earth creationism, such as a short chronology and a global Flood, originated with the Seventh-day Adventists (p. 216) rather than from the Bible. Even so, despite this difficulty and the caveats mentioned above, *Galileo Goes to Jail* is well worth reading and highly recommended.

Jonathan F. Henry
jonathanhenry@clearwater.edu



Book Review

Fossil Facts and Fantasies

by Joe Taylor

Mt. Blanco Publishing Company, Crosbyton, TX, 2009 revision, 80 pages, $12.00.

Joe Taylor is an experienced paleontologist, fossil restorationist, and believer in a young earth. He is well respected for his knowledge and skill—even among evolutionists. This book is different from other creation science books on the fossil record. Instead of reviewing areas other creation scientists have already discussed, Joe Taylor discusses, from his perspective as a young-earth creation paleontologist, the fossils he has personally discovered, excavated, and restored, all while disputing evolution.

This book is somewhat like a trip through the geologic column, filled with hundreds of full-color photographs of fossils and digs, stories of Taylor's personal discoveries, and many facts about fossils. It begins in the Cambrian with discussion of trilobites. The Permian section covers mummified sharks, rain prints, and anomalous footprints.

One chapter is devoted to each of the alleged periods of the Mesozoic era.

The Triassic beds of Texas yield fossils of phytosaurs (crocodile-like creatures with nostrils between their eyes), metoposaurs (giant salamanders), aetosaurs (plant-eating crocodile-like animals, some of which had horns), and fossilized dung. The Triassic section makes the case that crocodiles are more complex than cattle. The Jurassic Morrison Formation material describes stegosaurs, sauropods, and allosaurs. The Cretaceous chapter is an extensive chapter, covering sites from all over the world, including the *Triceratops* of North America, the *Protoceratops* of Mongolia, the tylosaurs, and other sea creatures. The chapter also includes an account of the creationist dinosaur digs at the Dragon's Grave site in Wyoming and photographs of the ZERBST track way, where a hadrosaur apparently slipped in mud. Dromaeosaur (or possibly troodontid) tracks were found at the same site.

Moving up through the geologic column, Taylor covers alleged horse evolution and shows why it fails: Fossils of three-toed horses have been found in layers above (and thus younger than) those containing the one-toed horses, invalidating the presumed sequence. Taylor makes the case that some of the beds of mammal fossils around the world were not formed in the worldwide Genesis Flood but rather by a worldwide earthquake event that occurred at the crucifixion of Christ.

Chapter 6 discusses human fossils but not the usual refutation of human evolution. Taylor discusses Malachite Man fossils, which he helped excavate. Several human skeletons were found in Jurassic rocks in Utah. Because of the predominantly green color of the bones, the skeletons were nicknamed Malachite Man. It is not known whether they were buried in the Flood or whether they were Anasazi Indians killed in the collapse of a mine. Taylor contends that there is evidence for both views and the site cannot be explained with certainty. Taylor next discusses ancient cave art. As a professional artist, his evaluation is that "these beautifully executed animal paintings were not done by some brute…their artwork is beautiful. This I can say without reservation and from a professional point of view, having been a working artist all of my adult life" (pp. 63, 64). The chapter also discusses giant humans from the Middle East, Patagonia, Ohio, Nevada, and Texas.

Taylor also discusses the very controversial alleged human footprints from the Paluxy River in Texas. "Are those real footprints, or are they carvings?" (p. 70), Taylor asks. "There's at least one track I know that no one 'carved,' because I personally excavated it," he answers. There are photos of the so-called Japanese humanlike print just a few inches from a dinosaur print, which Taylor also excavated. He believes that these tracks are real and properly identified. The reviewer is not ready to make any determination as to the validity of the Paluxy River argument. Nevertheless, I found this portion of the book to be one of its most interesting sections.

The book ends with several photos of the displays in Taylor's Mount Blanco Fossil Museum, located in Crosbyton, Texas. The museum is open by appointment only.

This book is in its third edition. Some of the items that DeYoung (2000) noted as problems in the first edition have been corrected. Many spelling errors have been corrected. There are still few references, but an index has been added.

Joe Taylor's book is definitely worth the reader's time. Written in a friendly, conversational manner, it is nonetheless a serious discussion of creationary work on fossils. Hopefully, it will motivate others to do more original research on the fossil record.

Andrew Ste. Marie
the-witness@sbcglobal.net

References

DeYoung, Don B. 2000. Review of *Fossil Facts & Fantasies*. *Creation Research Society Quarterly* 37(2):109.

Evaluation of the Ar/Ar Dating Process

Richard L. Overman*

Abstract

During the last half of the twentieth century, the argon-argon method of dating geologic rocks and formations became very popular. This method replaced K/Ar as the method of choice for many types of rocks. This paper explores the fundamental mathematics of the argon-argon dating method and evaluates the impact of the assumed date of the "standard sample" on the calculated argon-argon date. A method for testing the validity of an argon-argon date is proposed with example evaluations. The analysis in this paper shows that when the results of dating studies are validated against the foundational equations upon which the argon-argon dating method is based, the "older" the standard sample the greater the results differ from the foundational equations. This seems to indicate that the assumed age of the standard sample has an effect on the calculated age of the unknown sample. The paper proposes a way to further investigate and quantify the effect of the assumed age of the standard sample.

Introduction

The decay of radioactive potassium (^{40}K) to stable argon (^{40}Ar) was first used to attempt to measure the age of rocks in the 1940s. This dating technique is called the potassium-argon (K/Ar) dating method, and it became one of the preeminent radiometric dating techniques for dating rocks that are believed to be in the Cenozoic and earlier geologic layers. While a detailed discussion of the history of K/Ar dating is beyond the scope of this paper, McDougall and Harrison (1999; e.g., chapter 1) provides a brief but thorough overview of the history of K/Ar and argon-argon (^{40}Ar/^{39}Ar) dating.

As the K/Ar dating method was being developed, it became obvious that there is a problem with "excess Ar." Analysis of the phenomenon of excess Ar appeared in the literature in the 1960s. For example, Damon et al. (1967, p. 463) state, "It now appears that some level of excess ^{40}Ar in minerals is a ubiquitous phenomenon." It is the continued problem of excess ^{40}Ar that has caused some scientists to question the validity of the K/Ar dating method itself (e.g., Austin, 1996; Snelling, 1998)

In the 1960s, while investigations into the excess ^{40}Ar phenomenon were getting started, Merrihue and Turner (1966) pioneered a variation of the K/Ar dating method that utilized the ability to produce ^{39}Ar from ^{39}K with neutron interaction. This variant is called the ^{40}Ar/^{39}Ar dating method. Over time, the ^{40}Ar/^{39}Ar method has become preferred over the K/Ar method.

A point of interest is that the ^{40}Ar/^{39}Ar method relies on the use of a fluence monitor sample (also called the standard sample). The fluence monitor sample is a rock of "known age" that is irradiated with the unknown sample. In most cases, the "known age" of the fluence monitor sample is determined by the K/Ar dating method.

* Richard L. Overman, Middleburg, FL, rich@coreprinciplesllc.com

Accepted for publicaton February 27, 2010

This leads to a fundamental question that needs to be explored. That is, what effect, if any, does the "known age" of the fluence monitor sample have on the calculated age of the unknown sample? Another question to address is how young-earth creation scientists can use the naturally occurring phenomenon of radioactive decay to study the earth's history from a Biblical perspective. Both of these questions are explored in this paper.

Ar/Ar Dating Equations

McDougall and Harrison (1999) provide a detailed derivation of the equations used for $^{40}Ar/^{39}Ar$ dating. The final equation for the age of the unknown sample is shown in equation 1 (equation numbers in brackets are those given in the cited source). "λ is the constant of proportionality known as the decay constant, which is the probability of any particular atom decaying per unit time. Thus the decay constant can be thought of as the fraction of parent radioactive atoms decaying per unit time" (McDougall and Harrison, 1999, p. 17).

(1) [2.16] $t=(1/\lambda)\ln(1+J(^{40}Ar^*/^{39}Ar_K))$,

where:
t=sample age
λ = decay constant = $5.543(\pm0.010)\times10^{-10}$ a^{-1} (for ^{40}K)
J=Irradiation Parameter (explained below)
$^{40}Ar^*$ = Radiogenic Argon formed from ^{40}K decay in nature
$^{39}Ar_K$ = Argon 39 produced from ^{39}K by fast neutron irradiation

McDougall and Harrison (1999) provide the following equation for J:

(2) [2.14] $$J = \frac{^{39}K}{^{40}K^*}\frac{\lambda}{\lambda_e+\lambda_{e'}}\Delta\int\phi(E)\sigma(E)dE,$$

where:
^{39}K and $^{40}K^*$ = the amount of each potassium isotope

$\frac{\lambda}{\lambda_e+\lambda_{e'}}$ = Ratio of relevant partial decay constants to the decay constant (λ) of ^{40}K (As the reader will see below, this term is not important because it is replaced with another term later).

Δ = Duration of exposure to neutron radiation
Φ(E) = Neutron flux at energy E in units of neutron-cm/(cm^3sec-erg)
σ(E)= Neutron capture cross section at energy E

McDougall and Harrison (1999) then substitute Equation 3 for J, stating that the above parameters are difficult to measure:

> Because of the difficulties encountered in accurately determining the relevant integrated fast-neutron dose a sample has received, Merrihue and Turner (1966) suggested that a mineral of accurately known K/Ar age be irradiated together with the unknown to monitor the dose. (p. 18)

(3) [2.18] $J'=((e^{\lambda t'})-1)/(^{40}Ar^*/^{39}Ar_K)'$

Unfortunately, McDougall and Harrison (1999) do not adequately differentiate between the terms related to the fluence monitor sample of "known age" and the sample of unknown age. To help in this area, I will assign the (') symbol to terms related to the fluence monitor sample of "known age." Various authors use different notations, so I will convert all equations to a standard notation, where (') refers to values related to the fluence monitor sample of "known age" and terms without the (') refer to values related to the sample of unknown age. There is also a difference among authors for the convention of identifying isotopes. Some authors put the mass number in superscript before the chemical symbol (^{40}K), while others put the mass number in superscript after the chemical symbol (K^{40}). I will convert all equations to the convention of putting the mass number in superscript before the chemical symbol.

The use of J' as given by McDougall and Harrison (1999) is described below.

> As the age *t*(') of the standard sample is known from conventional K/Ar age measurement, the parameter *J* can be determined from eq. (2.18) [my equation 3] by simply measuring the $^{40}Ar^*/^{39}Ar_K$(') ratio in the gas extracted from the standard sample after irradiation. This value of *J* is then used in eq. (2.16) [my equation 1], together with the $^{40}Ar^*/^{39}Ar_K$ ratio measured on the unknown sample irradiated at the same time, so that the sample age can be determined. (p. 19)

Therefore, the date of the unknown sample is calculated by using equations 1 and 3. Table I provides the various forms of equations 1 and 3 that will be used throughout this paper. The table provides the equation number and the equation. Equations 1 and 3 are repeated in the table in the appropriate place.

Note that McDougall and Harrison (1999) rely upon the equivalence of J and J', but they do not demonstrate that equivalence. Their justification for doing so is referencing Merrihue and Turner (1966). There is nothing wrong with this, but we must now turn our attention to Merrihue and Turner.

Merrihue and Turner (1966) begin their derivation with equation 8 below. In Equation 8, τ (tau) is the "mean life," which is the half-life divided by 0.693. The half-life is assumed to be constant with a current value of 1.25×10^9 years. Equation

Table I. Ar/Ar Dating Equations

Eq. #	Sample of Unknown Age
1	$t=(1/\lambda)\ln(1+J(^{40}Ar^*/^{39}Ar_K))$
	λ (constant) = $5.543X10^{-10}$ ^{40}K
4	$J=((e^{\lambda t})-1)/(^{40}Ar^*/^{39}Ar_K)$
5	$(^{40}Ar^*/^{39}Ar_K)=((e^{\lambda t})-1)/J$
	Fluence Monitor Sample of "Known Age"
3	$J'=((e^{\lambda t'})-1)/(^{40}Ar^*/^{39}Ar_K)'$
6	$t'=(1/\lambda)\ln(1+J'(^{40}Ar^*/^{39}Ar_K)')$
7	$(^{40}Ar^*/^{39}Ar_K)'=((e^{\lambda t'})-1)/J'$

8 is, then, the foundation for the justification of the equivalency of J and J'. It is noted that J' as developed from equation 8 and the J needed in equation 1 are not mathematically equivalent. Instead, they are treated as functionally equivalent. That is, J' can serve the same function as J even though it is not mathematically equivalent.

(8) $[1]\ (^{40}Ar/^{40}K)/(^{40}Ar/^{40}K)'=$
$(^{40}Ar/^{39}Ar_k)/(^{40}Ar/^{39}Ar_k)'=$
$(^{41}Ar/^{39}Ar_k)/(^{41}Ar/^{39}Ar_k)'=((e^{t/\tau})-1)/(e^{t'/\tau})-1)$

By way of explanation, the isotopes ^{41}Ar and ^{39}Ar are produced by neutron irradiation of the sample in a nuclear reactor. The ^{41}Ar results from ^{40}Ar present in the sample by absorption of a neutron and emission of a gamma ray photon. The ^{39}Ar results from ^{39}K by the reaction of absorption of a neutron and emission of a proton. The probabilities of these reactions are known quantities, given by a so-called neutron-absorption cross section. Under the conditions assumed by Merrihue and Turner (1966), all of the ratios given in the above equation must be equal. Hence, by assuming a known value for the age t', Merrihue and Turner's hypothesis enabled the calculation of the age t of the unknown sample.

Proposed Ar/Ar Dating Validation

Since equation 8 is the foundation for accepting the functional equivalency of the J factors, this equation can be used to validate the results. The two relevant terms from equation 8 are shown in equation 9. The left side of equation 9 will be referred to as the "Ar Ratio," and the right side of equation 9 will be referred to as the "Age Ratio."

(9) $(^{40}Ar/^{39}Ar_k)/(^{40}Ar/^{39}Ar_k)'=((e^{t/\tau})-1)/(e^{t'/\tau})-1)$

It should be noted that equation 9 uses ^{40}Ar while equations 5 and 7 use radiogenic $^{40}Ar^*$. However, this is merely a difference in naming convention as Merrihue and Turner (1966, p. 2853) state, "For the sake of convenience we shall refer throughout the paper to all argon other than Ar^{39} ($^{39}Ar_k$) and radiogenic Ar^{40} ($^{40}Ar^*$) as contamination."

Each of the terms in equation 9 is input to, or derived from the $^{40}Ar/^{39}Ar$ dating process. Therefore, the data from the analysis can be used to calculate both the Ar ratio and the age ratio. For the calculated date of the unknown sample to be valid, the equality of equation 9 must be satisfied within statistical significance. If the Ar ratio and age ratio are not statistically equal, then some part of the analysis is incorrect. Generally, it should be either the assumed "known date" used for the fluence monitor or the calculated date of the unknown sample.

Validation Analysis

Renne et al. (1997) dated lava from the AD 79 eruption of Mt. Vesuvius using the $^{40}Ar/^{39}Ar$ dating method. This study is interesting because it is often referenced as being an example of the accuracy of $^{40}Ar/^{39}Ar$ dating. Table II provides information based on the data reported by Renne et al. (1997). The data in Table II is straightforward except for the value for the age of the unknown sample (the Vesuvius lava) "t." In their study, Renne et al. (1997) report an $^{40}Ar/^{39}Ar$ isochron age of 1925 ± 94 years, which is remarkable because the eruption occurred 1918 years before the analysis. However, this age is obtained by excluding the argon from the first two heating steps. They specifically state:

> Because there is no objective basis for excluding the lowest temperature steps, we prefer the isochron obtained from all 46 analyses as the best estimate of the age of this sample. The presence of extraneous ^{40}Ar is substantiated by the total gas results; the $^{40}Ar/^{39}Ar$ apparent age calculated from the sum of all gas released is 3300 ± 500 years, clearly distinct within error from the known calendar age. (Renne et al., 1997, p. 1297)

For this paper, I will use the 3300-year total gas date. The data are reported by Renne et al. (1997) as the mean age of

Table II. Mt. Vesuvius Data

Data	Source
t=3300	Renne, et. al.
$J=J'=1.413X10^{-5}$	Renne, et. al.
$t'=1.19X10^{6}$ years	Renne, et. al.
$(^{40}Ar^*/^{39}Ar_K)'=4.67X10^{1}$	Equation 7
$(^{40}Ar^*/^{39}Ar_K)=1.29x10^{-1}$	Equation 5

Table III. Detailed calculation

Term	$(^{40}Ar^*/^{39}Ar_K)'$	$(^{40}Ar^*/^{39}Ar_K)$
λ	$5.543X10^{-10}$	$5.543X10^{-10}$
t	$1.19X10^{6}$	3300
λt	0.000660331	0.00000182919
$e^{\lambda t}$	1.00066055	1.00000182919
$e^{\lambda t}$-1	0.00066055	0.00000182919
J	$1.413x10^{-5}$	$1.413x10^{-5}$
$(e^{\lambda t}-1)/j$	46.75	0.129

multiple samples of the Mt Vesuvius lava irradiated at the same time. Since they do not all give the exact same age, ± one standard deviation of the ages is reported to identify the variation. For the calculations below, I will simply use the mean value. Table III provides the detailed calculations for the last two terms of Table II.

From Table II, we can see that we have enough information to evaluate equation 9. Substituting the data from Table II into the left side of equation 9, we get a value for the Ar ratio as shown in Equation 10.

$$(10)\ (^{40}Ar/^{39}Ar_k)/(^{40}Ar/^{39}Ar_k)' = 1.29x10^{-1}/4.67X10^{1}=2.76X10^{-3}$$

Substituting from Table II into the right side of Equation 9 we get a value for the age ratio as shown in equation 11.

$$(11)\ ((e^{t/\tau})-1)/(e^{t'/\tau})-1)=((e^{(3300/1.25X10\text{^}9)}-1)/((e^{(1.19X10\text{^}6/1.25X10\text{^}9)}-1)=2.64X10^{-6}/9.52X10^{-4}=2.77X10^{-3}$$

Within rounding error, equation 9 seems to be valid at least to 3 significant figures. It is noted that if the 1925 date is used in equation 11 rather than the 3300 date, equation 11 equals $1.62X10^{-3}$ which is not equal to equation 10. Therefore, the 3300 date for the Mt. Vesuvius lava is more correct and the $^{40}Ar/^{39}Ar$ dating process gave a date that is 72% higher than it should be.

Evaluating the Influence of the Fluence Monitor Age

Since J and J' are not mathematically equal but are used as functionally equal, the next question is, to what extent does the age of the fluence monitoring sample affect the calculated $^{40}Ar/^{39}Ar$ age? The Mt. Vesuvius analysis adds credence to this question. For this analysis, the researchers did not use the standard fluence monitors that are considered to be tens or hundreds of millions of years old. Instead, they chose a fluence monitor that is considered to be 1.19 million years old. During their discussion of the laboratory procedures, Renne et al. (1997, p. 1280, emphasis added) state: "Finally, the use of an *appropriately aged* (Quaternary) neutron fluence monitor…" (emphasis added). What does "appropriately aged" mean, and is that why they used a younger-than-normal fluence monitor?

Dalrymple et al. (1993) performed an analysis of sedimentary rocks in the Beloc Formation, Haiti. The important thing about this study is that they dated the same material using three different fluence monitors and two different laboratories. Of interest to this paper are the different fluence monitors.

At the beginning of their discussion of the monitor material, Dalrymple et al. (1993) make the following comment:

> The $^{40}Ar/^{39}Ar$ ratios for the monitor minerals are used along with their known age to calculate a conversion efficiency factor, J, which is a measure of the fraction of ^{39}K converted to ^{39}Ar by the fast neutron reaction $^{39}K(n,p)^{39}Ar$. J is then used in the age equation to calculate the age of the unknown samples. The calibration of the monitor minerals, therefore, has a direct effect on the accuracy of the $^{40}Ar/^{39}Ar$ ages calculated for the unknown sample. … In addition, there is not universal agreement on the ages used for the monitor minerals, and different laboratories, including Menlo Park and Denver, sometimes use slightly different values (ages) for the same monitor mineral (pp. 6, 7).

Table IV gives the details about the three monitor minerals used by Dalrymple et al. (1993)

While they used three fluence monitors, they only report data on two of the monitors (MMbh-1 and Taylor Creek Rhyolite [TCR]) in their paper. Table V shows the calculation of the Ar ratio and age ratio for each of the samples reported in Table II of Dalrymple et al. (1993). Table V also includes the above Mt. Vesuvius (MV) calculation for comparison. Table V has the irradiation number, sample number, sample material, and monitor mineral as reported by Dalrymple et al. (1993). Following this header information is the calculation of the Ar ratio, which is shown in the first gray boxes. The age ratio is

Table IV. Fluence Monitors

Name	Age
Fish Canyon Tuff Sanidine	27.55 Ma
Taylor Creek Rhyolite	27.92 Ma
MMhb-1 Hornblende	513.9 Ma

shown in the second gray box. Table V is shown in two parts to fit on the page.

From inspection of Table V, it is seen that while the Ar and age ratios are generally close, they are not equal. The bottom row of Table V is a calculation of the % error using equation 12.

(12) % Error = (Ar Ratio-Age Ratio)/Ar Ratio*100

Comparison of Means

While the Ar ratio and the age ratios in Table V are not the same, we need to perform a comparison-of-means test to determine if the difference is statistically significant. The comparison-of-means test used is described in Mendenhall and Sincich (1989). Tables VI and VII provide the comparison-of-means calculations. Since the Mt. Vesuvius analysis only involved one data point, a comparison of means is not useful. Therefore, the comparison of means is performed on the other two studies from Table V.

The purpose of the comparison of means is to see if the difference in the average Ar ratio and the average age ratio for each of the fluence monitors (MMhb-1 and TCR) is statistically significant. From Table V, we see that there are two data sets for MMhb-1 and 11 data sets for TCR. In both cases small sample statistics are used to perform the test.

From Table VII, we see that the T-stat is greater than the

Table V. Calculation of Ar and Age Ratios for Dalrymple et. al. and Mt. Vesuvius data

Irradiation	GLN3-1	105-1	105-2	105-3	108-1	JD06-1	JD08-1
Sample #	90G15K	90G15K	90G15K	JFL-500C	JFL-500C	83-O-05	83-O-05
Sample Material	Haiti Tektites	Haiti Tektites	Haiti Tektites	Z-Coal Bentonite Sandine	Z-Coal Bentonite Sandine	Z-Coal Bentonite Sandine	Z-Coal Bentonite Sandine
Monitor Mineral	MMhb-1	TCR	TCR	TCR	TCR	TCR	TCR
lambda(λ)	5.54E-10	5.54E-10	5.54E-10	5.54E-10	5.54E-10	5.54E-10	5.54E-10
t'	5.14E+08	2.79E+07	2.79E+07	2.79E+07	2.79E+07	2.79E+07	2.79E+07
λt'	0.2849	0.0155	0.0155	0.0155	0.0155	0.0155	0.0155
$e^{(\lambda t')}$	1.3296	1.0156	1.0156	1.0156	1.0156	1.0156	1.0156
$e^{(\lambda t')}$-1	0.3296	0.0156	0.0156	0.0156	0.0156	0.0156	0.0156
J	0.004376	0.010398	0.010452	0.010452	0.009474	0.006862	0.006910
$(^{40}Ar/^{39}Ar)'$	75.3128	1.4999	1.4922	1.4922	1.6462	2.2729	2.2571
Average $(^{40}Ar/^{39}Ar)$	8.4331	3.5784	3.5672	3.5264	3.9478	5.3816	5.4098
Ar Ratio	0.1120	2.3857	2.3906	2.3632	2.3981	2.3678	2.3968
Tau (τ)	1.25E+09	1.25E+09	1.25E+09	1.25E+09	1.25E+09	1.25E+09	1.25E+09
t	6.45E+07	6.44E+07	6.44E+07	6.44E+07	6.52E+07	6.45E+07	6.45E+07
t/τ	0.0516	0.0515	0.0515	0.0515	0.0522	0.0516	0.0516
$e^{(t/\tau)}$	1.0529	1.0529	1.0529	1.0529	1.0535	1.0530	1.0529
$e^{(t/\tau)}$-1	0.0529	0.0529	0.0529	0.0529	0.0535	0.0530	0.0529
t'/τ	0.4111	0.0223	0.0223	0.0223	0.0223	0.0223	0.0223
$e^{(t'/\tau)}$	1.5085	1.0226	1.0226	1.0226	1.0226	1.0226	1.0226
$e^{(t'/\tau)}$-1	0.5085	0.0226	0.0226	0.0226	0.0226	0.0226	0.0226
Age Ratio	0.1041	2.3411	2.3411	2.3411	2.3705	2.3444	2.3429
% Error	7.044%	1.870%	2.070%	0.937%	1.148%	0.985%	2.248%

(table continues on next page)

Table V (continued)

Irradiation	108-2	108-3	JD06-2	JD08-2	GLN3-2	105-4	MV
Sample #	90G15K	90G15K	90G15K	90G15K	JFL-500C	JFL-500C	
Sample Material	Haiti Tektites	Haiti Tektites	Haiti Tektites	Haiti Tektites	Z-Coal Bentonite Sandine	Z-Coal Bentonite Sandine	
Monitor Mineral	TCR	TCR	TCR	TCR	MMhb-1	TCR	
lambda(λ)	5.54E-10	5.54E-10	5.54E-10	5.54E-10	5.54E-10	5.54E-10	5.54E-10
t'	2.79E+07	2.79E+07	2.79E+07	2.79E+07	5.14E+08	2.79E+07	1.19E+06
λt'	0.0155	0.0155	0.0155	0.0155	0.2849	0.0155	0.0007
$e^{(\lambda t')}$	1.0156	1.0156	1.0156	1.0156	1.3296	1.0156	1.0007
$e^{(\lambda t')}$-1	0.0156	0.0156	0.0156	0.0156	0.3296	0.0156	0.0007
J	0.009452	0.009495	0.006862	0.006910	0.004404	0.010322	0.0000
($^{40}Ar/^{39}Ar$)'	1.6501	1.6426	2.2729	2.2571	74.8340	1.5110	46.6974
Average ($^{40}Ar/^{39}Ar$)	3.9914	3.8938	5.3875	5.5703	8.3400	3.5820	0.1290
Ar Ratio	2.4189	2.3705	2.3704	2.4679	0.1114	2.3706	0.00276247
Tau (τ)	1.25E+09	1.25E+09	1.25E+09	1.25E+09	1.25E+09	1.25E+09	1.25E+09
t	6.45E+07	6.45E+07	6.45E+07	6.45E+07	6.45E+07	6.45E+07	3.30E+03
t/τ	0.0516	0.0516	0.0516	0.0516	0.0516	0.0516	2.64E-06
$e^{(t/\tau)}$	1.0529	1.0529	1.0529	1.0529	1.0529	1.0529	1.0000
$e^{(t/\tau)}$-1	0.0529	0.0529	0.0529	0.0529	0.0529	0.0529	2.64E-06
t'/τ	0.0223	0.0223	0.0223	0.0223	0.4111	0.0223	0.0010
$e^{(t'/\tau)}$	1.0226	1.0226	1.0226	1.0226	1.5085	1.0226	1.0010
$e^{(t'/\tau)}$-1	0.0226	0.0226	0.0226	0.0226	0.5085	0.0226	0.0010
Age Ratio	2.3429	2.3429	2.3429	2.3429	0.1041	2.3429	0.00277179
% Error	3.141%	1.163%	1.156%	5.063%	6.603%	1.168%	-0.338%

Table VI. Comparison-of-means data

Ar Ratio	Mean	Std. Dev. (s)	n	s^2
MMhb-1	0.1117	0.000373366	2	1.39402E-07
TCR	2.3910	0.030623973	11	0.000937828
Age Ratio				
MMhb-1	0.1042	0	2	0
TCR	2.3451	0.008511482	11	7.24453E-05

Table VII. Comparison of means calculation

Comparison of Means Calculation	MMhb-1	TCR
Pooled Estimate of Variance (s_p^2)	6.97011E-08	0.000505137
SQRT($s_p^2(1/n_1+1/n_2)$)	0.00026401	0.009583476
y_1-y_2	0.0075	0.0459
df (n_1+n_2-2)	2	20
$t_{\alpha/2}$ @ 95% confidence	4.303	2.086
t stat (Do=0)	28.52916064	4.786635516

$t_{\alpha/2}$ @ 95% confidence. Therefore, we can conclude that the differences in the mean are statistically significant to the 95% confidence level, so the underlying assumption of equation 9 is not met. This means that J and J' are not equal and the dates calculated for the unknown samples are not valid. With only one data point, we cannot draw conclusions about the difference in the means of the Mt. Vesuvius analysis.

Age/Error Relationship

Table VIII shows the average % error along with the "known age" of the fluence monitor for all 3 data sets. The fluence monitor for the Mt. Vesuvius study was Adler Creek sanidine (ACs).

From Table VIII, it appears that the older the assumed age of the fluence monitor, the greater the average error between the Ar and age ratios. At first glance it may seem that the % error is low, which validates the process. However, keep in mind that the error is the differences in the mean value of two sets of values that are supposed to be equal to one another. Therefore, the % error, by itself, does not provide enough information to determine if the values are in fact equal. The previous section provided the statistical comparison of the means to show that the values are not equal and the process is not valid. Graph 1 is the same data as in Table VIII along with a linear regression analysis trend line. From Graph 1, we see that there is a strong correlation between the assumed age of the fluence monitor and the % error. This indicates that the older the assumed age of the fluence monitor, the less valid the ages calculated from the process.

It should be noted that the first point in Graph 1 is from a different unknown sample, a different fluence monitor, and a different laboratory than the other two points. The other two points have the same unknown sample in common but use different fluence monitors and different laboratories. While these differences in the sources of the data can be problematic, the differences also make the high correlation more remarkable.

Proposed Follow-up Research

This study begins to show that $^{40}Ar/^{39}Ar$ dating may not be as valid as an absolute dating technique as some would like.

Table VIII. Average Error

Monitor	Age (Ma)	Avg % Error
ACs	1.19	-0.338
TCR	27.92	1.905
MMhb-1	513.9	6.742

Graph 1. Percent error between the Ar and Age Ratios for various fluence monitors

There appears to be a relationship such that the older the assumed date of the standard sample, the more the results err from the foundational equations. This relationship needs further exploration.

This could be done by irradiating a sample of unknown age with multiple fluence monitors of different assumed orders-of-magnitude ages in the same reactor at the same time. If the fluence monitor has an effect, the calculated age should be statistically significantly different. This will allow us to determine if there is a pattern to this relationship and possibly quantify the differences, which may lead to ways to calibrate $^{40}Ar/^{39}Ar$ dates from a young-earth perspective.

The value of this research to the young-earth community is that radioactive decay is a naturally occurring phenomenon. As such, we should be able to find a way to properly use this to make scientific discoveries about the age of the earth within the context of Scripture. The RATE project initiated this approach. They found that "one fundamental conclusion is that radioactive half-lives have not remained constant throughout the earth's history" (DeYoung, 2005, p. 142). The proposed research may continue down the road of discovery and quantification of those changes.

Conclusions

A method for validating $^{40}Ar/^{39}Ar$ dates was introduced and used to show that the $^{40}Ar/^{39}Ar$ dates obtained by Dalrymple et al. (1993) are not valid. There also appears to be a problem with the assumed age of the fluence monitor affecting the calculated age of the unknown sample. The observed relationship is that the older the assumed age of the fluence monitor, the greater the percent error of the analysis. The ability of $^{40}Ar/^{39}Ar$ dating to provide absolute ages is questionable.

A side conclusion is that claims that the Mt. Vesuvius analysis of Renne et al. (1997) demonstrates the accuracy of

$^{40}Ar/^{39}Ar$ dating are not correct. This study gave a date that is 72% older than the known eruption date.

Acknowledgments: I want to express appreciation to Dr. Joel Klenck, Dr. Don DeYoung, Dr. Andrew Snelling, Dr. Gene Chaffin, and the First Coast Creation Society for their encouragement and help with this article. I also want to thank Creation Education Resources, Inc. for funding the research for this article.

References

Austin, S. A. 1996. Excess argon within mineral concentrates from the New Dacite Lava Dome at Mount St. Helens volcano. *Journal of Creation* 10(3):335–343.

Dalrymple, G. B., G. A. Isett, L.W. Snee, and J.D. Obradovich. 1993. $^{40}Ar/^{39}Ar$ age spectra and total-fusion ages for tektites from Cretaceous-Tertiary boundary sedimentary rocks in the Beloc Formation, Haiti. *U.S. Geological Survey Bulletin* 2065, United States Government Printing Office, Washington DC.

Damon, P.E., A.W. Laughlin, and J.K. Percious. 1967. Problem of excess argon-40 in volcanic rocks. In *Radioactive Dating and Methods of Low-Level Counting*, pp. 463–481. International Atomic Energy Agency, Vienna, Austria.

DeYoung, D. 2005. *Thousands Not Billions*. Master Books, Green Forest, AR.

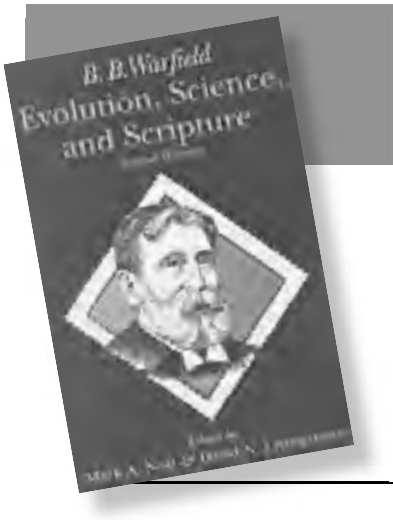
McDougall, I., and T.M. Harrison. 1999. *Geochronology and Thermochronology by the $^{40}Ar/^{39}Ar$ Method*, 2nd Edition. Oxford University Press, New York, NY.

Mendenhall, W., and T. Sincich.1989. *A Second Course in Business Statistics: Regression Analysis*, 3rd Edition. Collier Macmillian, London, UK.

Merrihue, C., and G. Turner. 1966. Potassium-argon dating by activation with fast neutrons. *Journal of Geophysical Research* 71:2852–2857.

Renne, P.R., W.D. Sharp, A.L. Deino, G. Orsi, and L. Civetta.1997. $^{40}Ar/^{39}Ar$ dating into the historical realm: calibration against Pliny the Younger. *Science* 277:1279–1280.

Snelling, A. A. 1998. The cause of anomalous potassium-argon "ages" for recent andesite flows at Mt. Ngauruhoe, New Zeland, and the implications for potassium-argon "dating." In Walsh, R.E. (editor), *Proceedings of the Fourth International Conference on Creationism*, pp 503–525.Creation Science Fellowship, Pittsburgh, PA.



Book Review

Evolution, Science, and Scripture: Selected Writings of B. B. Warfield

edited by Mark Noll and David Livingstone

Baker Books, Grand Rapids, 2000, 347 pages, $24.00.

Twenty-first-century creation scientists will be pleasantly surprised at what they may learn from a nineteenth-century theologian who accepted Darwinism. Considering Warfield's acceptance of both Darwinism and Christianity as a model to emulate in our own day, Noll and Livingstone have reprinted a great number of his relevant book reviews and essays. Their notes, as well as the introductory essay, help the reader understand Warfield's context. Notwithstanding the editors' purpose, many of his observations, which this review will highlight, are critical of Darwinism.

This book is a sequel to the authors' reprint of Charles Hodge's rebuttal of evolution (1994) and Noll's earlier work (1983) on Princeton Theological Seminary (PTS). According to Hodge, Warfield's predecessor at Princeton, Darwinism was atheism because it denied teleology. Wells (1996) reviewed this Hodge reprint from the intelligent design perspective. A strong defender of Biblical inerrancy, Warfield was professor of theology at Princeton from 1887 until his death in 1921. On a personal note, my grandfather, a PTS alumnus of that era, likewise held a high view of Scripture, though he opposed Darwinism. Dembski (2001) provided a recent

perspective on PTS from the intelligent design perspective.

In the real world, Warfield observed, there is no such thing as an objective scientific voice. Instead there are the many voices of subjective scientists (p. 329). Science should be in submission to Biblical revelation: "Science is not fact, but human reading of fact; and any human reading of fact may well bow humbly before the reading given by God" (p. 174). Concerning certain books promoting Darwinism, he wrote that if these authors hadn't assumed evolution in the first place, then it wouldn't have appeared in their conclusions (p. 184). Though Darwinists appeal to lots of time to bring about development, time itself is not a sufficient cause (pp. 228, 274). Another perceptive comment is that survival of the fittest may be only a "theory that fits in best with the presuppositions and prejudices of the times" (p. 264).

Similar comments to Warfield's in 1916 could be repeated in the twenty-first century: "We are rather surprised to find Mr. Shearman still operating with the embryonic-recapitulation theory … We have supposed that this notion had been long since exploded" (p. 320).

Commenting on Hubrecht's research that primates did not form easily into a phylogenetic tree, Warfield wrote that giving "the lines of descent more and more the aspect of parallel lines is certainly not to say that the progress of research is in the direction of establishing the original evolutionary assumption" (pp. 185–186). In fact, this evidence appears to support the young-earth hypothesis of original *baramins* having only limited development. Warfield's observation is similar to the often-suggested creation "orchard."

Though natural selection worked on the stream of descent, it didn't produce it in the first place (p. 239). Concerning abiogenesis, Warfield questioned how the earliest environment could produce an organism out of adaptation to itself (pp. 266–267). He also wondered why a tolerable adaptation hadn't been reached long ago, so that evolution should have ceased. Devoid of the observation of facts, theories of evolution have a highly speculative character. He wrote that Darwinism itself suggests the need of a miracle (p. 244, 256). Again he questioned the notion that scientists are objective seekers of truth: "It almost seems at times that facts cannot be accepted unless a causo-mechanical theory be ready to account for them. This looks amazingly like basing facts on theory rather than theory on facts" (p. 246).

Warfield's 1888 lecture at PTS expounded the following reasons to doubt evolution, which students could nevertheless accept (pp. 122–125): (1) Darwin defended his theory against the fossil record rather than using it as positive evidence. (2) Embryonic development shouldn't keep the variations from past generations since these are no longer found in the fetus. Therefore the embryonic recapitulation argument for evolution is illogical. (Recent studies also demonstrate that early proponents of this theory falsified the evidence.) (3) There is not enough time for evolution, undoubtedly based on Kelvin's arguments from global and solar cooling (pp. 40, 225, 275). Though since then some question Kelvin's estimates because of additional terrestrial heat from nuclear processes, Slusher and Gamwell (1978) argue that heat from this source is not sufficient and therefore this argument for a young earth stands. (To my knowledge neither side has quantified this, however.) (4) There are observed limits to biological change at present. (5) Phylogenesis parallels these limits (e.g. Hubrecht's primates mentioned above).

Though Warfield believed in an old earth, in 1903 he acknowledged that "students of the Bible" and "Bible readers at large" dated the creation of the globe to only a few thousand years ago (pp. 216–217, 271). He didn't mention the teachings of Seventh-Day Adventists (SDAs). This constitutes additional evidence against the mistaken hypothesis of Noll and other historians that evangelical belief in a young earth is derived from SDAs. Warfield contrasted the Biblical Fall of man from innocence into transgression with the evolutionary rise of man to morality. For evolution, the Fall, instead of being a crisis of morality, was a condition of morality (pp. 128–129).

Warfield challenged Robinson's idea that the soul was latently present in the original creation, emerging without divine intervention (p. 290). In 1905, James Orr mentioned the impossibility of the disparate development of man's mind and body. Therefore it is not feasible that man's body developed by the accumulation of small mutations from a brute and that the soul was created all at once by divine fiat for the physically completed man (pp. 232–233). Warfield responded that this objection might not hold against a theory of evolution by leaps (the punctuated equilibrium theory). However, when Orr stated that no Scripture teaches that animals suffer death because of man's sin, Warfield responded that the creation being cursed for man's sake and which will be delivered with man from the bondage of corruption [Romans 8:19–22] might be evidence for this position (p. 236).

Denying the supernatural, some scientists were enemies of Christianity (p. 327) in Warfield's day: "Any science which leaves no place for these facts [miracles] as such is not neutral but antagonistic to Christianity, and between that science and this religion there must be no eternal peace but eternal war."

The Anglican clergyman and scientist John Polkinghorne (1999), whom Noll and Livingstone consider a follower of Warfield (p. 15), opposed him, however, on this crucial point. Warfield noted that evolution is a philosophy of the universe allowing only natural causes and "has no claim to be called science" (pp. 130–131, 160–161.)

Reviewing Shearman's assertion that although Darwin didn't demonstrate how evolution occurred, he had proved it did occur, Warfield rejoined that if the method of evolution wasn't proven, then evolution itself wasn't yet proven (p. 319). His argument is still useful today in light of the conflicting ideas on how evolution occurred, whether by a neo-Darwinian slow and gradual change, by leaps (punctuated equilibrium), or by a quasi-pantheistic symbiosis.

Darwinism was not immune from critical examination in Warfield's class. His pedagogy was to "teach the controversy." Evangelicals tempted to accept evolution should consider Machen's prescient warning that naturalism, discontented with occupying Christianity's lower sphere (origins), forces its way into the citadel (denying the deity and miracles of Christ). Creation scientists concur with Noll and Livingstone, however, that Warfield was a worthy example in that he critically examined evolution and taught the surprisingly still relevant scientific evidence against it.

References

Dembski, William and Richardson (editors). 2001. *Unapologetic Apologetics*. InterVarsity Press, Downers Grove, IL.

Hodge, Charles. 1994. *What Is Darwnism?* Edited by M. Noll and D. Livingstone. Baker, Grand Rapids, MI. (Orig. pub. 1874).

Noll, Mark (editor and compiler). 1983. *The Princeton Theology: 1812–1921*. Baker, Grand Rapids, MI.

Polkinghorne, John. 1999. Statement that God may not intervene in the cosmos because this would be "capricious," Theology and the New Physics conference at Calvin College, April 16. Grand Rapids, MI.

Slusher, Harold, and Thomas Gamwell. 1978. *The Age of the Earth*. Technical Monograph No. 7. Institute for Creation Research, El Cajon, CA.

Wells, Jonathan. 1996. Politically dead wrong. *Origins & Design* 17:2. Also online at http://www.arn.org.

John Goertzen
bluejay@birdlover.com

Book Review

Our Created Moon: Earth's Fascinating Neighbor

by Don DeYoung and John Whitcomb

Master Books, Green Forest, AR, 2010, 94 pages, $16.00.

This colorful book is an updated version of DeYoung and Whitcomb's previous book with the same title. This edition contains 46 questions divided into five sections, each dealing with a different aspect of the moon's special place in creation. Topics include the history of the moon and moon references in Scripture. One of the most interesting sections concerns the many purposes of the moon. This includes the importance of our moon to life on earth. For example, the moon protects the earth from space collisions, provides an energy source for the ocean currents, and is the main cause of the tides. In addition, the moon provides light for the earth at night and has provided calendar systems throughout history. These are just some of the many vital purposes the moon serves for humanity.

Scattered throughout the book are vocabulary words, fun facts, moon activities, and suggestions for further study. It has the potential to be used at home or in school as an educational resource. There are many beautiful pictures of the moon, as well as tables and diagrams that make the answers easy to understand. There are two appendices that focus on observing the moon and possible future space travel to the moon. An index, glossary of terms, and list of references located in the back complete the book.

This book maintains the strong dedication to Scripture and the understandable writing style of the earlier edition and will be a valuable asset to anyone interested in learning more about our very different yet very special neighbor, the moon.

Jeremy Maurer
maurerjl@grace.edu

The Mystery of Trilobite Evolution

Jerry Bergman*

Abstract

One of the most ancient of all known fossils is the trilobite. Fortunately, a large number of well-preserved examples exist that allow a detailed study of this complex animal. As a result, much is known about it, including its external morphology and even its advanced, well-designed, complex eye. Research on the trilobite eye shows that it is far more complex and better designed than thought, even just a few years ago. This paper concludes that no evidence exists in the fossil record for trilobite evolution from lower forms of life and that the first trilobite was unequivocally a trilobite.

Introduction

Trilobita is a large class of extinct marine arthropods that were very abundant in both the Cambrian and Ordovician periods of history, with a range extending up into the Permian. They are believed by evolutionists to have flourished between about 250 and 521 million years ago (Schaefer, 2001). The trilobite fossil record extends all the way back to the lower Cambrian and possibly even the Precambrian (Waggner, 1999). Trilobite fossils are also so numerous that they are now one of the best known and documented extinct arthropods (Hartmann, 2007). They are also, by far, the most diverse of all extinct arthropods—so far, about 20,541 species, over 5,000 genera, and 165 families have been identified (Rábano and Gozalo, 2008). Most trilobitologists believe that, ecologically, trilobite habitats ranged from reefs to deep-water bottoms, and evidence exists as well that some were very efficient swimmers.

The enormous number of well-preserved trilobite fossils uncovered so far has allowed a detailed study of the animal's history and anatomy. Due to "unusually good fossil preservation," scholars also "know a good deal about the anatomy of the softer parts of trilobites," including their internal organs (Waggner, 1999, p. 1288). For all of these reasons trilobites are an excellent life-form to investigate the validity of macroevolution (Fortey and Owens, 1990).

Trilobite Evolution

The thousands of trilobite fossils uncovered in the past two centuries have yet to reveal evidence for a step-by-step evolution of more "primitive" ancestors leading up to the first trilobite. No evolutionary history exists for the first trilobites, when such evidence should be abundant due to the preservation quality of the hard trilobite shell, its commonality in the ancient world, and its abundant, well-preserved fossil record. Instead, what is found is enormous morphological variation *after* they appear in the fossil record. As two trilobite experts have opined:

> The introduction of a variety of organisms in the early Cambrian, including such complex forms of the arthropods as the trilobites, is surprising ... The introduction of abundant [trilobite] organisms in the record would not be so surprising if they were simple. Why should such complex organic forms be in rocks about six hundred million years old and be absent or unrecognized in the

* Jerry Bergman, Ph.D., Biology Department, Northwest State College, jbergman@northweststate.edu

Accepted for publication August 26, 2009

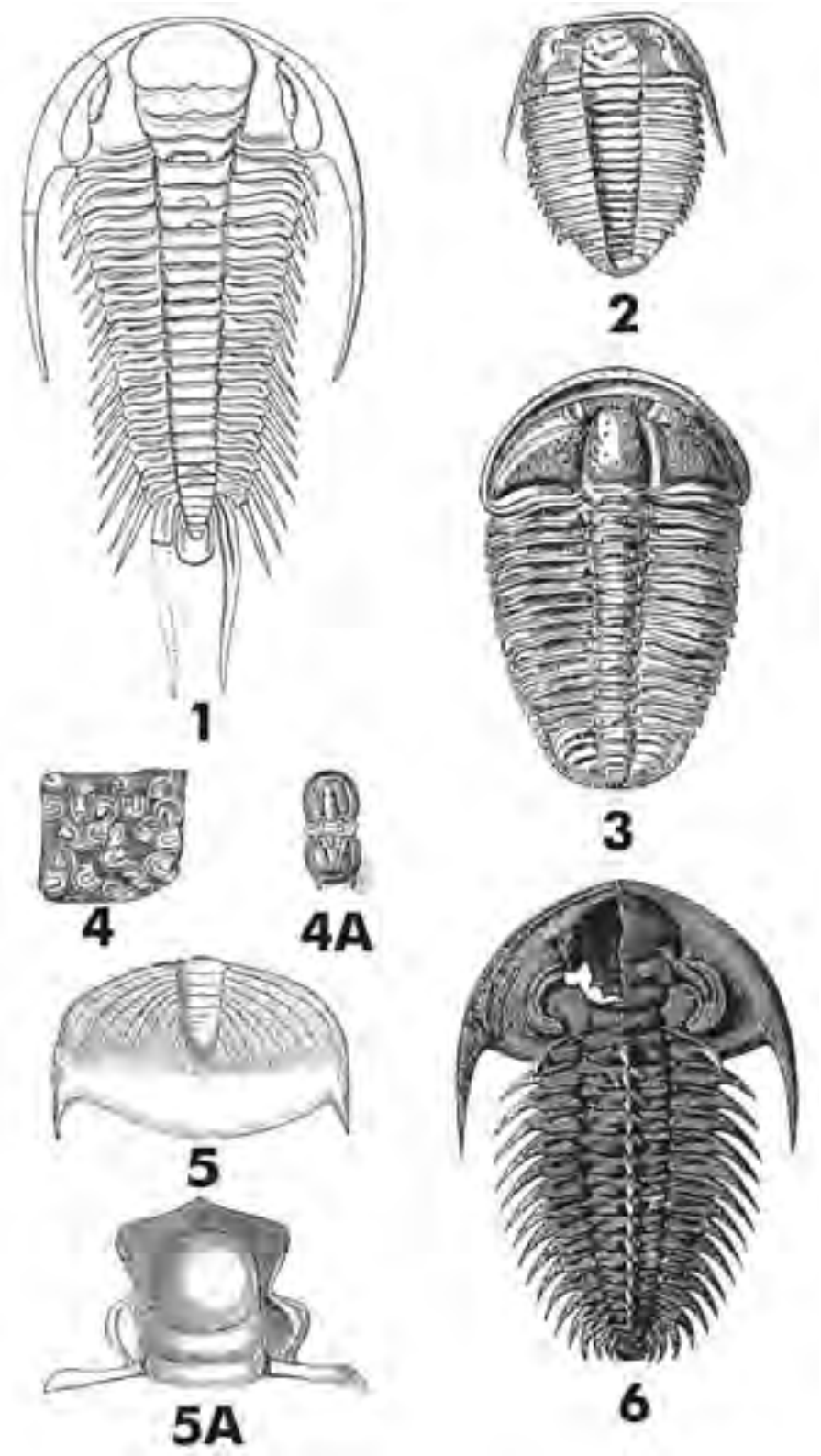


Figure 1. A selection of Cambrian trilobites showing their variety (1, 2, 3, 6), their common group assembly in the fossil record (4), an individual trilobite taken from 4 (4a), the trilobite tail shield (5), and the central part of a trilobite head (5a). Adapted from Kayser and Lake (1893).

> records of the preceding two billion years? If organisms evolved, it should have taken a long time for them to have developed into forms such as the arthropods … If there has been evolution of life, the absence of the requisite fossils in the rocks older than the Cambrian is puzzling. (Kay and Colbert, 1965, pp. 102–103)

Others have concluded that "the variety and structural complexity of trilobites found near the base of Cambrian rocks surely indicates a very long antecedent existence of animal life … No one has thus far been able to discover any fossil evidence to support this required long antecedent existence" (Moore et al., 1952, p. 475). Furthermore, the trilobite "fossil record shows … new species with the new characters appearing abruptly in the early Ordovician" (Whittington, 1992, p. 90). Debate exists not only on trilobite origins but even over how they should be classified (Waggner, 1999).

Unequivocal evidence of trilobites does not appear in the fossil record until the Mid-Lower Cambrian. The Cambrian is divided into four series and ten stages, and trilobites appear below the beginning of series 2, stage 4. Thus, by evolutionary timetables, an estimated 21 million years of evolution are completely missing between the Precambrian-Cambrian boundary and the first recorded appearances of the Trilobita.

Evolutionists have faith that someday evidence for trilobite origins will be uncovered that explains the "abrupt appearance" problem, assuming that trilobite evolution occurred so rapidly that the likelihood of fossilization was small (Whittington, 1992, p. 90). This unsupported a priori conclusion assumes evolutionary theory in spite of the missing (but nonetheless required) evidence. Absent evidence is not positive evidence, and, considering the fact that an estimated 5,000 genera exist, this indicates that billions of transitional fossils must have once existed, and at least a few thousand clear examples should

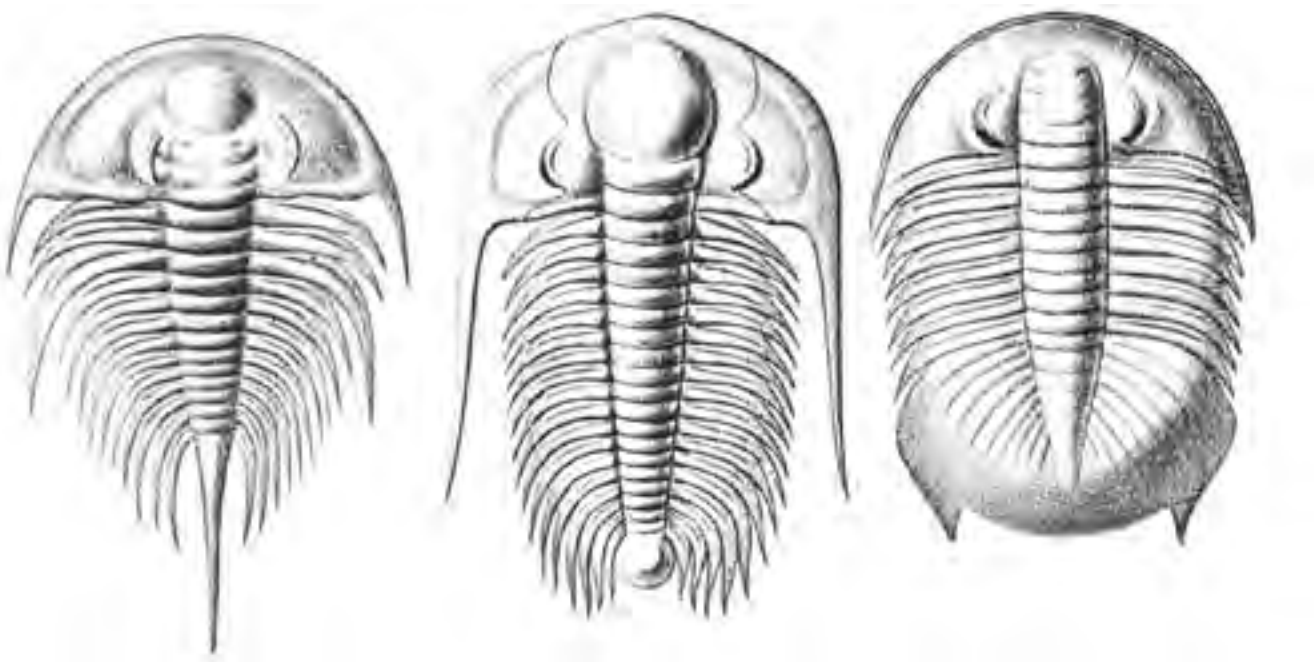


Figure 2. Three examples of Cambrian trilobites illustrating some of the enormous variety typical of trilobites. From Cleland (1925, p. 412). The author claims that "in nearly every particular they were very primitive or simple in structure" (pp. 412–413). It is now known that this is not true. The trilobite eye is the first known eye and is as advanced as many of the most modern eyes known. See text for details.

have been preserved in the fossil record. Gon (2007) noted:

> Some remarkable sites such as Chengjiang, Kaili, and the Burgess Shale reveal the rich diversity of non-calcified arachnomorph arthropods. The fossils of the Precambrian reveal some bilaterian diversity, among them a few species that *might be* candidates for trilobite ancestors. (p. 1, emphasis added)

These possible candidates were not selected on the basis of evidence, but because no other fossils are even plausible. Not only is the absence of trilobite ancestors "puzzling," but trilobite origins remains "cryptic" (Fortey et al., 1996) and assumes a "prior evolutionary history of which we know nothing" (Lipps and Signor, 1992, p. 345). Yet, evolutionists argue that trilobites "must have" somehow evolved from an as-of-yet-unknown ancestor. The stratigraphic sequence "does not present an unequivocal narrative of early trilobite evolution, and there *must have been* events in that evolution of which we have no record in the rocks" (Lipps and Signor, 1992, p. 345, emphasis added).

Actually, the trilobite is one of several thousand life-forms that suddenly appeared in the fossil record almost concurrently *with no trace of any ancestors*. Add to this the fact that field observations by trilobite specialists reveal stasis (i.e., little or no change) within the various trilobite species once they appeared in the fossil record (Eldredge, 1985). In one detailed study of trilobites, Eldredge concluded, "The most amazing feature of the entire *Phacops rana* [trilobite] story is its stasis—a persistence against change—through vast amount of time" (1972, p. 59). This problem is explained by Eldredge and Eldredge (1972) as follows:

> The fossil record is full of apparently sudden evolutionary jumps, where a parent species is followed by its daughter species without intermediate fossil links connecting the two. The traditional explanation for such jumps is an incomplete fossil record, but our findings contradict tradition. (p. 53)

Their solution to this problem is to suggest that:

> When conditions permitted, animals that had evolved far away and thousands, if not millions, of years previously, migrated to territories formerly occupied by their ancestors. The sudden jump effect in any one locality actually reflects the sudden appearance of a migrant that had already evolved elsewhere (Eldredge and Eldredge, 1972, p. 53).

The problem with this explanation is that no evidence exists *anywhere* for trilobite evolution from lower forms of life. It is significant that much evidence exists for small adaptive changes within

Figure 3. An unusual trilobite that contains prominent eyestalks. Picture courtesy of David Lines and Creation Evidence Museum.

the Trilobita, but none for its putative ancestors. For this reason migration does not explain their sudden appearance in the fossil record. Another problem is that the wide "diversity of fossil trilobites poses a challenge to traditional evolutionary theory" (Eldredge, 1980, p. 47) because no evidence exists that they evolved elsewhere.

Eldredge (1980, 1985) also tried to explain the origin of Trilobita and the whole problem of a lack of transitional fossils by a theory he and Stephen Jay Gould developed called *punctuated equilibrium*. This theory says that while stasis (stability) is the norm in animal history, it is interrupted by rapid evolution, evolution so rapid that no fossil record has been left today. The problem with this idea is that the theory is not based on evidence but rather on the lack of evidence. Eldredge and others (e.g., Gould, 2002) have documented microevolutionary change within the Trilobita, but no one has been able to document either a trilobite ancestor or descendent.

One evolutionary change noted in the fossil record is that Cambrian trilobites display much variability, and later, in the Ordovician, trilobites display *much less* variability, the opposite of that predicted by Darwinian evolution (Hunt, 2007). The trilobites were very abundant in the Cambrian (217 families) and the Ordovician (149 families), but by the Silurian only 44 trilobite families remained because many trilobite families had gone, or were going, extinct. Why they became extinct is unknown, although many theories have been proposed.

The Trilobite Eye

The trilobite eye has been the focus of much research because trilobites possessed the first known "compound" (multi-lensed) eye design type (specifically the diopter apparatus) that has been preserved in detail in the fossil record. Marine biologist Richard Ellis called the compound trilobite eye, a system containing hundreds of lenses, "far more complicated than the eyes of any vertebrates" (Ellis, 2001, p. 7). Paleontologists claim that the trilobite not only had "highly organized visual organs, but some of the recently discovered properties of trilobites' eye lenses represent an all-time feat of function optimization ... a very successful scheme of eye structure: the composite or compound eye" (Levi-Setti, 1993, p. 29).

Although the trilobite eye is the oldest eye of which we have fossil evidence (Sinclair, 1985, p. 9), the once misnamed "simple primitive" trilobite eye is now known to be an incredibly well-designed, complex optical-chemical system. A half-century ago Duke-Elder (1958, pp. 156–157) wrote that a

major problem in proving the evolution of vision is that in "the earliest fossils known to man—the Trilobites ... both median ocelli and lateral compound eyes are present which have reached a high stage of complexity."

Based on careful fossil study, researchers have concluded that trilobites could see exceptionally well, even though they often lived in the very deep (thus, very dark) sea bottom. One reason why is because the trilobite eye lens was designed specifically to function in low-light water environments. To do this, trilobites "possessed the most sophisticated eye lenses ever produced," and their vision may actually have been superior to modern living animals (Shawver, 1974, p. 72).

A compound eye is constructed from a large array of separate eye optical elements called *ommatidia*. Each ommatidia was pointed in a different direction to allow the trilobite to simultaneously see in front, on each side, and behind, giving it a panoramic view of the world (Fortey et al., 2004). A network of neurons then translated the many optical images picked up by the compound eye photoreceptors into a single composite picture. Evidence of the effectiveness of this eye design is the fact that it is still widely used today by both insects and crustaceans (Levi-Setti, 1993).

The Trilobite Eye Lens

The eye lens used on each ommatidium is another example of the excellent trilobite design (Fernald, 1997, 2001). The corneal lens was constructed out of clear calcite crystals, a hard mineral with very unique optical properties well suited for underwater vision. The trilobite calcite lens is unique in the entire animal kingdom—most eye lenses are the "soft" type constructed out of cuticle (Fortey et al., 2000, p. 92). The trilobite design employed two separate layers called a *doublet*, each with different optical properties that functioned together as a unit to focus the image.

Trilobite eyes were usually hexagon shaped, but some used square, elongated clear calcite prisms (Fortey et al., 2000). The result was a design that had a huge advantage in low light, even compared to most highly developed eyes of living animals. The lens used the spherical aplanatic design that largely eliminated the spherical aberration problem, the distortion caused by the lens shape (Fortey et al., 2004). Spherical distortion causes the image to lose sharpness and become slightly distorted—especially at the lens periphery compared to the lens center.)

> This optical doublet is a device so typically associated with human invention that its discovery in trilobites comes as something of a shock. The realization that trilobites developed and used such devices half a billion years ago makes the shock even greater. And a final discovery—that the refracting interface between the two lens elements in a trilobite's eye was designed in accordance with optical constructions worked out by Descartes and Huygens in the mid-seventeenth century—borders on sheer science fiction. (Levi-Setti, 1993, p. 54)

The Three Basic Trilobite Eye Designs

A large amount of variety exists in both the body and the eye design of

Figure 4. An example of an unidentified trilobite still largely embedded in rock, showing the challenge of removing them from solid rock. It is partly rolled up in a ball and appears to have been forced into the mud. Picture courtesy of David Lines and Creation Evidence Museum.

the estimated 5,000 different trilobite genera. For example, specific trilobite eye design varied according to the light environment in which the trilobite lived (Clarkson, 1975). Some trilobites were equipped with eyes that used a few lenses; others had eyes with lenses numbering in the thousands. Some eyes took up most of the cephalic surface, and others were fairly small. The most common eye design was a turret shape that produced a combined visual field able to survey the animal's entire surroundings (Levi-Setti, 1993).

Three basic designs exist: the *holochroal*, the *schizochroal*, and the *abathochroal*. The *holochroal* variety was both the most common and the most complex trilobite eye design. This design consisted of thousands of small hexagonal-shaped lenses that functioned together as a unit. Each lens used a shelled, biconvex design consisting of a thin calcite lamellae covered by a protective film. This design, utilized in all trilobite orders, is found in many different species. Post-Cambrian trilobites, though, tended to have thicker lenses.

The second trilobite eye type, the aggregate or *schizochroal* eye, was similar to the holochroal type except that it had fewer and larger biconvex lenses that were set in a turret-like arrangement, separated by an intrascleral membrane. This "highly sophisticated" eye design is found only in the Phacopida trilobite order and is a "visual system quite different from any other eye that has ever appeared in the animal kingdom" (Levi-Setti, 1993, p. 43; see also Fortey et al., 2004, p. 449). This eye appeared fully formed in the fossil record during the late Cambrian period. The juvenile holochroal eye resembled a schizochroal eye, and Darwinists believe that it was paedomorphically derived—paedomorphosis being the retention of ancestral juvenile characteristics into adulthood (Clarkson, 1975).

The last basic trilobite eye type, the *abathochroal* form, resembled a schizochroal eye, except that it did not have interlensral membranes between individual lenses. This design was utilized in only a few types of Cambrian trilobites.

A few eyeless trilobite species also existed, all of which lived in the darkness of the deep sea floor below the photic (sunlit) zone (Fortey et al., 2004, p. 449). Instead of labeling these trilobites more primitive than sighted trilobites, because lobsters and other crustaceans that live on the deep sea floor are also eyeless, evolutionists speculate that their eyes were slowly lost during evolution. The Darwinist's explanation of the origin of the trilobite eye design is that:

> through natural selection operating on chance variations—trilobites evolved a remarkably sophisticated optical system. For an optical engineer to develop such a system would require considerable knowledge of such things as Fermat's principle, Abbe's sine law, Shell's laws of refraction, the optics of birefringent crystals, and quite a bit of ingenuity. (Stanley and Raup, 1978, p. 182)

Lack of fossil evidence has forced scientists to speculate on the path of trilobite evolution, and lack of evidence for trilobite eye evolution is especially problematic for Darwin's theory. For this reason "views on eye evolution have flip-flopped, alternately favoring one or many origins" (Fernald, 2006, p. 1917). The trilobite eye is the earliest known eye existing in the fossil record, yet it is extremely well designed. It is not primitive but, rather, a highly advanced and very effective eye, especially given the trilobites' typical environment at the bottom of deep water that normally is close to completely dark.

Conclusions

As Whittington notes, trilobites pose two major problems in evolution: the "abrupt appearance of different kinds of trilobites in the Lower Cambrian" and their replacement by new trilobites during the transition from the Cambrian to Ordovician (Whittington, 1992, p. 84). He adds that "no evidence, such as a transitional series of fossils" exists to support trilobite evolution, concluding that there exists "no lack of either interpretation or speculation" (Whittington, 1992, pp. 84–85).

As to why no evidence exists, he stresses only that "what is needed is evidence" (Whittington, 1992, p. 85). Whittington lists a critical appraisal of existing collections, and asserts that a search for new material relevant to these problems from promising sites is a start needed to find the evidence that he believes exists, based on his Darwinist worldview. However, after decades of new fossil discoveries by many researchers, the picture remains the same—no transitional fossils exist for their origins. In short, "trilobites are both complex and diverse when they appear in the lower Cambrian." (Black, 1988, p. 158)

Trilobite eyes, which, as documented in this review, are among the most complex eyes known, appeared abruptly and *very early* in the fossil record. The trilobite eye optics were anything but primitive and would have required an enormous amount of time to evolve, but there are no documented ancestral precursors.

Although trilobite eyes are well preserved and abundant in the fossil record, no evidence exists of their evolution—they appear fully formed in the fossil record. The external similarities of the "primitive" trilobite eye "to those of some modern insects (for example, the ant) is quite remarkable" (Levi-Setti, 1993, p. 34). From similar comparisons the schizochroal eye "probably evolved from the holochroal eye" (Levi-Setti, 1993, p. 34), a conclusion based solely on morphological comparisons, not fossil evidence.

Summary

Trilobites are an "impressive feat of early evolution," but even though they were the most prevalent animal in the Cambrian Sea and an abundant fossil record exists that some conclude dates back to the early Cambrian, no evidence of trilobite evolution from its putative ancestors has yet been uncovered (Shawver, 1974, pp. 72–73). The nonexistent evidence for trilobite evolutionary origins in the fossil record is one factor that motivated Eldredge (1977) to conclude that "to the present day, we paleontologists have managed to contribute relatively little to explicit theories of the evolutionary process" (p. 308). Specifically, trilobite species "tend to remain relatively unchanged … throughout their stratigraphy ranges" (Eldredge, 1977, p. 309).

This is especially true of trilobite eye evolution. The most that scientists can now conclude is that we "have some understanding of how eyes *might* have evolved" (Fernald, 2004, p. 141, emphasis mine). As Levi-Setti (1993, p. 54) concluded, the "real surprise" is not that the trilobite eyes functioned according to the laws of physics, but that their "basic lens designs" were engineered "with such ingenuity." (p. 54). This evidence contradicts Darwin's (1859) prediction that the earliest eyes should be primitive and that a large number of transitional forms proving eye evolution from simple to complex would be found in the fossil record.

Acknowledgments: I wish to thank Jody Allen, Clifford Lillo, and John UpChurch for their comments on an earlier draft of the manuscript

References

Black, R. 1988. *The Elements of Palaeontology,* 2nd Edition. Cambridge University Press, Cambridge, UK.

Clarkson, E.N.K. 1975. The evolution of the eye in trilobites. *Fossils and Strata* 4:7–31.

Cleland, H. 1925. *Geology: Physical and Historical*. American Book Company, New York, NY.

Darwin, C. 1859. *The Origin of Species*. John Murray, London, UK.

Duke-Elder, S. 1958. *System of Ophthalmology, Volume 1: The Eye in Evolution*. Mosby, St. Louis, MO.

Eldredge, N. 1977. Trilobites and Evolutionary Patterns. In Hallman, A. (editor), *Patterns of Evolution*, pp. 306–332. Elsevier, New York, NY.

Eldredge, N. 1980. An extravagance of species. *Natural History* 89:46–51.

Eldredge, N. 1985. *Timeframes.* Princeton University Press, Princeton, NJ.

Eldredge, N., and M. Eldredge. 1972. A trilobite odyssey. *Natural History* 81:53–59.

Ellis, R. 2001. *Aquagenesis: The Origin and Evolution of Life in the Sea*. Viking, New York, NY.

Fernald, R. 1997. The evolution of eyes. *Brain, Behavior and Evolution* 50(4):253–259.

Fernald, R. 2001. The evolution of eyes. *Karger Gazette* 64:1–4.

Fernald, R. 2004. Eyes: variety, development and evolution. *Brain, Behavior and Evolution* 64(3):141–147.

Fernald, R. 2006. Casting a genetic light on the evolution of eyes. *Science* 313:1914–1918.

Fortey, R.A., and R.M. Owens. 1990. Trilobites. In Kenneth J. McNamara (editor), *Evolutionary Trends,* pp. 121–142. The University of Arizona Press, Tucson, AZ.

Fortey, R.A., R.M. Owens, D.E.G. Briggs, and M.A. Wills. 1996. The Cambrian Evolutionary "explosion": decoupling cladogenesis from morphological disparity. *Biological Journal of the Linnaean Society* 57:13–33

Fortey, R.A., R.M. Owens, D.E.G. Briggs, and M.A. Wills. 2000. *Trilobite! Eyewitness to Evolution*. Knopf, New York, NY.

Fortey, R.A., R.M. Owens, D.E.G. Briggs, and M.A. Wills. 2004. The lifestyles of the trilobites: these denizens of the Paleozoic Era seas were surprisingly diverse. *American Scientist* 92:446–453.

Gon, S.M., III. 2007. The question 'where did trilobites come from' is not so simple to answer. Origins of Trilobites. http://www.trilobites.info/origins.htm (as of June 14, 2008).

Gould, S. 2002. *The Structure of Evolutionary Theory.* Harvard University Press, Cambridge, MA.

Hartmann, A. 2007. Rapid evolution in early trilobites fueled by high variation. *Geotimes*. http://www.geotimes.org/july07/article.html?id=WebExtra072707.html (as of September 21, 2009).

Hunt, G. 2007. Variation and early evolution. *Science* 317:459–460.

Kay, M., and E.H. Colbert. 1965. *Stratigraphy and Life History*. Wiley, New York, NY.

Kayser, E., and P. Lake. 1893. *Text Book of Comparative Geology*. Macmillan, New York, NY.

Levi-Setti, R. 1993. *Trilobites.* University of Chicago Press, Chicago, IL.

Lipps, J.H., and P.W. Signor. 1992. *Origin and Early Evolution of the Metazoa*. Springer Press, New York, NY.

Moore, R.C., C.G. Lalicker, and A.G. Fischer. 1952. *Invertebrate Fossils*. McGraw Hill, New York, NY.

Rábano I., and R. Gozalo (editors). 2008. *Advances in Trilobite Research: Proceedings of the* Fourth *International Trilobite Conference*. Toledo, Spain.

Schaefer, L. 2001. *Trilobites.* Richard C. Owen Publishers, Inc., Katonah, NY.

Shawver, L.J. 1974. Trilobite eyes: an impressive feat of early evolution. *Science News* 105:72–73.

Sinclair, S. 1985. *How Animals See*. Facts of Life, New York, NY.

Stanley, S., and D. Raup. 1978. *Principles of Paleontology*, 2nd Edition. W. H. Freeman, San Francisco, CA.

Waggner, B. 1999. Trilobites. In Singer, R. (editor), *Encyclopedia of Paleontology*, pp. 1288–1295. Fitzory Dearborn Publishers, Chicago, IL.

Whittington, H.B. 1992. *Trilobites*. The Boydell Press, Suffolk, UK.

Book Review

The Ultimate Proof of Creation: Resolving the Origins Debate

by Jason Lisle

Master Books, Green Forrest, AR, 2009, 254 pages, $14.00

On the question of method, among creationists there seem to be two schools, perhaps based on personality. One type is the practical professional scientist, the person who loves scientific creationism and detailed technical arguments. This school burst into twentieth-century positivism, gained a firm foothold, and assured Christians that they need not bend the knee to Baal just because he was wearing a white lab coat. The other type is the theologian/philosopher, focusing on secular theories as manifestations of complex webs we have come to call worldviews. These must be addressed by logical, philosophical, and theological arguments.

Both are necessary and, fortunately, often work well together. However, many scientists lack the interest or background to pursue theology and philosophy, and many professional theologians and philosophers are intimidated by science. Although scientific discourse is moving forward, there is a growing emphasis on debating worldviews, and this contribution comes from Jason Lisle. In *The Ultimate Proof of Creation*, he zeroes in on the primary weakness of naturalism: It is self-refuting because its foundational axioms can be justified only by Biblical Christianity. The argument has many benefits: (1) As an issue of logical validity, it is conclusive apart from science (Reed, 1996a), (2) it is accessible to Christians not trained in the sciences (Reed, 1996a), and (3) it is lethally direct.

Though not original to Lisle (e.g., Glover, 1984; Hooykaas, 1999; Klevberg, 1999; Reed, 1996a, 1996b, 2000a, 2000b, 2005; Reed et al., 2004; Stark, 2003), this book is easily the most accessible and well-developed discussion of this argument. It includes background on logic, as well as real-life examples employing his argument that most will find helpful. Finally, Jason Lisle does a bang-up job of creating a flow that takes you from the basics to more complex issues in a well-developed, rational sequence.

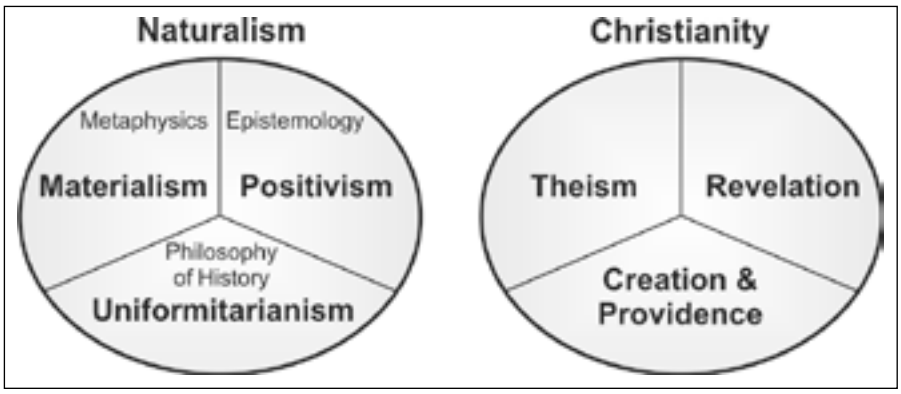
In his first chapter, Dr. Lisle reviews scientific arguments, concluding that though these are significant, both Christianity and naturalism—being worldviews—must be addressed as such: "The ultimate proof of biblical creation must deal with worldviews" (p. 29). Like Schlossberg (1983) and Noebel (1991), Lisle sees naturalism as an idolatrous religious construct. In the second chapter, he draws an obvious inference: there is no neutral ground in this fight, and secularists have used that chimera to lure Christians away from their Biblical foundations.

It is important to distinguish between "neutral ground" and "common ground." The former is impossible; the two worldviews are diametrically opposed, and for a Christian to abandon revelation—the epistemological basis of his worldview—is to commit rational suicide. Yet the latter is possible because: (1) Every man is created in God's image, and (2) naturalism glorifies science, the child of Christianity (Glover, 1984; Hooykaas, 1972; 1999; Reed et al., 2004; Stark, 2003). The problem is not that science and reason are not valid methods. It is the secular insistence that they are the only way to incorrigible truth that falsifies their position. Since both reason and science are products of the Christian worldview, there is common ground, but neutrality is a myth.

As an aside, this is a primary error of the intelligent design (ID) school. When it began, it hoped to be the "wedge of truth" between Biblical creation and secular natural history. Intelligent design advocates assumed that a denatured version that emphasized "common ground" would unveil a "neutrality" that would allow ID to go where Biblical creationism could not. The past two decades have vindicated Dr. Lisle's assertion of the impossibility of neutrality—an extension of Christian dogma dating back to the teaching by Jesus that people are either for or against Him.

Lisle continues in the second chapter, noting a crucial foundation: that worldviews can be comparatively assessed by the truth test of consistency. Then he notes that Christian epistemology opens the door to truth, while natu-

ralism does not. A logical comparison of the two worldviews is aided by defining their essentials, as is done in the following figure (Reed, 2000b).



Lisle concludes the chapter noting the necessity of justifying a worldview's axioms, which turns out to be the fatal weakness of naturalism. This follows the thought of C. S. Lewis and Francis Schaeffer, who both exploited this weakness in naturalism, even though they did not make the final positive connection to the corresponding strength of Christianity in its doctrine of Creation (Glover, 1984; Reed, 1996b). Their failure to do so illustrates the power of Enlightenment propaganda about both history and science that has only recently begun to crumble (Stark, 2003).

Chapter 3 takes us into the heart of the book. Lisle begins immediately, "The evolutionist must use biblical creation principles in order to argue against biblical creation" (p. 45). As Reed et al. (2004, p. 216) noted: "Naturalism is highly susceptible… since its virulently anti-Christian exterior rests on presuppositions derived from Christian theology." Lisle goes on to discuss the laws of logic, uniformity (cf. Reed, 1998; 2010), and the preconditions for science. Ironically, he concludes that the evolutionist is guilty of the sins of which he accuses the Christian—being arbitrary and depending on blind faith. Hogan (2010) recently discussed a facet of this in addressing the growing realization by secular philosophers that science cannot be defined absent an absolute standard.

Chapter 4 builds on the necessity and importance of presuppositions to worldviews and develops a technique called "Answer: Don't Answer" to apply this truth to the origins debate. It is this kind of Biblically centered (Proverbs) and practical advice that makes this book so valuable. His primary goal is to push the evolutionist to understand that he cannot make *any* argument from science without assuming some aspect of Christian reality. Then he supports this view with an assessment of human nature from Biblical theology, driving another nail into the coffin of the secularist. The Biblical view of man is predictive of sociological reality as we experience it, just as the Biblical view of Creation (nature and man) upholds science.

Chapter 5 provides a checklist for laymen intended to organize the apologetic arguments that Lisle calls the "AIP" test. "A" stands for arbitrariness, "I" for inconsistency, and "P" for preconditions. He carefully shows Christians how to detect and answer these fallacies in evolutionist arguments. An appendix provides real-life examples.

A potential argument against Dr. Lisle's approach is that it makes science irrelevant. He addresses this in chapter 6, where he discusses four uses of evidence: (1) confirming Biblical creation, (2) showing the necessity of worldviews, (3) showing inconsistency and arbitrariness, and (4) leading into the "ultimate proof" of naturalism's self-refuting nature. As he notes at the end, "God has called *everyone* to be ready to give a defense of the Christian faith" (p. 102). That supports his emphasis on the logical arguments because although everyone is not a scientist, everyone is (at some level) a philosopher (Adler, 1965).

The philosopher best known for explicating rules of logic is Aristotle. His ability to define, classify, clarify, and defend these rules makes his work relevant today. As Adler (1965) noted, Aristotle not only followed Plato in defining the first-order issues of philosophy, but he initiated the second-order critical and linguistic analysis prevalent today. In chapters 7 and 8, Lisle follows in this tradition, noting that most arguments about origins resolve to logical fallacies. So he spends these chapters providing a very good and readable summary of the elementary principles of logic and discussing numerous fallacies and how to answer them. These chapters alone make the book worth its price.

Finally, in chapters 9 and 10, Lisle moves into a deeper discussion of the apologetic basis for his approach. He begins by noting that everyone needs an ultimate standard as the foundation for truth. He goes on to say that the Bible is the only reasonable standard, because while appeal to its self-attesting nature is circular, it is not arbitrarily circular. At this point I diverge from the author and encourage the interested reader to delve into the various schools of apologetics to understand the underlying complexity of the subject. While not wanting to (or qualified to) write a treatise on apologetics, I will try to clarify Dr. Lisle's stance. He credits the teaching of the Presbyterian theologian Dr. Greg Bahnsen for his apologetic insight. Apologetically, Bahnsen was a follower of the Dutch theologian Cornelius Van Til, who in turn was a student of Herman Dooyeweerd of the Free University of Amsterdam. Van Til

wrote numerous books on apologetics in the mid-twentieth century, developing the school of thought that has come to be called "presuppositionalism." In Reformed circles, this school is continued by scholars like John Frame. However, it is opposed by other theologians like the late Gordon Clark and R. C. Sproul (Sproul et al., 1984), and in evangelical circles by thinkers like Norman Geisler. In my opinion, the basic argument of the self-refuting nature of naturalism does not require Van Til's self-attesting Scripture. In fact, Sproul's method of validating the Scriptures as God's Word would work equally well, since he arrives at the same point of the Bible as incorrigible truth but by a longer route.

Before wrapping up the apologetic side, a distinction made by Mortimer Adler (1965) is helpful. In defining philosophy, Adler noted the importance of two Greek terms for knowledge, *epistēmē* and *doxa*. The former refers to indubitable and incorrigible truth and the latter to contingent, testable truth. Adler noted that philosophy has found very little in the category of *epistēmē*, and that the pursuit of such knowledge has proven deleterious to philosophy throughout its history. It is no stretch to see the Bible as *epistēmē* and human disciplines of philosophy, science, and history as *doxa*. And that is a key question for Dr. Lisle's argument: What constitutes *epistēmē* and *doxa* in apologetics, in theology, in philosophy, and in science? If our arguments are to have the force of *epistēmē*, then what is the place of mutable knowledge, or *doxa*, in our thought? Or to put it theologically, can man possess God's certainty outside the Bible? If so, how does it extend to human disciplines, such as theology, philosophy, science, and history?

Dr. Lisle's treatise does not stand or fall on its ability to answer these questions, although that discussion is relevant—perhaps more than most believe. For if logic itself yields conclusions that qualify as *epistēmē* in terms of their syllogistic validity, then the argument against naturalism is irresistible. These issues also open the door to debates between Christians and the "new atheists," demonstrating the epistemological problems of the atheists, and to conundrums arising from the philosophy and history of science. Glover (1984) wisely noted that it was the similarities rather than the differences between Christians and modern Western secularists that opened the most fruitful lines of understanding, because the similarities demonstrate the points at which secularists have stolen Christian axioms. That insight is vindicated in *The Ultimate Proof of Creation*.

My only disappointment with this book was the near absence of notes and references to the numerous works that have anticipated and led up to this book. That background may be of less interest to laymen but would have made the book of much greater interest to scholars in the long run. This technique was well used in Vox Day's *The Irrational Atheist*, which combined a snappy narrative with extensive, well-researched notes.

Finally, every reader must be careful to avoid a potential fallacy that could come from unwarranted extrapolation or misunderstanding of Dr. Lisle's thesis. That would be the position that man apart from the Bible is incapable of finding *any* truth. The noetic effects of sin are not absolute. For example, Aristotle was certainly not Christian. His metaphysic, while cogently argued, devolved ultimately to an unmoved mover thinking about himself thinking. We know that the true ultimate reality, God, is personal, immanent, and the Creator of all things. So we reject Aristotelian metaphysics. On the other hand, Aristotle made many true and insightful observations about nature, human nature, ethics, and the categories of thought, logic, and communication. It is no accident that the medieval Scholastics attempted a synthesis of logic and Christianity based on Aristotle's writings. Likewise, modern scientists may discover many true things about nature, even though they may fit better inside the Christian worldview.

This is as an important work because the main problem since the Enlightenment has been the retreat of the church before naturalism and a concomitant and paralyzing fear among many theologians of losing their "academic respectability" if they fought back. But if the church as a whole would rise up against naturalism, its life span would be counted in days. This book provides the means by which everyday Christians can switch on the light bulb of inspiration and thus break the hold of fear and intimidation that secularists have held over Christians for far too long. For that reason, it deserves and needs to be widely read and understood by all Christians. Scholars should investigate the underlying apologetic for the reasons cited above, but any uncertainty there does not detract from the force of the book and its argument. As Reed et al. (2004, p. 229) noted:

> The environment is ripe for a new attack on Naturalism by creationists. The times, however, call for a formal attack, not another empirical one. No special education or training will be necessary for the public to see the glaring contradictions in Naturalism. Unless they abandon reason, they will be forced to admit (grudgingly and under compulsion of the truth) that Christianity again has the high ground.

I highly recommend this book and believe that it will prove valuable to scientists, philosophers, and theologians alike.

References

Adler, M.J. 1965. *The Conditions of Philosophy*. Atheneum Books, New York, NY.

Day, V. 2008. *The Irrational Atheist*. BenBella Books, Dallas, TX.

Glover, W. 1984. *Biblical Origins of Modern Secular Culture*. Mercer University Press, Macon, GA.

Hogan, T. 2010. Some implications of the demise of the demarcation problem. *CRSQ* 46:167–176.

Hooykaas, R. 1972. *Religion and the Rise of Modern Science*. Regent College Publishing, Vancouver, Canada.

Hooykaas, R. 1999. *Fact, Faith and Fiction in the Development of Science: The Gifford Lectures Given in the University of St Andrews 1976*. Kluwer Academic Publications, Norwell, MA.

Klevberg, P. 1999. The philosophy of sequence stratigraphy, part I—philosophic background. *CRSQ* 36:72–80.

Noebel, D.A. 1991. *Understanding the Times: The Religious Worldviews of our Day and the Search for Truth*. Harvest House Publishers, Eugene, OR.

Reed, J.K. 1996a. A biblical Christian framework for earth history research, part I: critique of the naturalist-uniformitarian system. *CRSQ* 33:6–12.

Reed, J.K. 1996b. A biblical Christian framework for earth history research, part II: foundation and method of historical analysis within the biblical Christian system. *CSRQ* 33:210–216.

Reed, J.K. 1998. Demythologizing uniformitarian history. *CRSQ* 35:156–165.

Reed, J.K. 2000a. Historiography and natural history. *CRSQ* 37:160–175.

Reed, J.K. 2000b. *Plain Talk about Genesis*. Word Ministries, Evans GA, and Deo Volente Publishing, Humboldt, TN.

Reed, J.K. 2005. *Crucial Questions about Creation*. Word Ministries, Evans, GA.

Reed, J.K. 2010. Untangling uniformitarianism, level I: a quest for clarity. *Answers Research Journal* 3:37–59.

Reed, J.K., P. Klevberg, C.R. Froede, Jr., A.J. Akridge, and T.L. Lott. 2004. Beyond scientific creationism. *CRSQ* 41:216–230.

Schlossberg, H. 1983. *Idols for Destruction*. Thomas Nelson Publishers, Nashville, TN.

Sproul, R.C., J.H. Gertsner, and A.W. Lindsley. 1984. *Classical Apologetics*. Acadamie Books, Grand Rapids, MI.

Stark, R. 2003. *For the Glory of God*. Princeton University Press, Princeton, NJ.

John K. Reed
Evans, GA

Book Review

Discovery of Design: Searching Out the Creator's Secrets

by Don DeYoung and Derrik Hobbs

Master Books, Green Forest, AR, 2009, 233 pages, $13.00.

This book by DeYoung and Hobbs is unique both in its content and format. The book is filled with specific examples of design from nature that have been copied by human engineers, architects, and scientists. The book is divided into eight sections, each focusing on one specific part of nature: microorganisms, insects, flying creatures, underwater life, land animals, people, plants, and nonliving objects. Each section contains several specific examples in nature that humans have used to improve life. These include the human femur, cockleburs, beech leaves, the octopus, and the kingfisher bird. Each example gives a short description of the object and how it has inspired new products, questions for further study, pictures, references, and key words for Internet searching. There is also a helpful list of general references, a glossary, and subject index. The book demonstrates that the amazing designs we see in nature, both from living and nonliving things, point directly to the Creator of the universe. It is sure to become a favorite for scientists and non-scientists alike.

Jeremy Maurer
maurerjl@grace.edu

Book Review

Mokele-Mbembe: Mystery Beast of the Congo Basin

by William Gibbons

Coachwhip Publications, Landisville, PA, 2010, 270 pages, $25.00.

British author Bill Gibbons has made six expeditions to Africa in the period 1985–2008 in search of living dinosaurs. His early trips were summarized in an ICR *Impact* article (Gibbons, 2002). One mission was surprisingly financed by Ringo Starr and Mick Jagger (p. 86). More recent ventures were funded by the BBC and the History Channel. Logistics and rampant African government corruption require tens of thousands of dollars for each journey. The book shows good familiarity with other cryptozoology explorers, both past and present, including Bernard Heuvelmans, William Hitchens, Hans Schomburgk, and Roy Mackal,

The book's bottom line is that no dinosaurs have been seen or photographed by the author. He did find worn-down riverbanks and riverside caves, and he heard some unexplained splashes in the distance on misty lakes. Meanwhile, there continue to be secondhand reports of sightings of dinosaur-like beasts. Natives often recognize dinosaur drawings they are shown and express eyewitness familiarity with the creatures. The animals appear to be reptilian, semiaquatic, herbivorous, rare, and dangerous.

Gibbons has concentrated his search for living fossils in the Congo Basin, especially the Cameroon. Helpful maps summarize all of the reported dinosaur sightings (pp. 227–231).

The author remains steadfast: "I propose that dinosaurs, or at least creatures that look remarkably like them, are still very much with us today in the dark and remote recesses of our modern, fast-paced world" (p. 9). His dedication is evident in his personal investment, as well as the malaria, intestinal parasites, and extreme hardship he has endured while visiting the heart of Africa.

Gibbons speaks highly of a missionary couple who dedicated their lives to evangelism in the Congo (Brazzaville) and also the Republic of the Congo. They are Gene and Sandy Thomas from Ohio, who worked with United World Mission. Gene (1925–2005) helped the author in many difficult situations. On an early expedition, Gene Thomas led author William Gibbons from an occult worldview to a saving biblical faith.

Fifteen years ago, I visited with Gene Thomas in Winona Lake, Indiana, as he attended summer classes at Grace Seminary. Gene displayed a balanced life of gospel outreach, understanding, and social help given to African natives and a lively interest in living dinosaurs. One of Gene's goals was to drift over the region in a balloon, in search of beasts, but this approach never took place.

The book has too many spelling errors and no subject index. However, this historical review of African dinosaur reports, with some helpful references, is valuable. The creationist worldview might predict that we have not heard the last word on the mystery beast of the Congo Basin.

Reference

Gibbons, William. 2002. In search of the Congo dinosaur. *Impact* #349, July 2002. Institute for Creation Research, Dallas, TX.

Don DeYoung
DBDeYoung@Grace.edu

The Origin of Grand Canyon

Part III: A Geomorphological Problem

Michael J. Oard*

Abstract

Though the origin of Grand Canyon is of great interest to sedimentologists and structural geologists, the problem more properly rests within the field of geomorphology. That is because in spite of its imposing size, it is a water gap—one of over a thousand catalogued across the Earth. Like many other geomorphological features, most water gaps are best explained as formed during the retreating stage of the Flood. Clues to the formation of Grand Canyon are provided by the processes that occurred when the glacial Lake Missoula flood overtopped a ridge between Washtucna Coulee and the Snake River in the southeast Channeled Scabland. There are other water gaps present on the Colorado Plateau, and all are readily explained by the distinct processes of the retreating stage of the Flood. None of these features are easily explained by any dam-breach hypothesis.

Introduction

The origin of Grand Canyon has been an insoluble mystery for uniformitarian geologists for nearly 150 years. Their hypotheses—all hampered by their commitment to the uniformitarian principle—fail miserably to explain the observed field evidence (Oard, 2010a). Thus, catastrophist alternatives are well worth exploring.

Because of its high visibility with the public, creation scientists have attempted to explain Grand Canyon within their paradigm to promote the general Flood model. Research to date has yielded no spectacular breakthroughs. Initially, creation scientists attributed the canyon to late Flood erosion (Gish, 1989; Whitcomb and Morris, 1961), but in the 1980s the dam-breach hypothesis was developed (Austin, 1994; Brown, 2001; 2008). The two published versions of this hypothesis posited the catastrophic emptying of two to three post-Flood lakes caused by a dam breach, approximately 200 to 500 years after the Flood. However, these iterations of the dam-breach model do not explain the relevant field data (Oard, 2010b). In particular, neither can explain the absence of evidence for the needed lakes, and neither can explain the erosion of tributary canyons in the same event. Furthermore, the glacial Lake Missoula flood provides a good analogy for a dam-breach event, but there are significant differences between that flood's Channeled Scablands and Grand Canyon (Oard, 2004).

Since both uniformitarian and post-Flood dam-breach models consistently fail to explain the origin of Grand Canyon, another look is warranted at erosion during the Flood. Obviously, this event would have been late in the Flood, and

* Michael J. Oard, Bozeman, MT, mikeoard@bridgeband.com
Accepted for publication March 23, 2009

the development of a Flood-oriented sequence of geologic events by Walker (1994) provides a good framework (Figure 1). Walker (1994) proposed that the retreating stage of the Flood included two phases: an initial sheet-flow phase and a later channelized-flow stage. This two-stage sequence of events can explain the features of the Colorado Plateau, including Grand Canyon, and can make sense of field data that other models cannot explain.

Geomorphology is the study of the landscape features of Earth's surface. It is the area of geology best suited to examine Grand Canyon. Within the different classes of landscape features, Grand Canyon is best classified as a water gap. A water gap is a deep, perpendicular cut in a ridge, mountain range, plateau, or some other transverse barrier that carries a river or stream (Douglass, 2005). This paper will provide evidence for the late Flood *timing* for the carving of the canyon, based on geomorphology and a comparison with other geomorphological features of the Earth's surface. The next paper in this series will address the widespread sheet erosion event that occurred across the entire Colorado Plateau prior to the erosion of Grand Canyon. This event is called the "Great Denudation" by secular geologists. Large-scale sheet erosion occurred over vast areas of the southwest United States, caused by very broad currents that were flowing east to northeastward. It was only after the Great Denudation that Grand Canyon was eroded by more restricted channelized currents that flowed in the opposite direction. This stage will be addressed in the final paper of this series.

Over the course of this series, I will seek to demonstrate that the key to understanding Grand Canyon in its geological and geomorphological setting is the two-stage nature of the late Flood retreat off of North America. I propose that no other catastrophist or uniformitarian model has the comprehensive explanatory value of this simple Flood explanation.

Geomorphology Demonstrates a Late-Flood Origin

In very few places on Earth can geologists study sedimentary strata or structural features as well as they can in Grand Canyon. However, there is a distinction between the geology that the canyon makes visible and the canyon itself. The origin of Grand Canyon is essentially a problem in geomorphology (Meek and Douglass, 2001) because it is a landform. Geomorphology is the geological science that studies the general configuration of Earth's surface, especially the classification, description, nature, and origin of landforms and their relationships to the underlying geological structures (Bates and Jackson, 1984). Landforms are features that when taken together make up the surface of the Earth (Bates and Jackson, 1984). They include broad features such as mountain ranges, plateaus, or plains, as well as small-scale features such as hills, valleys, slopes, canyons, or alluvial fans. Geomorphology is concerned with geography, topography, shape, and other pertinent features of landforms.

The uniformitarian study of the geomorphology of Grand Canyon has not provided a solution to its origin, as Hill et al. (2008, p. 316) lament:

> The history of Grand Canyon—its age and how it formed as a physiographic unit—has been, and is, one of the great unsolved problems of geomorphology. Past workers have hypothesized practically every direction imaginable for the ancestral route of the Colorado River through the Grand Canyon region. They have set dates for drainage through the canyon as early Eocene, late Eocene, early Miocene, Miocene, Pliocene, and Pleistocene. They have described the Colorado River as being wholly, or in part, antecedent, superimposed, subsequent, consequent, obsequent, or resequent. And, they have debated (without resolution) how the disparate geomorphic sections of Grand Canyon have evolved together to create the total integrated canyon that we see today.

This uniformitarian fog around Grand Canyon is not unique; mysteries abound in the uniformitarian attempt to explain other types of landforms (Oard, 2008a). Many of those mysteries can be solved by applying a new paradigm—that of the Genesis Flood, especially the two phases of the retreating stage (Figure 1), the sheet-flow and the channelized-flow phases.

The secret to understanding landforms is the realization that each of these two distinct phases of Floodwater retreat had its own distinct erosional patterns and that the channelized-flow patterns are superimposed on top of features created by the sheet-flow phase. This is demonstrated clearly with the Colorado Plateau and Grand Canyon. But first, we will delve into the geomorphological evidence that Grand Canyon was indeed carved late in the Genesis Flood.

Since the Flood provides reasonable explanations for geomorphological features on a global scale (Oard, 2008a), and since Grand Canyon is merely one of those features, it stands to reason that the Grand Canyon was carved during the late-Flood period.

Grand Canyon: Just Another Water Gap

A water gap is defined as "a deep pass in a mountain ridge, through which a stream flows; esp. a narrow gorge or ravine cut through resistant rocks by an antecedent or superposed stream" (Neuendorf et al., 2005, p. 715). This definition is similar to that from the older *Dictionary of Geological Terms* (Bates and Jackson, 1984), and both contain genetic mechanisms that should not be part of any geological definition. What is interesting about these genetic terms (antecedent and superposed stream) is that they leave out the most popular uniformitarian mechanism for the formation of water

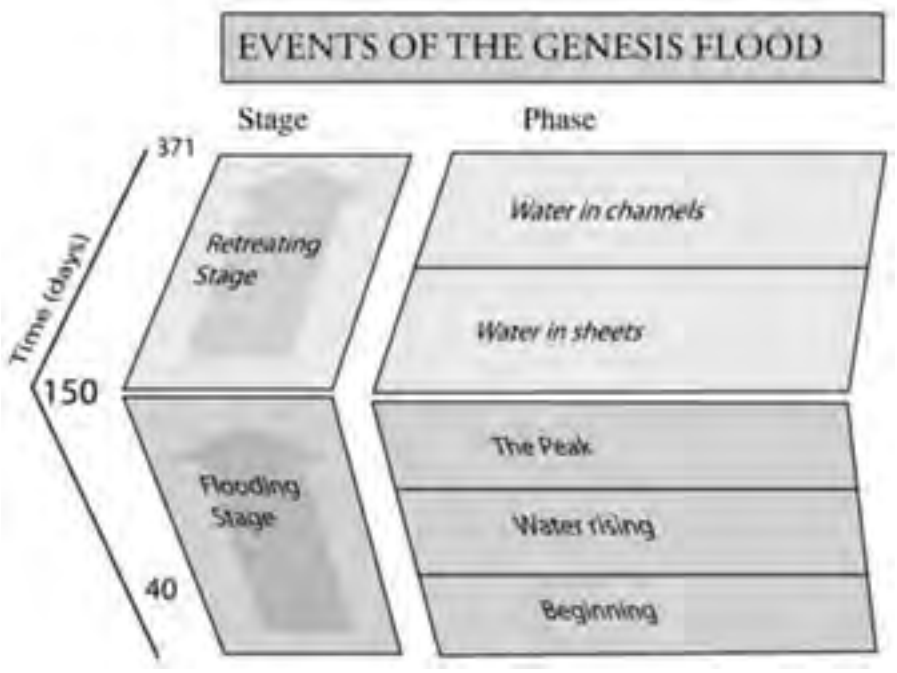


Figure 1. Tas Walker's Biblical Flood model with the stages and phases renamed (from Oard, 2008a).

gaps, that is, stream piracy, and instead use mostly rejected mechanisms for the suggested origin of water gaps.

Another problem with the definition of a water gap is that it is employed only for a gorge through a mountain ridge. In practice, a water gap refers to a gorge through any structural barrier. Such cuts are also called transverse drainage, which would also include a plateau, a series of plateaus, or even an isolated mountain. For instance, John Douglass (2005, p. 1, emphasis mine) states in his PhD dissertation on the origin of water gaps:

> Many of the world's largest river systems follow seemingly anomalous paths, incising gorges across structural and topographic highs. … Examples can be found in the Pyrenees … Apennine Mountains … Decinska Vrchovina Highland … Zagros Mountains … Zambezi River … Himalayan Mountains … Rocky Mountains … the *Grand Canyon*, and the Appalachian Mountains.

As spectacular as it is, Grand Canyon is just another *water gap* through a high barrier, the Kaibab Plateau and the other plateaus to the west. The Colorado River lies about 6,000 feet below the Kaibab Plateau in eastern Grand Canyon. Though few are as visually stunning as Grand Canyon, water gaps are common throughout the world (Oard, 2007a; 2008a). In the uniformitarian paradigm, the Kaibab Plateau supposedly began uplifting and became a barrier to rivers about 70 million years ago (Karlstrom et al., 2007). If the ancestral Colorado River was also that age, as believed by John Wesley Powell and many others, it should have cut through the Kaibab Plateau at a different location from Grand Canyon. That is because the lowest points across the plateau today—about 6,000 feet (1,829 m) msl—are located both north and south of the highest part. The highest point is a little over 9,000 feet (2,743 m). One of the most perplexing questions for uniformitarians is why Grand Canyon was cut at an intermediate height between the low and high points of the Kaibab Plateau.

There are at least a thousand water gaps on Earth, with 300 alone in the Zagros Mountains of Iran (Oberlander, 1965). Figure 2 shows the Shoshone water gap west of Cody, Wyoming, which carries the Shoshone River through a 2,500-foot (762 m) deep gorge. Ironically, this water gap is another thorn in the side of uniformitarian geology; the river could have easily flowed around the south end of the Rattlesnake Mountains, following topography (Figure 3). Water gaps are common in the Appalachian Mountains (Figure 4), and six cut through the Alaska Range from the south to the north (Figure 5) (Oard, 2008b). Though not as well known as Grand Canyon, there are deeper water gaps; the deepest cut through the Himalayas. Water gaps as a whole are easily explained by the runoff of the Floodwater from the continents (Oard, 2007a; 2007b; 2008a).

Thus, the Grand Canyon is not unique; it is one of a class of landforms found all over the world. It is similar to other water gaps on the Colorado Plateau, described below. Therefore, logic suggests that we look for the origin of Grand Canyon by investigating the origin of water gaps as a class, and all of those on the Colorado Plateau in particular. One mechanism that can account for all of these water gaps is late-Flood channelized erosion (Oard, 2008a). Interestingly, no other mechanism explains water gaps as well as the retreating stage of the Flood. Figure 6 presents a schematic of the Flood formation of water and wind gaps. A wind gap is a notch in a ridge or mountain range that was not cut quite deep enough for a river or a stream to run through it. Only wind passes through.

Although Grand Canyon is the longest water gap in the world (277 miles,

Figure 2. Shoshone water gap (view west from the eastern edge of Cody, Wyoming).

446 km), it is not the deepest. Many other water gaps are deeper, even in North America. For example, the Hells Canyon water gap along the Oregon/Idaho border reaches about 8,000 ft (2,438 m) on the Idaho side, making it the deepest canyon in North America (Vallier, 1998). Hells Canyon is a long water gap (90 miles, 145 km) when measured from the Oxbow to the mouth of the Grand Ronde River, but still much shorter than Grand Canyon.

Catastrophic Ice Age Floods Carved Water and Wind Gaps

Catastrophic floods are known to cause water gaps. Bishop (1995, p. 461) stated in regard to the glacial Lake Missoula flood: "Catastrophic divide breaching and drainage rearrangement are prominent features of the Channeled Scablands of northwest USA." One outstanding example is Palouse Canyon, formed when the water of the glacial Lake Missoula flood overtopped a ridge between Washtucna Coulee and the Snake River (Oard, 2003; 2004). The

Figure 3. Buffalo Bill Reservoir (view southeast) west of Shoshone water gap (arrow). Notice how low the land is south of the reservoir. When the sediments were higher in the valley, the river should have easily gone south around the Rattlesnake Mountains, but instead appears to have cut straight east through a 2,500-foot (760 m) deep gorge.

Figure 4. Delaware water gap on Delaware River (view north from Columbia Travel Center, milepost 4, I-80 New Jersey).

Figure 5. Nenana water gap through the Alaska Range.

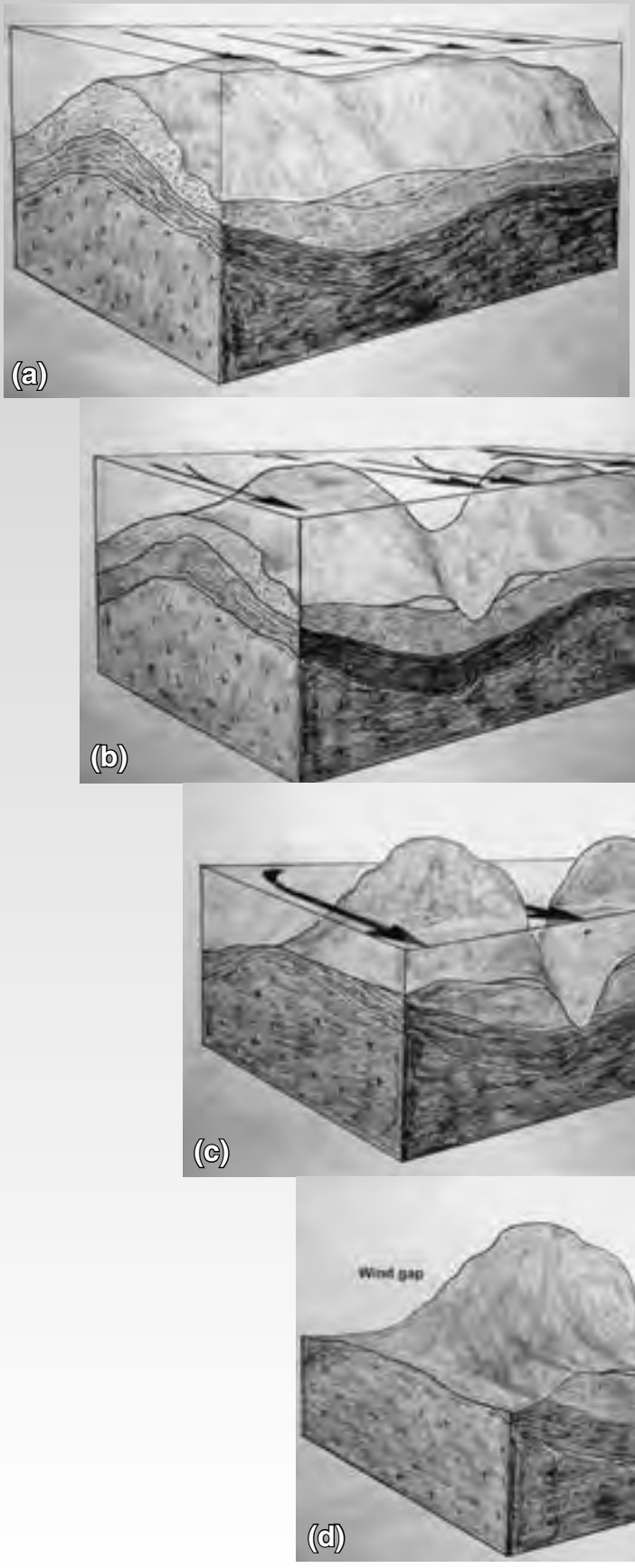


Figure 6. Series showing the formation of water and wind gaps (drawn by Peter Klevberg).

(a) Water flowing perpendicular to a transverse ridge forms shallow notches on the ridge.

(b) Notches erode farther as the water level drops below the top of the ridge.

(c) Floodwater continues to drain as notches deepen.

(d) Floodwater completely drained with a river running through the lowest north, the water gap. Erosion ceased too early through the other notch, leaving a wind gap.

Figure 7. Palouse Canyon.

flood quickly excavated a 500-foot (152 m) deep vertical-walled gorge mostly in basalt lavas (Figure 7). Before the flood, the Palouse River flowed westward down Washtucna Coulee to the Columbia River. Today it takes a left-hand turn and flows south through this gorge into the Snake River. Fifteen miles (24 km) west, another 500-foot (152 m) deep gorge was cut through the ridge, but the channelized erosion of the Lake Missoula flood failed to cut deep enough for a stream to pass through, leaving it a wind gap. Numerous other wind gaps are found in the Channeled Scablands.

The glacial Lake Missoula flood provides an outstanding example of how late-Genesis Flood channelized erosion would rapidly form water and wind gaps. Although the glacial Lake Missoula flood was from a dam breach, that mechanism, which eroded both water and wind gaps in the Channeled Scablands, cannot serve as an analogue for a dam-breach model for Grand Canyon, because the water and wind gaps were not caused by the initial breach through a barrier, such as is posited for Grand Canyon. Instead, the proper analogy is found in that a large flood of water was able to erode these gaps once it overtopped a ridge. This would be similar to the retreating Floodwater flowing perpendicular to a structural barrier (Figure 6). Thus, the Genesis Flood appears to be the only possible mechanism for cutting the numerous water and wind gaps across the Earth—Grand Canyon simply being one water gap in this pattern.

Anomalous Drainage Typical of the Colorado Plateau

The Colorado River is not the only river on the Colorado Plateau that flows through a barrier, which it could have more easily bypassed. Water gaps are common on the Colorado Plateau (Figure 8), and the larger rivers commonly pass through structural barriers (Hunt, 1956). Starting in the northeast and circling in a clockwise direction around the edges of the Colorado Plateau, we will survey these rivers.

Along the northern boundary, the Green River passes through the high Uinta Mountains in a very narrow water gap called Lodore Canyon (Figure 9). This water gap is number 2 on Figure 8. It is 2,300 ft (701 m) deep (Hansen, 1986). Strangely enough, if the river had flowed only a short distance (3 km) east, it could have passed around the eastern end of the Uinta Mountains at a lower elevation (Powell, 2005). To add to the puzzle, the Lodore water gap is only 5 million years old or late Tertiary in the uniformitarian timescale—in other words quite recent relative to the Uinta Mountains (Powell, 2005).

Before passing through Lodore Canyon, the Green River also enters the Uinta Mountains farther west but then turns and flows back out of the mountains, ending up only half a mile (804 m) down a valley from where it entered (Figure 10), forming Horseshoe Canyon (number 1 on Figure 8), first described by John Wesley Powell (1895, p. 137):

> Where the river turns to the left above, it takes a course directly into the mountain, penetrating to its very heart, then wheels back upon itself, and runs out into the valley from

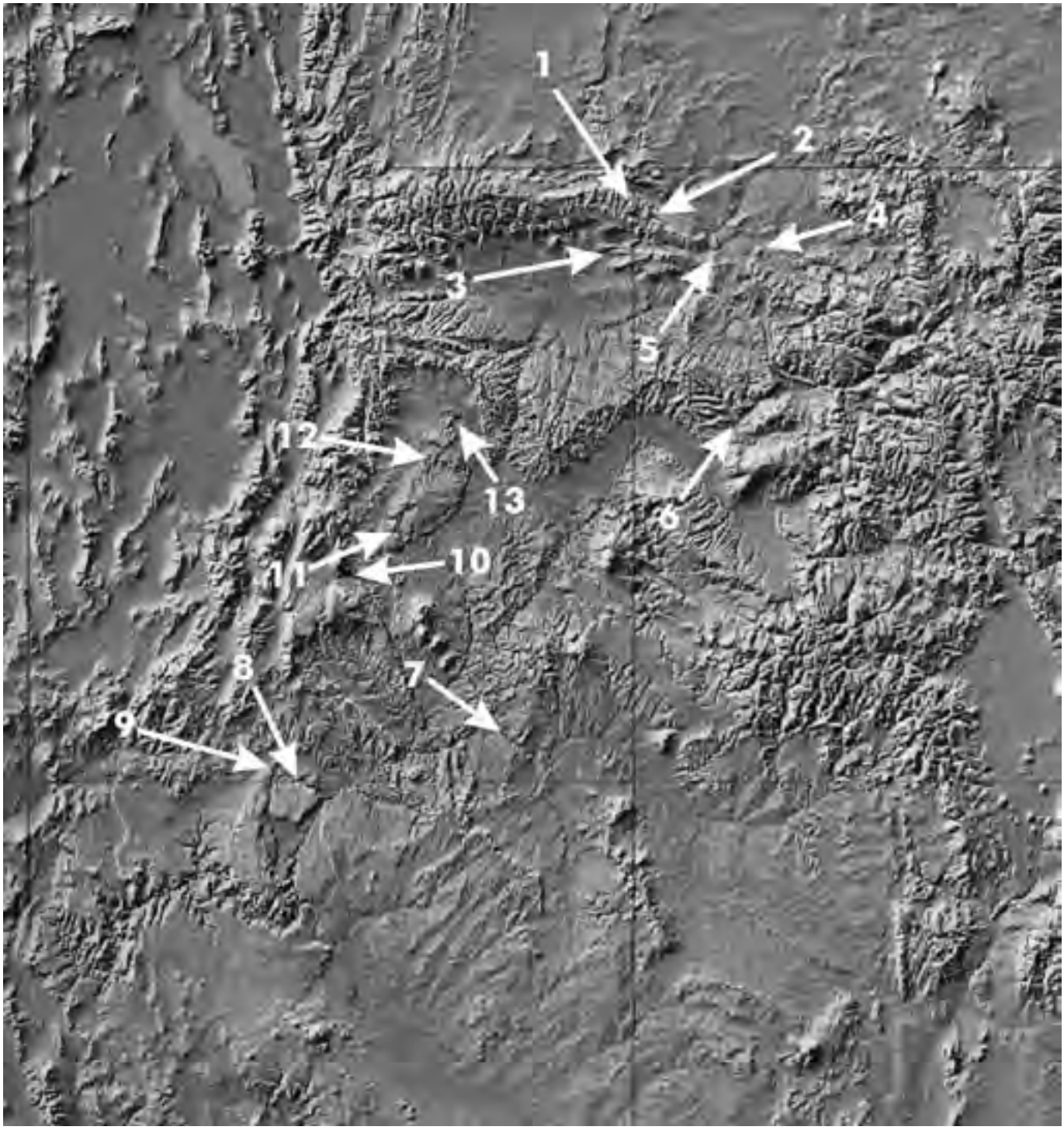


Figure 8. Thirteen major water gaps on Colorado Plateau. A major water gap is a gorge through a ridge, mountain range, or some other barrier when the river could have gone around the obstruction at a lower altitude. Map background provided by Ray Sterner and drawn by Peter Klevberg.

which it started only half a mile below the point at which it entered; so the canyon is in the form of an elongated letter U, with the apex in the center of the mountain. We name it Horseshoe Canyon.

After Lodore Canyon and before passing Dinosaur National Monument, the Green River cuts a canyon over 2,500 ft (762 m) deep through the Split Mountain anticline (Figure 11 and number 3 on Figure 8). Part of the

Figure 9. Lodore Canyon, Green River, through the eastern Uinta Mountains (courtesy of USGS).

Figure 10. Horseshoe Canyon (from Powell, 1895, p. 136). Notice how the Green River flows into the Uinta Mountains and then comes back out in the valley half a mile away.

course of the river runs along the long dimension of the anticline.

Moving east, the Yampa River on the northeastern Colorado Plateau emerges from the Rocky Mountains foothills into open country and then "crosses two anticlinal upwarps [numbers 4 and 5 of Figure 8] with apparent disregard for rock structure" (Hunt, 1956, p. 68; also see Hansen, 1986, pp. 64–67). An anticline is a fold in sedimentary rocks that is generally convex upward and whose core contains older rock. One anticlinal ridge is Cross Mountain, Colorado, in which the Yampa River passes through in a 1,000-ft (305 m) deep, vertically-walled gorge. Hard rocks that have been elevated should be able to deflect a river, but that is not the case with the Yampa River. Although it could have easily gone around these anticlines through softer beds, it did not.

Grand Canyon is not the only place the Colorado River follows an unexpected course. The river enters the Colorado Plateau at Rifle, Colorado, about 60 miles (97 km) northeast of Grand Junction. There it crosses the Grand Hogback (Hunt, 1956) (number 6 on Figure 8). In southeast Utah, it flows through valleys marked by eroded anticlines that are cored (at depth) by salt. Instead of following the low topography, the river cuts at right angles across the valleys. Baars (2000, p. 66) exclaimed:

> For some unknown reason the major rivers did not flow along the valleys, as is customary. Instead, such large rivers as the Colorado and the Dolores cut sharply across the valleys in strange fashion. The Colorado River crosses Moab Valley near the town of Moab at nearly right angles, and the Dolores River was found to do the same unusual trick in another valley southeast of Moab. This incongruity caused the pioneers to name the latter valley "Paradox Valley" for the paradoxical geomorphic phenomenon.

Downstream, below its junction with Green River, the Colorado obliquely crosses the Henry Mountains basin (Hunt, 1956).

The San Juan River is another example of this unusual drainage (number 7 on Figure 8). It crosses the crest of

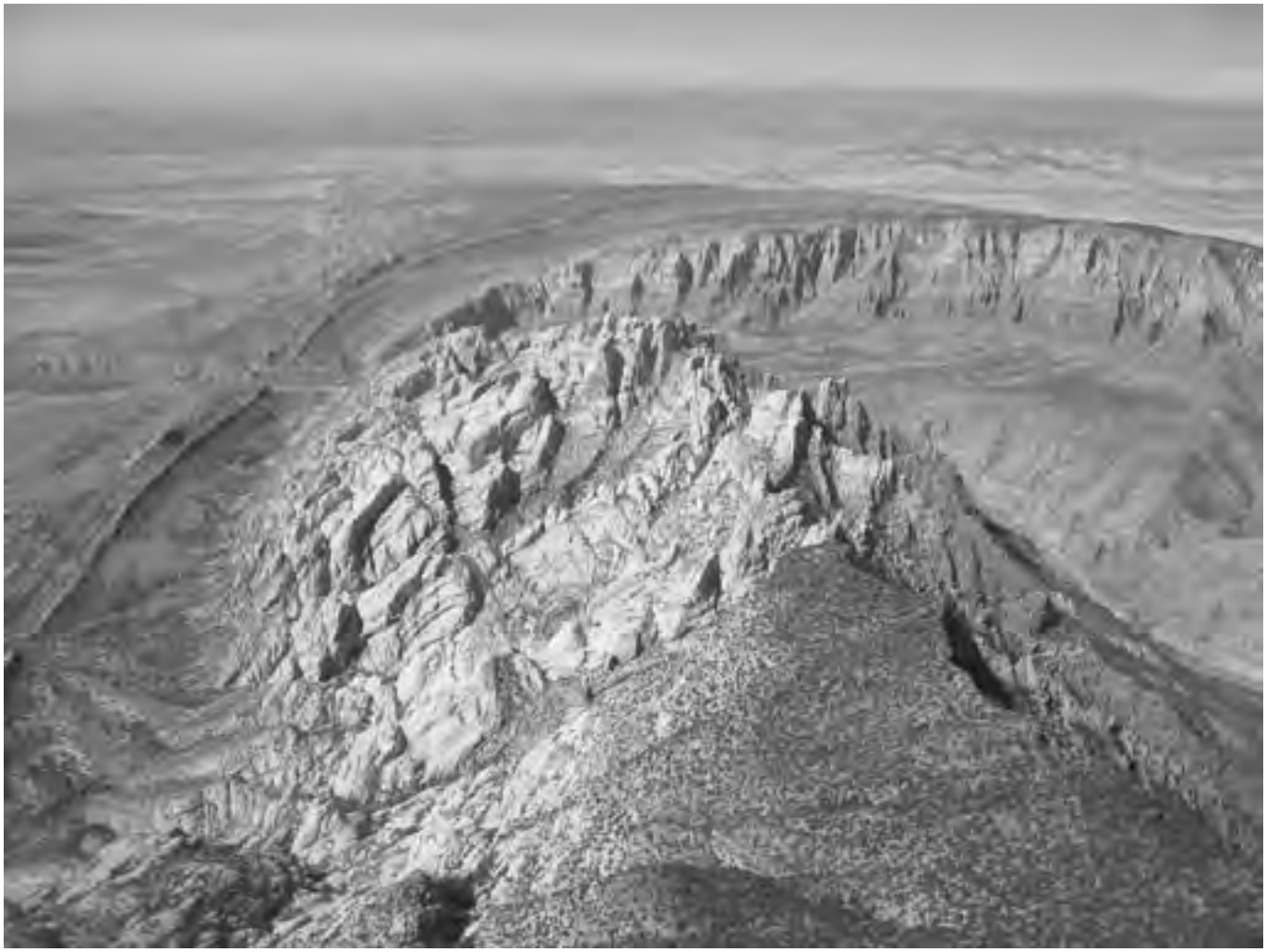


Figure 11. Aerial photo of the western Split Mountain anticline. The Green River, which passes through the anticline, could have easily passed around to the north and west. The anticline is greatly eroded based on the tilted erosional remnants seen around the anticline. The top of the anticline has been significantly eroded (view west, photo courtesy of Tony Kostusik).

the Monument Upwarp, including the anticlines on the upwarp. Baars (2000, p. 92, 93) is mystified:

> The San Juan River, a major tributary of the Colorado River, flows across the width of the prominent Monument Upwarp with the same arrogance with which the Colorado flows across the Kaibab uplift through Grand Canyon. The San Juan was not as accomplished at dissecting the earth as the Colorado, but carved canyons of 1,500- to 2,000-foot depths for many miles as it crossed the uplifted structure … The river crosses upturned beds of Mesozoic and Permian formations without difficulty.

In the process, the San Juan River carved entrenched meanders across the crest of the uplift, of which the Goosenecks are the most famous (Figure 12).

In the western Colorado Plateau, the Paria Plateau rises up to just over 7,000 ft (2,134 m) just west of the northern Kaibab Plateau. House Rock Valley separates the two plateaus. The Paria River starts in Utah east of Bryce Canyon National Park and flows south, cutting through the higher Paria Plateau (number 8 on Figure 8) before entering the Colorado River just east of Lee's Ferry. The river could have gone around the plateau at lower altitudes. A small stream starts on the high plateaus of south central Utah and moves southeast through the Kaibab Plateau in a gulch 1,500 feet (457 m) deep (number 9 on Figure 8). The stream crosses House Rock Valley without deflection and enters another gorge in the Paria Plateau and enters the Paria River within the Paria Plateau (Babenroth and Strahler, 1945). The origin of this drainage into

Figure 12. The goosenecks on the San Juan River through the Monument Upwarp

the Paria Plateau is highly problematical (e.g., Babenroth and Strahler, 1945, p. 145).

In the northwest Colorado Plateau, the upstream section of the Fremont River and several associated streams flow across the Waterpocket Fold in Capital Reef National Park (Harris et al., 1997) (number 10 on Figure 8). Starting from the north, the Price, San Rafael, and Muddy Rivers (numbers 13, 12, and 11, respectively on Figure 8) all cut across the San Rafael Swell instead of going around the anticline (Baars, 2000; Hunt, 1956).

Baars (2000, p. 195) summarized the anomalous drainage pattern on the Colorado Plateau:

> Many enigmas remain. The primary problem in a nutshell is: How can a river carve its path directly into the very crest of a major uplifted area and come out the victor?

The Colorado Plateau is geomorphologically unique in that river after river crosses the larger uplifts, showing no regard for the convention or the laws of nature. Instead of flowing around the high structural features, as any respectable river would do, the rivers of the plateau flow directly into the uplift. They carve impressive channels across the highest parts, and emerge on the opposite flank as if this were the easiest thing to do.

He eliminates stream capture, one of their main hypotheses for the origin of water gaps (see Oard, 2010a) as the explanation for the San Juan River crossing the Monument Upwarp:

> For example, why are the entrenched meanders of the "Goosenecks of the San Juan River" perched on top of the Monument Upwarp, where headward erosion and piracy should

> have been most active? Headward erosion of stream courses does NOT produce meanders of this type (Baars, 2000, p. 199, emphasis in original)!

In summary, the Colorado Plateau is littered with water gaps; Grand Canyon is just the most impressive. The distribution of these water gaps (Figure 8) shows that flow late in the Flood was focused on the southwest Colorado Plateau. The same mechanism that carved Grand Canyon also eroded other water gaps, probably at the same time. That is another major problem for the dam-breach hypothesis; even if it could explain Grand Canyon, it could not explain all the other water gaps on the plateau, much less those on other continents. Runoff from a global flood, however, is a very reasonable explanation for these globally distributed, unique geomorphological features.

Deep Canyons Carved by Late-Flood Channelized Erosion

Not every canyon in the world is a water gap, but some are of a scale equal to or greater than Grand Canyon. That volume of erosion demands large volumes of water with elevated current velocities, operating at a scale unknown today. Only the Flood can provide a reasonable explanation, and the stubborn refusal of uniformitarian geologists to even consider it as an alternative model demonstrates how tightly they are bound to their subjective paradigm—quite the opposite of the cool Enlightenment rationality that they project to the public.

There are many deep canyons of the world, some with vertical walls, which start at high elevations near ridge tops and descend to lower elevations, sometimes to sea level. The vertical walls strongly suggest the youth of these features (Oard, 2008a). A magnificent example is Copper Canyon in the Sierra Madre Occidental Mountains of the state of Chihuahua, northwest Mexico (Fisher, 2001), about 600 miles (966 km) south of Grand Canyon. Copper Canyon is deeper than Grand Canyon and about 100 miles (161 km) long, including some meanders. The region is arid, though summer thunderstorms are common.

Chihuahua contains four other canyons—all deeper than Grand Canyon. Both Grand Canyon and Copper Canyon are cut in high terrain and descend westward to lower elevations, near the Gulf of California in the case of Copper Canyon. However, there is one major difference: Grand Canyon cuts through high terrain, while Copper Canyon starts on a high ridge near the mountain divide and follows the topography down toward the ocean. Unlike Grand Canyon, it is not a water gap, though the depth of erosion is the same.

The location and features of Copper Canyon are incompatible with a dam-breach event. Yet these amazing features both require vast volumes of energetic water flowing over large areas at high altitudes—a good description of the late-Flood runoff.

Summary

Grand Canyon is a water gap, a landform common to many other places on Earth, though few are as spectacular or well known. Because it is a landform, its origin is a problem for the discipline of geomorphology. Grand Canyon is not unique; more than 1,000 water gaps have been documented across the globe. But geomorphologists cannot credibly explain the canyon or other water gaps. That is because their uniformitarian paradigm forces them toward low-energy, longtime explanations, usually involving the rivers currently flowing through these water gaps.

The Flood paradigm allows us to examine the water gaps independent of the rivers that flow through them. This simple transition solves many of the problems that have tied uniformitarians in knots for 150 years. Furthermore, the two-stage retreat of the Flood's water off the continents provides an answer for many other puzzling mysteries. At Grand Canyon, it provides a mechanism for both the Great Denudation of the Colorado Plateau and the erosion of Grand Canyon and its tributaries—as well as all the other mysterious water gaps scattered across the plateau. The relative youth of Grand Canyon and the other water gaps further supports the late-Flood interpretation, and the existence of so many water gaps with vertical walls suggests that uniformitarian dates of these features are far too old.

References

Austin, S.A. 1994. How was Grand Canyon eroded? In Austin, S.A. (editor), *Grand Canyon—Monument to Catastrophism*, pp. 83–110. Institute for Creation Research, Santee, CA.

Baars, D.L. 2000. *The Colorado Plateau: A Geologic History*. University of New Mexico Press, Albuquerque, NM.

Babenroth, D.L., and A.N. Strahler. 1945. Geomorphology and structure of the East Kaibab Monocline, Arizona and Utah. *Geological Society of America Bulletin* 56:107–150.

Bates, R.L., and J.A. Jackson (editors). 1984. *Dictionary of Geological Terms*, 3rd Edition. Anchor Press/Doubleday, Garden City, NY.

Bishop, P. 1995. Drainage rearrangement by river capture, beheading and diversion. *Progress in Physical Geography* 19(4):449–473.

Brown, W. 2001. *In the Beginning: Compelling Evidence for Creation and the Flood*, 7th Edition. Center for Scientific Creation, Phoenix, AZ.

Brown, W. 2008. *In the Beginning: Compelling Evidence for Creation and the Flood*, 8th Edition, Center for Scientific Creation, Phoenix, AZ.

Douglass, J.C. 2005. *Criterion Approach to Transverse Drainages*. PhD thesis. Arizona State University, Tucson, AZ.

Fisher, R.D. 2001. *The Best of Mexico's*

Copper Canyon. Sunracer Publications, Tucson, AZ.

Gish, D.T. 1989. More creationist research (14 years)—Part II: biological research. *Creation Research Society Quarterly* 26(1):5–12.

Hansen, W.R. 1986. Neogene tectonics and geomorphology of the Eastern Uinta Mountains in Utah, Colorado, and Wyoming. *U.S. Geological Survey Professional Paper 1356*, Washington, D.C.

Harris, A.G., E. Tuttle, and S.D. Tuttle. 1997. *Geology of National Parks*, 5th Edition. Kendal/Hunt Publishing Company, Dubuque, IA.

Hill, C.A., N. Eberz, and R.H. Buecher. 2008. A karst connection model for Grand Canyon, Arizona, USA. *Geomorphology* 95:316–334.

Hunt, C.B. 1956. Cenozoic geology of the Colorado Plateau. *U.S. Geological Survey Professional Paper* 279 Washington, DC.

Karlstrom, K.E., R.S. Crow, L. Peters, W. McIntosh, J. Raucci, L.J. Crossey, P. Umhoefer, N. Dunbar. 2007. $^{40}Ar/^{39}Ar$ and field studies of Quaternary basalts in Grand Canyon and model for carving Grand Canyon: quantifying the interaction of river incision and normal faulting across the western edge of the Colorado Plateau. *Geological Society of America Bulletin* 119:1,283–1,312.

Meek, N., and J. Douglass. 2001. Lake overflow: An alternative hypothesis for Grand Canyon incision and development of the Colorado River. In Young, R.A., and E.E. Spamer (editors), *Colorado River Origin and Evolution: Proceedings of a Symposium Held at Grand Canyon National Park in June, 2000*, pp. 199–204. Grand Canyon Association, Grand Canyon, AZ.

Neuendorf, K.K.E., J.P. Mehl, Jr., and J.A. Jackson. 2005. *Glossary of Geology*, 5th Edition. American Geological Institute, Alexandria, VA.

Oard, M.J. 2003. Evidence for only one gigantic Lake Missoula flood. In Ivey, R.L., Jr. (editor), *The Fifth International Conference on Creationism*, technical symposium sessions, pp. 219–231. Creation Science Fellowship, Pittsburgh, PA.

Oard, M.J. 2004. *The Missoula Flood Controversy and the Genesis Flood*. Creation Research Society Monograph No. 13, Chino Valley, AZ.

Oard, M.J. 2007a. Do rivers erode through mountains? Water gaps are strong evidence for the Genesis Flood. *Creation Ex Nihilo* 29(3):18–23.

Oard, M.J. 2007b. Defining the Flood/post-Flood boundary in sedimentary rocks. *Journal of Creation* 21(1):98–110.

Oard, M.J. 2008a. *Flood by Design: Receding Water Shapes the Earth's Surface*. Master Books, Green Forest, AR.

Oard, M.J. 2008b. Water gaps in the Alaska Range. *Creation Research Society Quarterly* 44(3):180–192.

Oard, M.J. 2010a. The origin of Grand Canyon. Part 1: Uniformitarianism fails to explain Grand Canyon. *Creation Research Society Quarterly* 46:185–200.

Oard, M.J. 2010b. The origin of Grand Canyon. Part II: Fatal problems with the dam-breach hypothesis. *Creation Research Society Quarterly* 46:290–307.

Oberlander, T. 1965. *The Zagros Streams: A New Interpretation of Transverse Drainage in an Orogenic Zone*. Syracuse Geographical Series No. 1, Syracuse, NY.

Powell, J.L. 2005. *Grand Canyon: Solving Earth's Grandest Puzzle*. PI Press, New York, NY.

Powell, J.W. 1895. *The Exploration of the Colorado River and Its Canyons*. Republished by Dover Publishing, New York, NY, 1961.

Vallier, T. 1998. *Islands & Rapids: A Geological Story of Hells Canyon*. Confluence Press, Lewiston, ID.

Walker, T. 1994. A biblical geological model. In Walsh, R.E. (editor), *Proceedings of the Third International Conference on Creationism*, technical symposium sessions, pp. 581–592. Creation Science Fellowship, Pittsburgh, PA.

Whitcomb, J.C. Jr., and H.M. Morris. 1961. *The Genesis Flood*. Baker Book House, Grand Rapids, MI.

Book Review

Radioactive and Radiocarbon Dating: Turning Foe into Friend (DVD)

by Andrew Snelling

from Answers in Genesis, 2009, $13.00.

This DVD features Andrew Snelling and is a part of the Answers in Genesis Creation Library Series. It was originally filmed at the AIG Creation College 3. It highlights the recent work by creationists in the field of isotope geology. Dr. Snelling first analyzes the assumptions involved in any type of radiometric dating and then delves into the work of creation scientists who tested these assumptions. He begins with helium diffusion from zircons. This project was one of the first major research projects done by creationists in isotope geology and was a great success. Helium diffusion rates matched young-earth predictions much better than old-earth requirements. This research sparked further analysis of radiometric dating, which focused on accelerated nuclear decay as a possible explanation for the apparent old age of many rocks.

Dr. Snelling continues by discussing the RATE project's seminal work on radioisotopes, and in particular the evidence for accelerated nuclear decay. This includes comparing various radioisotope ages against one another for the same rock sample, which often results in discordant ages between the different methods. It also involves important work on radiocarbon, one of the better-known dating methods. This research finds significant evidence for *in situ* radiocarbon in many carbon samples purported to be multiple millions of years old, evidence consistent with a young earth. Dr. Snelling points out in his presentation that many different lines of evidence suggest that there has been some accelerated nuclear decay in the past, with the implication that earth rocks are only thousands of years old, not billions.

This DVD is a bit technical for those unfamiliar with scientific terms and concepts, but the information is broken down as simply as possible. There are many graphs and pictures that aid the learners' understanding. It is a valuable summary of creationist research in isotope studies for the past decade and will be a helpful addition to the creation library.

Jeremy Maurer
maurerjl@grace.edu

Notes from the Panorama of Science

Can a Laboratory Make an Authentic Fossil?

Scientists have long wondered how once-living plants and animals were turned into the fossil remains that we find in abundance on the earth today. What processes may have been involved in their formation, and how might time have figured into the fossilization process? No rock-solid recipe for animal fossil formation exists in the technical literature; however, a recipe for "fossilization" of wood products actually has been patented (Hicks, 1986; Snelling, 1995). The patent claims that the process of soaking wood in a heated, supersaturated solution of calcium, magnesium, and manganese, along with other metal salts and a weak acid (citric or malic), results in "fossilized" (or hardened) wood. The processed wood looks like normal wood, but it will not burn, even if soaked again in water and dried, and could have applications in the construction industry, among others. However, this recipe has not been employed with animal carcasses or reported in the technical literature as a successful one that can yield fossils. One thing is certain: most naturally occurring fossils seem to be associated with sediments that appear to have been deposited in connection with water and certain minerals such as phosphorus, calcium, and silica.

Millions of fossils have been collected and cataloged in museums all over the world. Thousands of papers, journal articles, and textbooks have been written describing the bewildering array of fossil types and their possible formation. Thousands of advanced degrees have been awarded to scientists specializing in paleontology. Yet one cannot go into the laboratory today and produce a fish fossil that is anything like those found in sediments (for example, the Brazilian Cretaceous sediments known as the Santana Formation; Martill, 1998). The remarkable level of soft tissue preservation (phosphatization) in those deposits is illustrated with scanning electron microscope (SEM) photos of muscle fibers, gill fragments, and bone (e.g., Martill, 1998, pp.10, 13). In a more recent work, scientists have found excellent levels of preservation of fish eye pigments in the Santana Formation (Martill et al., 2008), indicating that extremely unusual conditions must have been occurring at the time. That report concluded that preservation occurred within days or weeks (unlike most dated theories concluding that long periods of time were involved in fossilization). Scientists have learned much about the fossilization process, but there is much more to learn before we can adequately understand how fossil preservation occurs. We are truly in need of a better understanding of these unique artifacts called fossils.

Many types of fossils exist, but generally speaking, fossils are the partial or complete remains of things that lived some time ago. Some, called "trace fossils," are relics of living creatures that show their activity while alive—e.g., footprints, burrows, and tunnels. Fossilized feces are also common.

Fossils have been formed by a variety of mechanisms, including tree resin encapsulation that later hardens into amber, capture in sediments that later harden into stone, or by simply a pressing into soft sediment or other material leaving an imprint of the plant or animal (compression or impression fossils). Although rare, the soft, fleshy parts of animals and plants are found preserved within fossils (as noted above, particularly in the Santana Formation). At times their preservation is so good that the micro-anatomical structures are preserved (Zhang and Pratt, 1994; Babcock et al., 2006).

Plants or animals buried in sediments that later turn into stone can be *petrified* when the organic components of the dead organism are replaced with minerals such as silica or calcite. Alternatively, they can be *permineralized* when groundwater brings dissolved minerals into microscopic pores of the dead organism, later solidifying it into stone. More recently it has been reported that subcellular preservation of tissues (ultrastructural preservation) seems to occur when bacteria closely associated with the decomposition of buried tissues release ions that replicate soft tissue morphology by allowing the rapid growth of minerals on a microscopic level (Briggs, 2003; Trinajstic et al., 2007). Low pH also seems to be associated with fine-structure preservation (Briggs and Kear, 1993). It seems that the highest level of preservation occurs when mats of bacteria (that grow in place as soft tissues are being broken down by the bacteria) produce the chemicals necessary to fossilize subcellular structures.

Taphonomy is the scientific discipline of studying fossil remains in the rock record and comparing them to decaying organisms over time in order to understand how fossilization occurs. It involves the study of fossil materials and the probable conditions associated with their formation and performing

experiments to try to understand these processes.

Many taphonomy experiments have been conducted in the laboratory with fish (e.g., Baas et al., 1995; Monge-Najera and Hou, 2002; Whitmore, 2003; Channing and Edwards, 2004; Soja, Sunderlin, and Close, 2004; Gupta et al., 2006; Raff et al., 2006), but none have resulted in perfectly preserved fossils such as those we find buried in the earth's crust. (Other animals besides fish have been studied in this way as well.) Some soft tissue preservation, which resembles what is seen in the fossil record, has been noted (Briggs et al., 1993; Briggs and Kear, 1993); however, no complete fossils with extremely well preserved ultrastructure have been produced. Channing and Edwards (2004) studied leaves, which had been collected alive and placed for 11 months into silica-rich geothermal geyser pools at Yellowstone National Park. High magnification SEM photos of the treated leaves show remarkable preservation of microanatomy; however, they were merely suspended in silica-rich pools of water—they were not buried in sediment. Fine preservation occurs in hot water that is saturated with silica, a condition that would seem to cause fish to decompose and disarticulate very quickly (Whitmore, 2003). A good synopsis of some of this work and an analysis of the Biblical implications for rapid, recent fossilization has been published online recently by a creationist worker (Everett, 2009).

A creationist has performed taphonomy experiments employing fish examined over time, placed into water and not directly into sediment (Whitmore, 2003). The fish were rapidly consumed by microbial activity. Some articulation of the bones was maintained, but no tissues were examined at high magnification to see if the association with microbes resulted in preservation. In one experiment where fish were observed to decay in aquaria with "pond mud" at the bottom, several fish appeared "to have become 'fossilized' on [or in] the mud." No evidence was presented, however, that fish fossils resembling those we observe today were produced and, furthermore, the "mud" was not reported to have turned into stone.

Many researchers have found that fish decay quickly in water, both in anaerobic and aerobic settings, within weeks or days (Krumholz, 1950; Zangerl and Richardson, 1963; Schäfer, 1972; Elder, 1985; Britton, 1988; Elder and Smith, 1988; Weigelt, 1989; Minshall et al., 1991; Parmenter and Lamarra, 1991; Schneider, 1998; Hankin and McCanne, 2000; Whitmore, 2003). Therefore, burial in sediment must have been rapid, the right combination of chemicals must have been available, and bacterial growth must have ensued to produce the fine-structure preservation we observe today. Whether fish are buried alive or buried after death, preservation seems dependent on very rapid burial under unique circumstances.

Another difficulty discerned from simple water preservation experiments is that fish often surface when submerged in water, leaving them available to surface predation and mechanical actions that can alter or destroy tissues. Furthermore, fish rupture due to internal gas buildup, resulting in significant alteration of body structures and articulation disruption (Rupp and DeRoche, 1965; Henley, 1967; Parker, 1967; Axon et al., 1980; Whitmore 2003). Yet billions of perfectly preserved, well-articulated fish exist in the fossil record.

Whitmore's observations (2003, pp. 117–131) of fossil fish from various quarries show that most have at least as good a level of preservation, and many have perfect preservation (complete articulation of vertebral column including ribs, all scales present, perfect fin preservation, and minimal soft body decay). Furthermore, he surmises that at one quarry (Warfield Springs Quarry, Wyoming) excellent preservation was a result of rapid burial and high deposition rates of sediments in calcium-rich water (Whitmore, 2003, pp. 156–157).

Other reports indicate that many different fossilized organisms display significant soft-tissue preservation (see Briggs et al., 1997, for dinosaurs; see Bartels et al., 1998, for other marine organisms; and see Morlo et al., 2004, for other organisms). However, the results of ongoing taphonomy experiments do not completely explain the extraordinary preservation of birds, mammals, reptiles, fish, and other organisms in the rock record.

The controversy regarding the mechanism and speed of fossil formation is a significant component of the ongoing creation-evolution debate. Creationists are skeptical of the explanations given by some scientists to explain the formation of fossilized organisms under everyday conditions (i.e., slow sediment deposition, typical water action, etc.). They argue that unusual and specialized conditions are required to produce the beautifully preserved fossils commonly found. They stress that certain minerals must be present, that heat may be required, and that burial under these unique sedimentary conditions must be rapid and complete. Theories of fossil formation in the recent literature include the notion that preservation must be rapid if it is going to happen at all, especially at the ultrastructural level; therefore, there is good reason to believe that creationist theories of fossil formation might be the norm. Furthermore, a clear financial and scientific incentive exists to rapidly make fossils, given the cost and rarity of well-preserved fossils. Fossils are a multibillion-dollar business. Such a feat would go a long way in supporting creationist theories that fossils formed rapidly, possibly during Noah's Flood.

Creationists and others have conducted much good research, but many questions remain. Experimentation done in this area should attempt to de-

velop hypotheses about fossil formation that can be adequately tested in order to simulate the unusual conditions of Noah's Flood needed to produce well-preserved fossils.

To test a basic hypothesis about how fish preservation could have occurred with rapid burial of the fish in sediment, two coastal tidal blennies (an estuarine fish) were humanely euthanized to see what would result from immediately encasing them in mud and allowing them to dry out. Sediment from Southern California known to yield significant numbers of well-preserved middle Miocene fossils (Saul and Stadum, 2005; Squires and Saul, 2007) was collected from a road cut on Old Topanga Canyon Highway in the San Fernando Valley suburb of Los Angeles. This sediment was made into a slurry by adding water into a 2:1 mixture of sediment and heavily silicified diatomaceous earth (collected from the diatomaceous earth beds at Lompoc, CA).

The fish employed in this study (Figure 1, probably *Hypsoblennius* sp.) were collected during a parasitological host study conducted in September of 1996 at the Point Mugu Naval Air Weapons Station (Point Mugu, CA) under the supervision of environmental officer Tom Keeney. The fish were euthanized and placed onto the slurry mixture at the midpoint of a five-gallon plastic bucket (Figure 2). Paper business cards were placed on both sides of the two fish so that the proper level could be located again. The rest of the bucket was filled (Figure 3) with the remaining slurry, and the bucket was tightly capped with a clip-fitting plastic lid. Weights were set on the bucket, which was left outside in the Southern California coastal climate for two years.

After two years the dried sediment was split open and the fish remains were located, photographed, and examined under a dissecting microscope (Figure 4). Ribs of the fish were identified and several of the vertebral bones and skull

Figure 1. Estuary fish (blennies—probably *Hypsoblennius* sp.), used in this preliminary fossilization experiment.

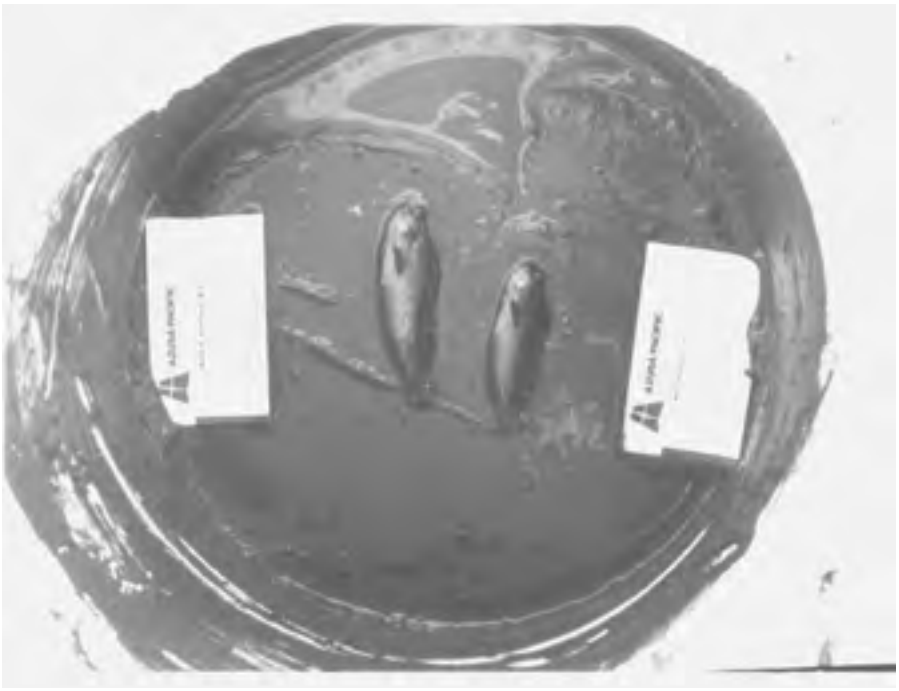


Figure 2. Fish from Figure 1 placed on top of about 6 inches of a mud slurry, made from combining sediment from Southern California known to yield significant numbers of well-preserved middle Miocene fossils with heavily silicified diatomaceous earth.

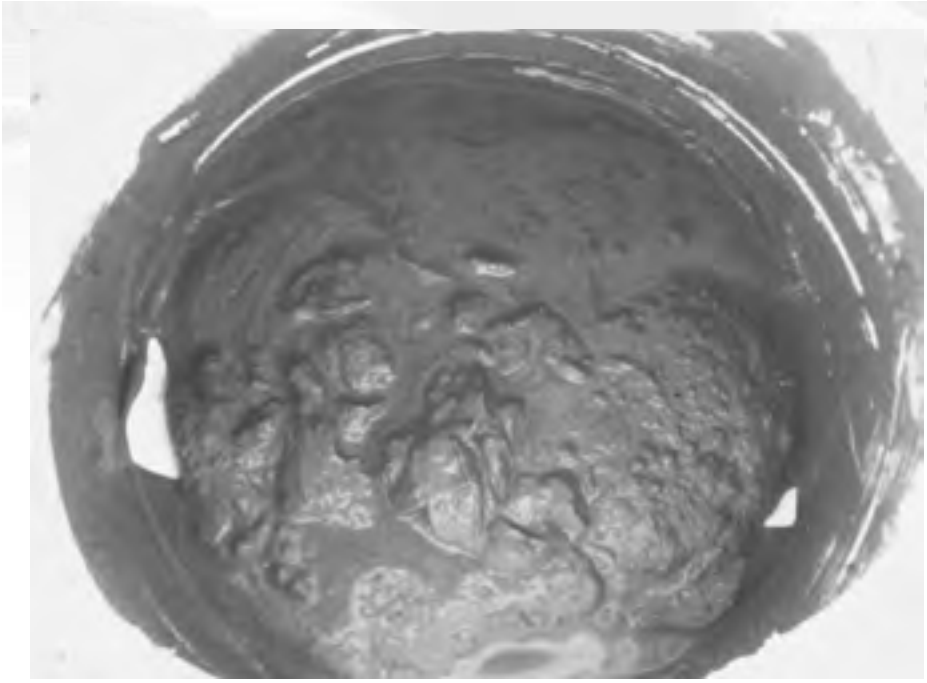


Figure 3. The fish were covered with another 6 inches of slurry, covered with a tightly fitting plastic lid and left outside for 2 years.

bones were found, but all the soft tissues (with the exception of the skin) were completely absent. The skin was dehydrated, brittle, and covered on the inside layer with fungal hyphae and fruiting bodies (Figures 5 and 6).

For illustrative purposes, Figure 4 was modified electronically to produce Figure 7, which shows the fish in the soil matrix (black arrow) and a matching white template drawn above (white arrow) to assist in identifying the location of the fish remains in the next few figures. An X-ray image was made of the soil matrix and the fish remains in an attempt to image any remaining bone material (Figure 8a). The X-ray machine used was a full-table X-ray system installed in the physical therapy department of a small, private university in the Los Angeles area. The first X-ray attempt resulted in a somewhat washed-out appearance, with a large, diffuse cloud of what could be bone material spread out around the fish remains. Note the white template indicating where the fish remains were located. To produce a higher-contrast image of suspected bone mineral, the magnitude of the X-ray emission on the machine was increased, and another X-ray image was taken (Figure 8b). Clearly seen is a bone mineral cloud emanating away from the fish (white template) and into the surrounding soil matrix.

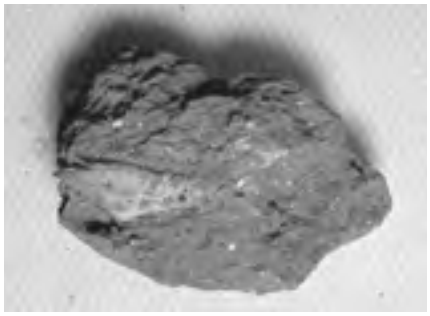


Figure 4. A portion of the dried sediment with a partial fish carcass protruding after 2 years.

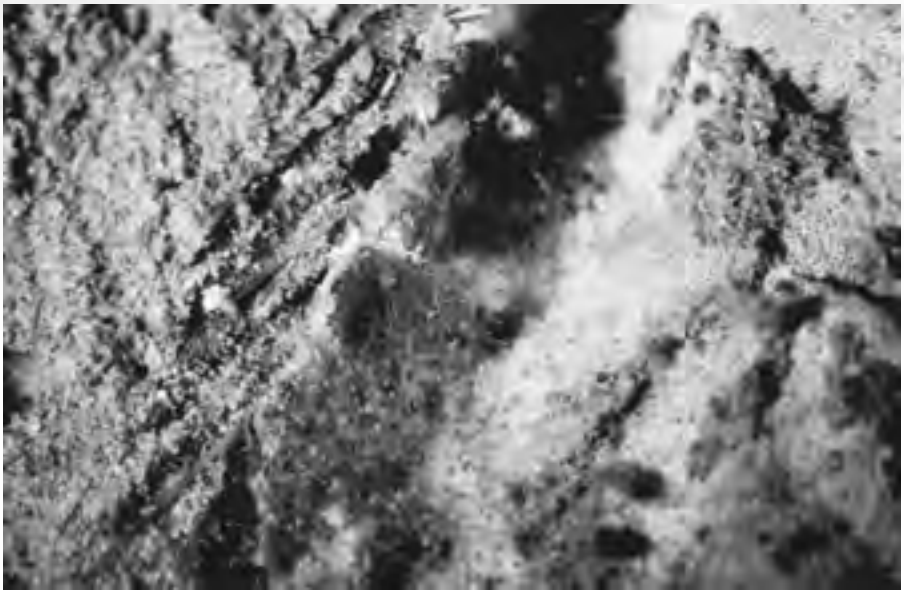
It was then decided that a more conclusive test could be performed using a Norland DEXA machine, which was designed specifically to image bone mineral to test humans for bone loss. The DEXA machine used was also in the physical therapy department of the university. Figure 9 shows the hip joint of a 51-year-old Caucasian female with moderate bone loss at the femoral neck (two large white rectangles). These images are normally in color, but for current purposes it is sufficient to note that the whiter areas of the image indicate more bone mineral. Figure 10 shows the DEXA image of the experimental fish, and the location of the bone mineral is again seen in a diffuse mass just above, and to the side, of the fish remains. Figures 8b and 10 correlate almost perfectly in the shape and orientation of the bone mineral cloud.

This preliminary experiment resulted in:

(a) no fossilization of the fish in spite of using well-characterized Miocene sediments known to yield well-preserved fossils;
(b) dehydrated and cracked skin and the absence of all soft tissues, in the presence of a heavy fungal infestation; and
(c) the complete loss of some bones (dissolution?) and the presence of a bone mineral cloud that can be seen emanating from the fish into the surrounding soil matrix.

Future experiments should examine this bone mineral cloud to verify what minerals are present. It may be that some bones were lost during the extraction from the dried sediment in this experiment; therefore, careful extraction of remains must be done. Furthermore, a variation of the experiment should be conducted with flowing water containing minerals known to be present in well-preserved fossil material. More work is certainly warranted to attempt to manufacture fossils in the laboratory.

Acknowledgments: I thank Jerry Bergman and George Howe for considerable help in making this a better manuscript. I also thank the anonymous reviewers who donate many hours of reading and



Figures 5, 6. Photomicrograph of fungal hyphae and spores attached to the inside layer of the fish skin.

editing to the Society. Finally, I thank the donors to the CRS endowment funds, in particular Ray and Lois Strom and Arlin and Lois Penner. A portion of these funds helped to pay for this study. Soli Deo Gloria!

References

Axon, J.R., L. Hart, and V. Nash. 1980. Recovery of tagged fish during the Crooked Creek Bay rotenone study at Barkely Lake, Kentucky. *Proceedings of the Annual Conference, Southeastern Association of Fish and Wildlife Agencies* 33:680–687.

Baas, M., D.E.G Briggs, J.D.H van Heemst, A.J. Kear, and J.W. de Leeuw. 1995. Selective preservation of chitin during the decay of shrimp. *Geochimica et Cosmochimica Acta* 59(5):945–951.

Babcock, L.E., S.A. Leslie, D.H. Elliot, A.L. Stigall, L.A. Ford, and D.E. Briggs. 2006. The "preservation paradox": microbes as a key to exceptional fossil preservation in the Kirkpatrick basalt (Jurassic), Antarctica. *The Sedimentary Record* 4(4):4–8

Bartels, C., D.E.G. Briggs, and G. Brassel. 1998 *Fossils of the Hunsrück Slate—Marine Life in the Devonian*. Cambridge University Press, Cambridge, UK.

Briggs, D.E.G. 2003. The role of decay and mineralization in the preservation of soft-bodied fossils. *Annual Review of Earth and Planetary Sciences* 31:275–301.

Briggs, D.E.G., and A.J. Kear. 1993. Fossilization of soft tissue in the laboratory. *Science* 259 (5100):1439–1442.

Briggs, D.E.G, A..J. Kear, D.M. Martill, and P.R. Willby. 1993. Phosphatization of soft-tissue in experiments and fossils. *Journal of the Geological Society* 150(6):1035–1038.

Briggs, D.E.G., P.R. Wilby, B.P. Perez Moreno, J.L. Sanz, M. Fregenal- artinez. 1997. The mineralization of dinosaur soft tissue in the Lower Cretaceous of Las Hoyas, Spain. *Journal of the Geological Society, London* 154:587–588.

Britton, D.R., 1988. The occurrence of fish remains in modern lake systems: a test of the stratified-lake model. Master's thesis, Loma Linda University, Loma Linda, CA.

Channing, A., and D. Edwards. 2004. Experimental taphonomy: silicification of plants in Yellowstone hot spring environments. *Transactions of the Royal Society of Edinburgh. Earth Sciences* 94:503–521.

Elder, R.L., 1985. Principles of aquatic taphonomy with examples from the fossil record. Doctoral diss., University of Michigan, Ann Arbor, MI.

Elder, R.L., and G.R. Smith. 1988. Fish taphonomy and environmental inference in Paleolimnology. *Palaeogeography, Palaeoclimatology, Palaoecology* 62:577–592.

Everett, V. 2009. Soft tissue fossilization: evidence for sudden, extensive destruction of life consistent with the Genesis Flood account. http://www.answersingenesis.

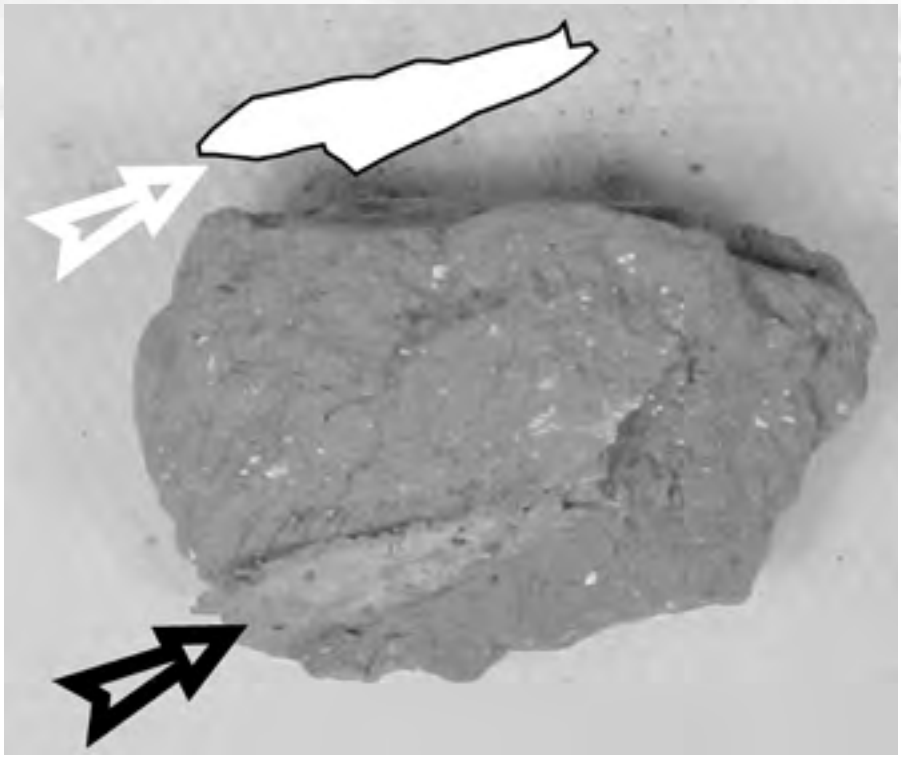


Figure 7. Same as Figure 4, but now a template of the fish has been drawn in white to assist with the next figures.

org/articles/aid/v4/n1/soft-tissue-fossilization (accessed January 22, 2010).

Gupta, N.S., R. Michels, D.E.G Briggs, R.P. Evershed, and R.D. Pancost. 2006. The organic preservation of fossil arthropods: an experimental study. *Proceedings of the Royal Society B: Biological Sciences*. 273:2777–2783.

Hankin, D.G., and D. McCanne. 2000. Estimating the number of fish and crayfish killed and the proportions of wild and hatchery rainbow trout in the Cantara spill. *California Fish and Game* 86:4–20.

Henley, J.P., 1967. Evaluation of rotenone sampling with SCUBA gear. *Proceedings of the Annual Conference, Southeastern Association of Game and Fish Commissioners* 20:439–446.

Hicks, H. 1986. Mineralized sodium silicate solutions for artificial petrification of wood. http://www.patentstorm.us/patents/4612050/description.html (accessed February 10, 2010).

Krumholz, L.A. 1950. Some practical considerations in the use of rotenone in fisheries research. *Journal of Wildlife Management* 14:413–424.

Martill, D.M. 1998. Preservation of fish in the Cretaceous Santa Formation of Brazil. *Palaeontology* 31(1):1–18.

Martin, D.M., P.M. Brito, and J. Washington-Evans. 2008. Mass mortality of fishes in the Santana Formation (Lower Cretaceous, ?Albian) of northeast Brazil. *Cretaceous Research* 29(4):649–658.

Minshall, G.W., E. Hitchcock, and J.R. Barnes. 1991. Decomposition of rainbow trout (*Oncorhynchus mykiss*) carcasses in a forest stream ecosystem inhabited only by nonanadromous fish populations. *Canadian Journal of Fisheries and Aquatic Sciences* 48:191–195.

Monge-Najera, J., and X. Hou. 2002. Experimental taphonomy of velvet worms (Onychophora) and implications for the Cambrian "explosion, disparity and decimation" model. *Revista de Biología Tropical* 50(304):1133–1138.

Morlo, M., S. Schaal, G. Mayr, and C. Seiffert. 2004. An annotated taxonomic list of the Middle Eocene (MP 11) vertebrata of Messel. *Courier Forschungsinstitut Senckenberg* 252:95–108.

Parker, R.O. 1967. Rotenone and fish population estimations. Masters thesis, Ohio State University, Columbus, OH.

Parmenter, R.R., and V.A. Lamarra. 1991. Nutrient cycling in a freshwater marsh: The decomposition of fish and waterfowl carrion. *Limnology and Oceanography* 36:976–987.

Raff, E.C., J.T. Villinski, F.R. Turner, P.C.J. Donoghue, and R.A. Raff. 2006. Experimental taphonomy shows the feasibility of fossil embryos. *Proceedings of the National Academy of Sciences* 130(15):5846–5851.

Rupp, R.S., and S.S. DeRoche. 1965. Standing crops of fishes in three small lakes compared with C14 estimates of net primary productivity. *Transactions of the American Fisheries Society* 94:9–25.

Saul, L.R., and C.J. Stadum. 2005. Fossil Argonauts (Mollusca: Cephalopoda: Octopodida) from late Miocene siltstones of the Los Angeles basin, California. *Journal of Paleontology* 79(3): 520–531.

Schäfer, W. 1972. *Ecology and Palaeoecology of Marine Environments*. University of Chicago Press, Chicago, IL.

Schneider, J.C. 1998. Fate of dead fish in a small lake. *The American Midland Naturalist* 140:192–196.

Snelling, A. 1995. "Instant" petrified wood. *Creation* 17(4):38–40.

Soja, C.M., D. Sunderlin, and S.J. Close. 2004. Using burial experiments to unscramble dinosaur egg taphonomy. *Geological Society of America Abstracts with Programs* 36(5):382 (Palentology VIII Processes of fossilization).

Squires, R.L., and L.R. Saul. 2007. Paleocene pareorine turritellid gastropods from the Pacific slope of North America. *The Nautilus* 121(1):1–16.

Trinajstic, K., C. Marshall, J. Long, and K. Bifield. 2007. Exceptional preservation of nerve and muscle tissues in Late

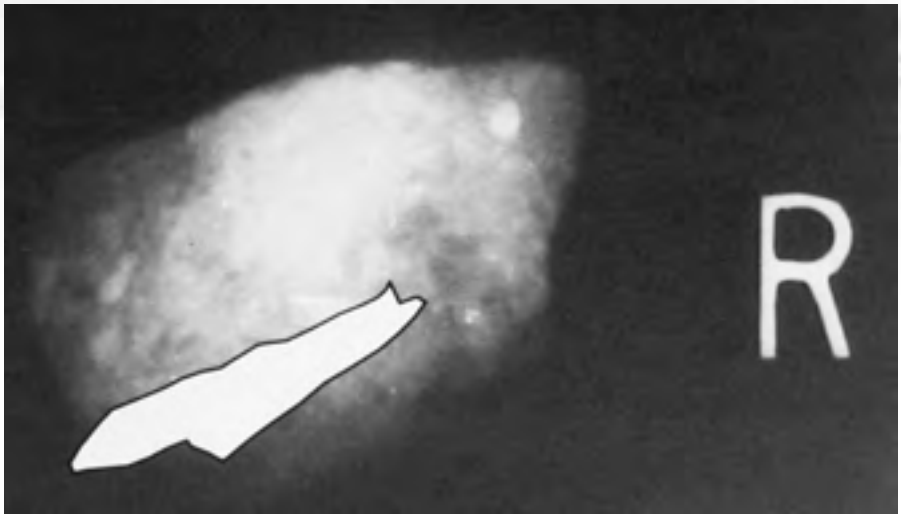


Figure 8a. Initial X-ray of the dried sediment with the template of the fish carcass in white, showing the position of the fish remains, and a large, diffuse cloud of what might be bone mineral.

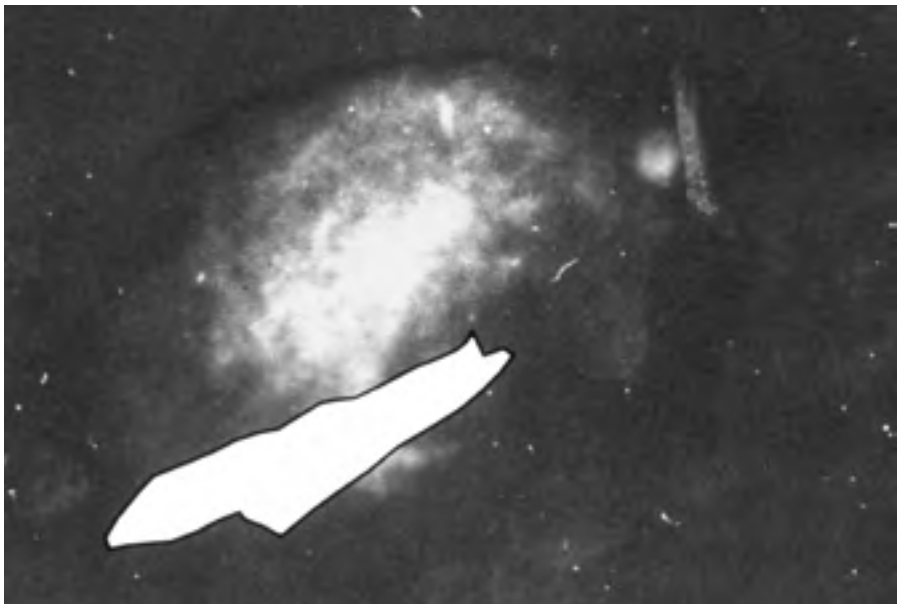


Figure 8b. Higher-contrast X-ray of the dried sediment specimen from Figure 8a. Note the position of the more well-defined cloud of what might be bone mineral emanating from the fish carcass.

Figure 9. Bone densitometry hip scan of a 51-yr-old Caucasian female showing marked bone loss at the femoral neck (dark area) and normal bone mass at the edges (white area).

Figure 10. Bone densitometry scan of the dried sediment with the template of the fish carcass in white showing the position of the fish remains and a large, diffuse cloud of what might be bone mineral. This scan has good correlation with the X-ray in Figure 8b.

Devonian placoderm fish and their evolutionary implications. *Biology Letters* 3(2):197–200.

Weigelt, J. 1989. *Recent Vertebrate Carcasses and Their Paleobiological Implications*. University of Chicago Press, Chicago, IL.

Whitmore, J.H. 2003. Experimental fish taphonomy with a comparison to fossil fishes. Ph.D. diss., Loma Linda University, Loma Linda, CA.

Zangerl, R., and E.S. Richardson Jr. 1963. *The Paleoecological History of Two Pennsylvanican Black Shales*. Chicago Natural History Museum, Chicago, IL.

Zhang, X.G., and B.R. Pratt. 1994. Middle Cambrian embryos with blastomeres. *Science* 266(5185):637–639.

Mark H. Armitage, M.S., Ed.S
Visiting Scientist
Van Andel Creation Research Center
micromark@juno.com

Pyrenoids and Evolution: Why Abandon a Great Idea?

Introduction

Complex biological plant structures called *pyrenoids* are found in the chloroplasts of some plant cells. They have wide implications for creation, because they are found in only a few plants that are separated widely in the taxonomic outline. A more thorough examination of the pyrenoid will be presented at a later date.

As discussed in a previous CRSQ paper (Armitage and Howe, 2007), the pyrenoid is an organelle found within the chloroplasts of various algae and certain land plants. An example is the microscopic green alga *Trebouxia*, known to have a symbiotic relationship with certain fungi in lichens (Armitage and Howe, 2007, Figure 1).

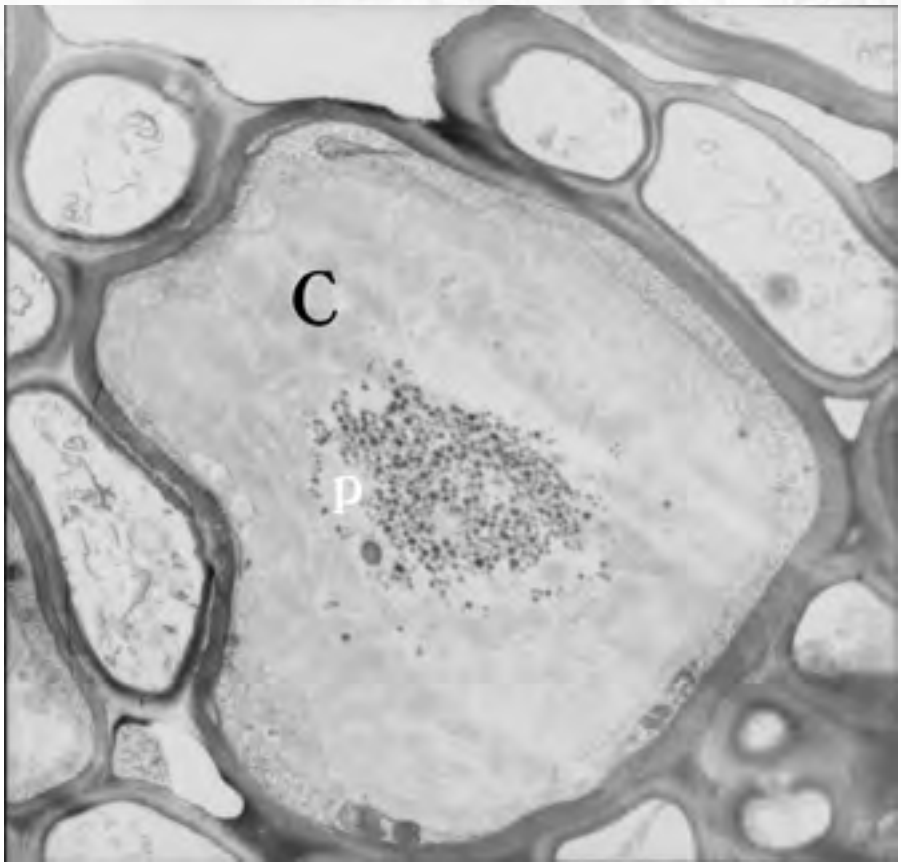


Figure 1. Transmission electron micrograph (TEM) of a thin section of the lichen Candelariella, 10,000X magnification. The pyrenoid is shown at the center of the large algal cell chloroplast (C). The minute dark spots are called pyrenoglobuli (P), a site of water and lipid storage.

The Role of Pyrenoids

The pyrenoid/chloroplast complex performs some remarkable functions. The pyrenoid functions as the storage site for proteins and starches (Stern, 2000). Not all pyrenoids store starch, however; and although most algae have pyrenoids, most land plants lack these structures within their chloroplasts.

Carbon dioxide, water, and sunlight are biochemically converted to sugar compounds by energy from photosynthesis. Large amounts of atmospheric carbon dioxide also can be sequestered and stored in a form that can be used later by the plant when conditions warrant. Lipids (fats), as well as water, are produced and stored within tiny pyrenoglobuli, spheres found within pyrenoids (Alberts et al., 2002; Ahmadjian, 1993) (see Figure 1). The storage of water and lipids is one reason why lichens can withstand severe desiccation and heat.

In plants, Rubisco, a complex 5-carbon molecule, accepts atmospheric CO_2 and makes 6-carbon sugars such as glucose. All plants employ Rubisco to photosynthesize but pyrenoids are not essential to the process.

During times of heavy photosynthesis, glucose is converted into a polysaccharide (many sugars strung together in chains) such as starch (Stern, 2000). Starch grains show up as white ovals or circles in thin sections of chloroplasts (Figure 2).

All algae (kingdom Protista, subkingdom Phycobionta) contain pyrenoids within their chloroplasts. This is remarkable, because there exist several divisions of the subkingdom Phycobionta (diatoms, green algae, red algae, euglena, and dinoflagellates, plus a few others), which are all very different from each other. Diatoms contain pyrenoids in which they produce high quality oil and store it as a reserve rather than making and storing starch (Drum, 1963; Holdsworth, 1968; Holdsworth, 1971; Taylor, 1972; Medlin and Kaczmarska, 2004). Some of the dinoflagellates, (another aquatic protist) possess a pyrenoid as well (Jenks, 1998). Ratti et al., however, found that some dinoflagellates have an advanced method of concentrating carbon dioxide in the absence of a pyrenoid (2007). This mechanism actually "bombards Rubisco molecules with CO_2" in order to increase the amount of

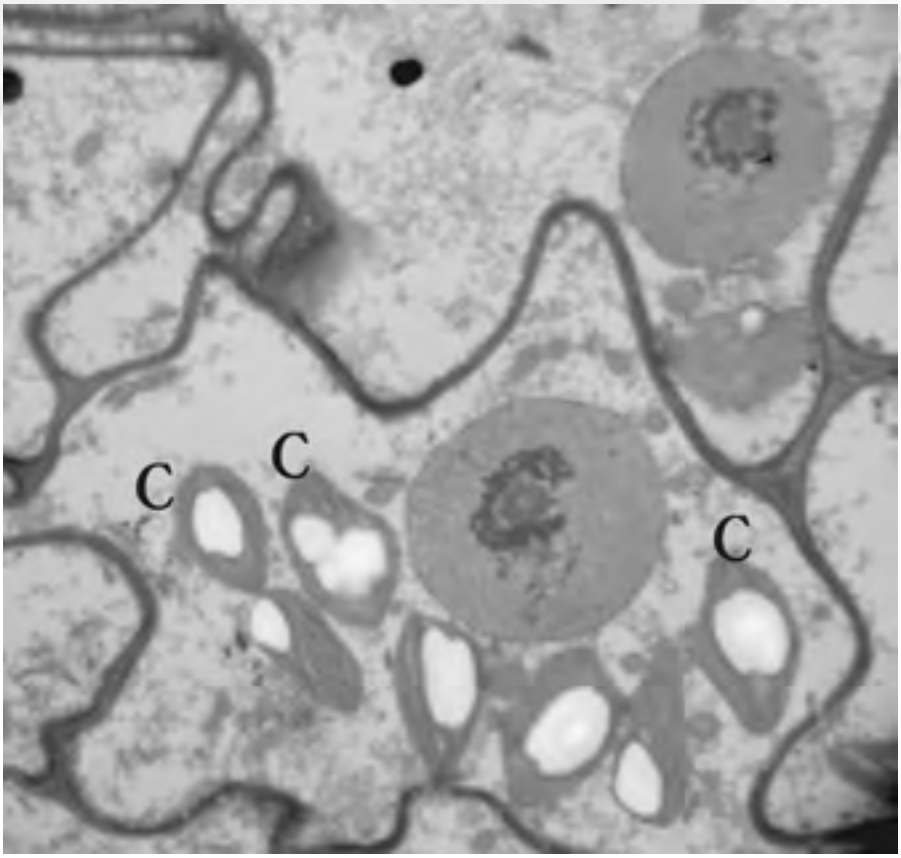


Figure 2. TEM of a moss phyllid (leaf), 2500X magnification. The chloroplasts (C) are seen bulging with stored starch (the white grains inside each chloroplast).

carbon available for sugar production. They also state, "Our data indicate that *P.Protceratium reticulatum* has an inducible carbon-concentrating mechanism (CCM) that operates in the absence of pyrenoids and with little intracellular CO_2 accumulation" (Ratti et al., 2007, p. 699). In actuality, however, this CCM is typical of many algae and cyanobacteria, as well at the lichens and hornworts (Smith and Griffiths, 1996), whether or not a pyrenoid is present. Yet in certain algae within lichens (*Trebouxia* and *Coccomyxa*), the activity of the CCM is directly correlated with the *presence* of a pyrenoid (Smith and Griffiths, 1996). Thus, there seems to be no evolutionary (phylogenetic) logic for the correlation of the CCM and of pyrenoids found in widely separated taxonomic groups. If the CCM can operate efficiently in the absence of a pyrenoid, why is this structure preserved in some cases and abandoned in others?

Two other subkingdoms in the Protista, the Myxobionta and the Mastigobionta, are similar to organisms in another kingdom (the fungi in kingdom Fungi), but pyrenoids have never been found in them. This is not surprising, however, since these organisms do not photosynthesize.

More Pyrenoid Problems for Evolution Theory

From an evolutionary perspective, the pyrenoid/chloroplast complex would have conferred a distinct advantage to plants that moved onto land where water and other resources were scarce. One might expect that the pyrenoid would have been preserved through the terrestrial descendants because they made their transition onto the land. Therefore, we should see this marvelous pyrenoid system only in "advanced" plants, not in putative, primitive plants.

Some evolutionists consider lichens to be one of the "earliest" colonizers of the land (Atsatt, 1998) because they are comprised of an alga and a fungus—both seemingly "primitive." Strangely enough, we see pyrenoids in these lowly lichen algae, but then they do not appear further up the evolutionary tree until one gets to the hornworts.

In fact, evolution theory would need to have depended on the pyrenoid as a structure to deal with the transition from an anoxic (low oxygen and high carbon dioxide) atmosphere to one with lower CO_2 levels. Bendall et al. stated, "One way that algae evolved to cope with the problem of falling CO_2 was by the evolution of a pyrenoid, an extension of the chloroplast that is made up of over 95% Rubisco protein" (2008, p. 2626). But for some unknown reason, evolution did not perpetuate the pyrenoid system very far among the land plants that likewise faced dropping carbon dioxide concentrations.

There is some controversy over whether the green alga *Trebouxia* can exist as a free-living organism. Some authors even contend that it has never been found free-living outside lichens, making the presence of pyrenoids in *Trebouxia* even more troubling for evolutionists, posing the major question, "Where did the pyrenoids come from?"

Liverworts, Hornworts, and More Evolutionary Problems

Hornworts are small land plants, called bryophytes, in division Anthocerophyta (kingdom Plantae—two full kingdoms "up the ladder" from the algae). Bendall et al. (2008, p. 2625) note, "Hornworts also contain a pyrenoid, allowing speculation on the origin and function of pyrenoids in land plants," a fact that confounds the "descent with modifica-

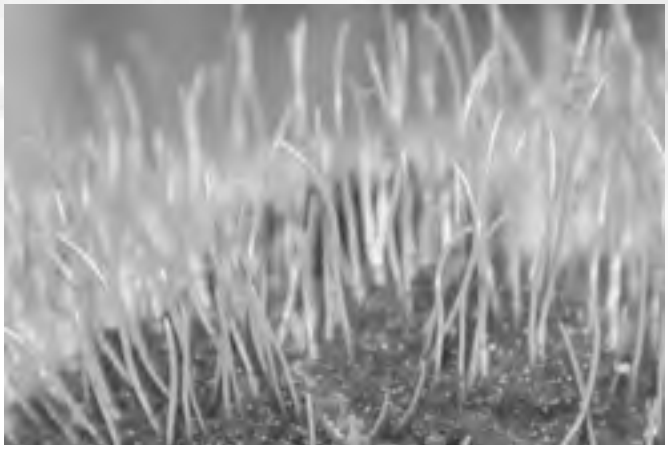


Figure 3a. Macrophotograph of a hornwort *(Anthoceros sp.)* collected from the Santa Monica Mountains in Southern California. Note the moist and low-growing gametophyte portion of the plant. The vertical posts or "horns" are the sporophyte (or spore-producing) generation of the hornwort life cycle.

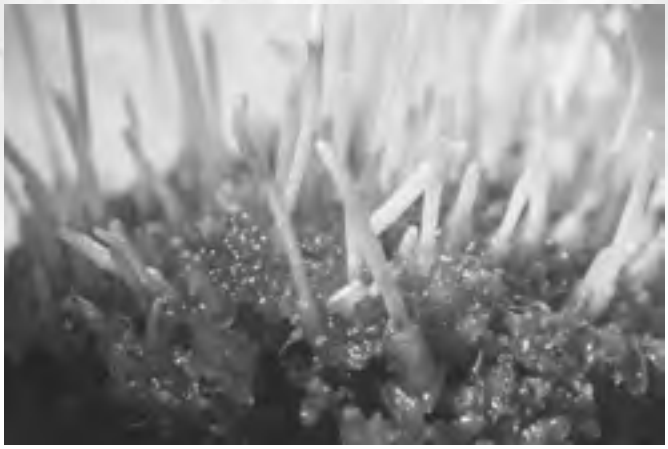


Figure 3b. A close-up macrophotograph of the hornwort in Figure 3a. One can clearly make out the vertical horns, which split open releasing spores. New spores will germinate into a new hornwort gametophyte if conditions are right, beginning the cycle again.

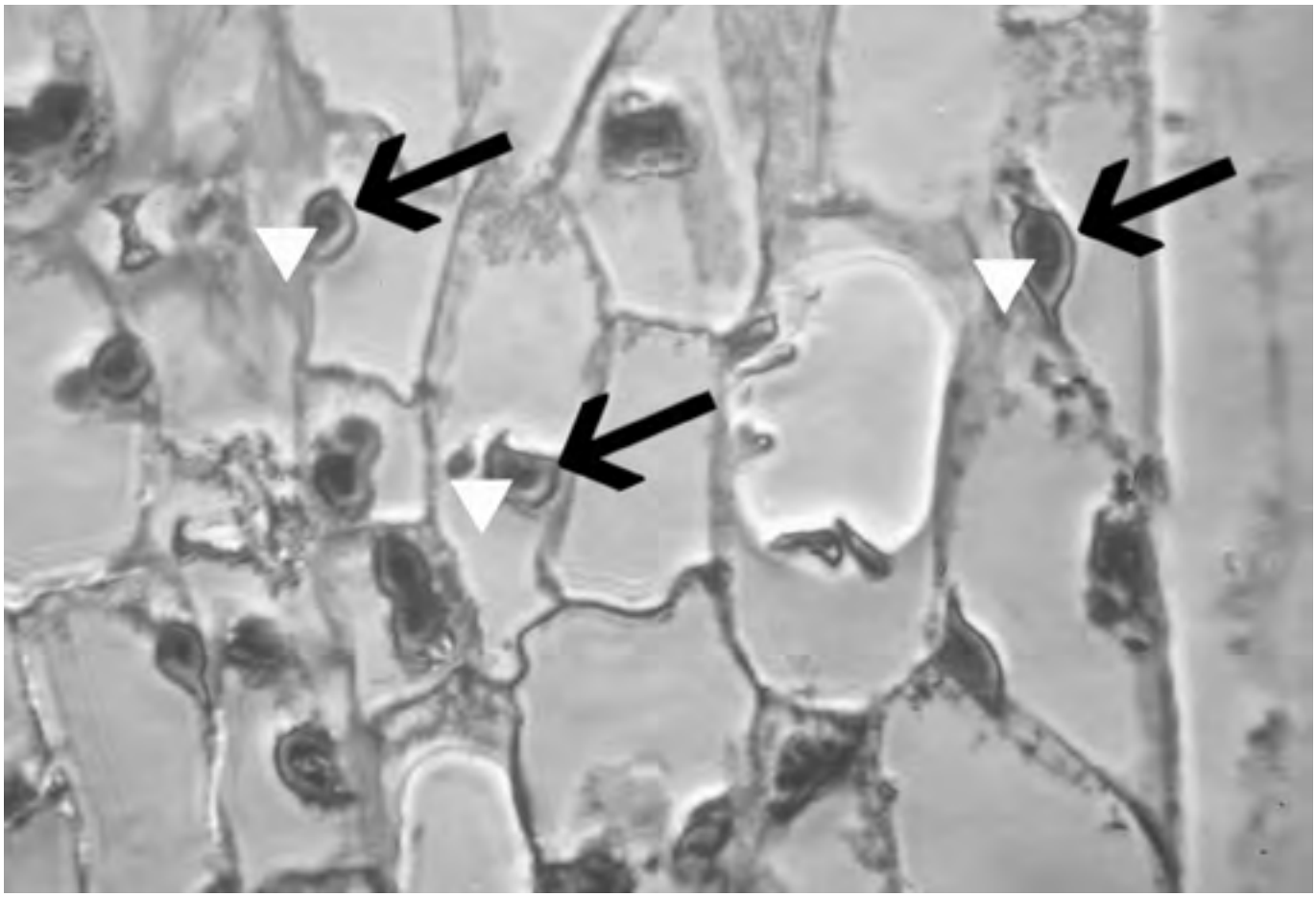


Figure 4. A thin section light micrograph through the vertical horn of the sporophyte of Anthoceros. Note the many oval- to round-shaped chloroplasts (dark arrows) where photosynthesis takes place. The dark centers of these chloroplasts (white arrows) are presumed to be the pyrenoid portion of the chlororplast.

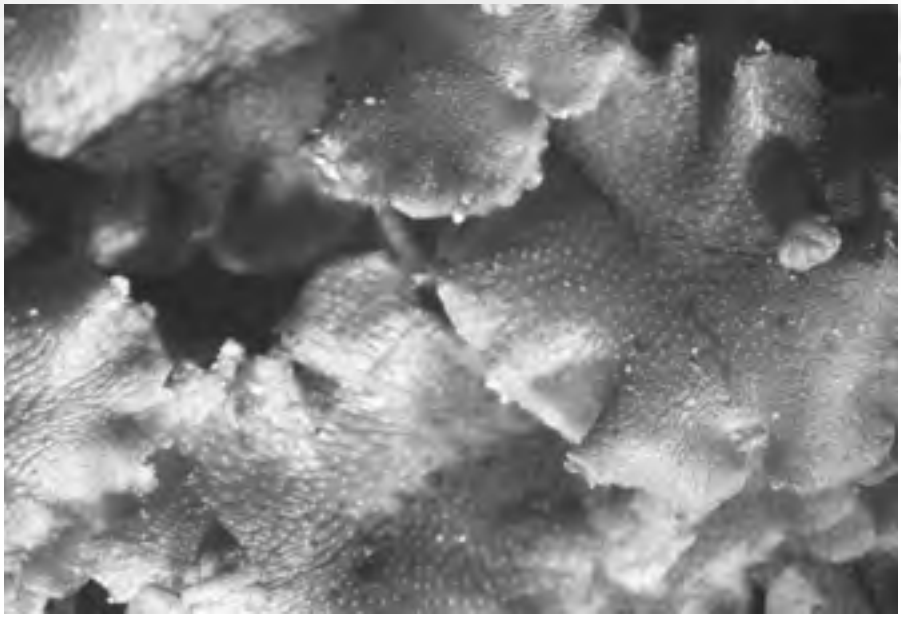


Figure 5a. A macrophotograph of the liverwort *Conocephalus*, considered to be the direct descendent of the green algae. A search will be made for pyrenoids in the chloroplasts in this liverwort plant.

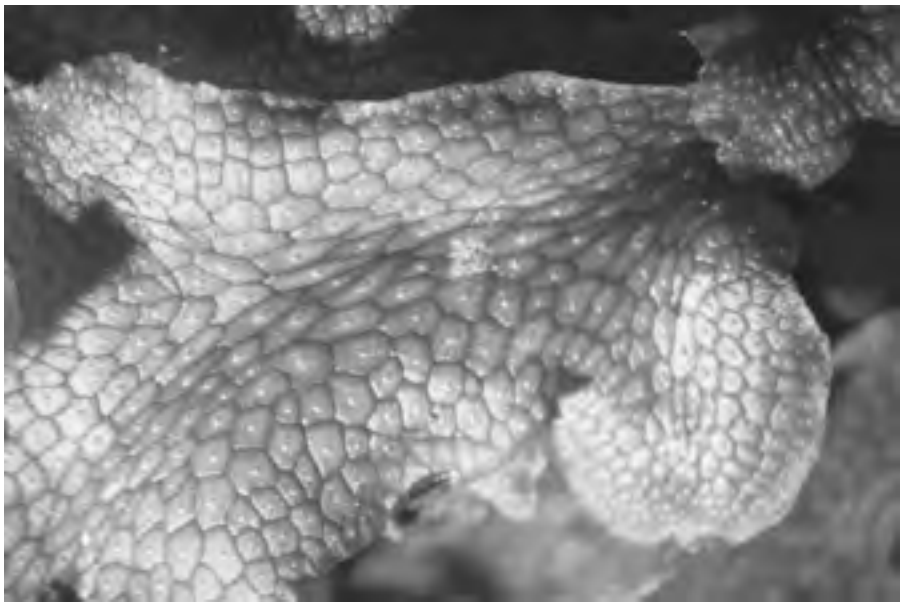


Figure 5b. A macrophotograph of the liverwort *Marcantia*, considered to be the direct descendent of the green algae. A search will be made for pyrenoids in the chloroplasts in this liverwort plant as well.

tion" puzzle even more. If hornworts (Figures 3a, 3b) descended from green algae such as *Trebouxia* (as some, but not all, evolutionists believe), then we would expect to find pyrenoids in hornworts, as we do (Figure 4). Yet another group of small bryophyte plants, the liverworts (Figures 5a, 5b), are likewise thought to be the direct descendants of the green algae, but no evidence exists that pyrenoids are found in their chloroplasts. Furthermore, the moss bryophytes do not possess pyrenoids either. This great problem for evolution theory poses no problem for the creation view.

This continuing project will look for evidence for pyrenoid structures in liverworts, mosses, and other land plants to further elucidate the structure of the pyrenoids.

Acknowledgments: The author gratefully acknowledges the assistance of Dr. George Howe and Dr. Jerry Bergman, as well as the anonymous reviewers, all of whom contributed to making this a better manuscript. In addition, contributors to the CRS Research Endowment Fund and the Van Andel Creation Research Center fund, most notably Arlin and Lois Penner and Ray and Lois Strom, are gratefully acknowledged. Money from these funds supported this research. *Soli Deo Gloria*.

Literature cited

CRSQ: Creation Research Society Quarterly

Ahmadjian, V. 1993. *The Lichen Symbiosis.* John Wiley and Sons, New York, NY.

Alberts, B., A. Johnson, J. Lewis, M. Raff, K. Roberts, and P. Walter. 2002. *Molecular Biology of the Cell*, 4th edition. Garland Science Publishers, New York, NY.

Armitage, M., and G.F. Howe. 2007. The ultrastructure of lichen cells supports creation and not macroevolution. *CRSQ* 44:40–53.

Atsatt, P.R. 1988. Are vascular plants "inside-out" lichens? *Ecology* 69(1):17–23.

Bendall, D.S., C.J. Howe, E.G. Nisbet, and R.E.R. Nisbet. 2008. Introduction. Photosynthetic and atmopheric evolution. *Philosophical Transactions of the Royal Society B* 363:2625–2628.

Drum, R.W. 1963. The cytoplasmic fine structure of the diatom *Nitzschia palea*. *Journal of Cell Biology* 18:429–440.

Holdsworth, R.H. 1968. The presence of

a crystalline matrix in pyrenoids of the diatom *Achanthes brevipes*. *Journal of Cell Biology* 37:831–837.

Holdsworth, R.H. 1971. The isolation and partial characterization of the pyrenoid protein of *Eremosphera viridis*. *Journal of Cell Biology* 51:499–513.

Jenks, A. 1998. The dinoflagellate chloroplast: immunolocalization of two unique plastid proteins. Master's Thesis, McGill University, Montreal, Quebec.

Medlin, L.K., and I. Kaczmarska. 2004. Evolution of the diatoms: V. Morphological and cytological support for the major clades and a taxonomic revision. *Phycologia* 43:245–270.

Ratti, S., M. Giordano, and D. Morse. 2007. CO_2-concentrating mechanisms of the potentially toxic dinoflagellate *Protoceratium reticulatum* (Dinophyceae, Gonyaulacales). *Journal of Phycology* 43:693–701.

Smith, E.C., and H. Griffiths. 1996. The occurrence of the chloroplast pyrenoid is correlated with the activity of a CO_2-concentrating mechanism and carbon isotope discrimination in lichens and bryophytes. *Planta* 198(1): 6–16.

Stern, K.R. 2000. *Introductory Plant Biology*, 8th edition. McGraw-Hill, Boston, MA.

Taylor, D.L. 1972. Ultrastructure of *Cocconeis diminuta* Pantocsek. *Archives of Microbiology* 81:136–145.

Mark H. Armitage, M.S., Ed.S
Visiting Scientist
Van Andel Creation Research Center
micromark@juno.com

Can "Relative" Radiometric Dating Help Refine Biblical Chronology?

The discipline of Biblical chronology is probably as old as the Bible, although we associate its Western heyday with the post-Renaissance work of the sixteenth- and seventeenth-century chronologers. They were influenced by the hermeneutical views of the Reformation, which demanded a high view of Scripture. Even secular historians acknowledge the impact of the discipline on the developing understanding of history (Rudwick, 1999), since the framework of modern history is, of course, chronology. Biblical chronology reached its apex in the 1645 publication of James Ussher's *Annals of the World*, but his scholarly compilation became a target for Enlightenment ridicule. Following that trend, most people hold a skeptical attitude toward the historical validity of the Bible and Genesis in particular and are surprised to learn of the depth of Ussher's work or the prominence of fellow chronologers. The authors heard disparaging and sarcastic remarks about Ussher in geology classes in college.

Thankfully, that trend began to be reversed by the advent of the modern creation movement in the late 1900s. Instead of making fun of Ussher, some scholars actually read him, and this led to a republication of *Annals* (Ussher et al., 2003) and of similar works advocating a high view of Biblical history and skepticism regarding the anti-Biblical archeological dating schemes for ancient cultures (e.g., Jones, 2005).

However, the influence of secular natural history runs deep, bolstered by its own chronology, which in turn rests upon the geological timescale and, increasingly in modern times, on radiometric dating. The influence of secular history is seen in the advocacy by some creation scientists for the relative chronostratigraphy of the timescale, although they eschew its geochronology of billions of years. Likewise, there has been an interest in using "relative" radiometric dates—based on the concept of accelerated nuclear decay—to reinforce Biblical chronology in the arena of natural history (e.g., Dickens and Snelling 2008a, 2008b). These positions grant validity to the foundations of secular natural history that is neither warranted nor ultimately helpful.

There are several problems with these proposals that must be answered:

(1) Using "science" to undermine the Bible has been a tactic of secularists for several centuries. Are creation scientists unconsciously allowing this? If the Bible is sufficient to provide history's time line, then how necessary are these relative radiometric ages? Some might claim that they merely fill in details in the rock record not provided by the Bible, but we can look back on past centuries when well-intentioned schemes to "support" the Bible have quickly become ill-founded schemes to supplant the Bible.

(2) It is an article of faith among secular geologists that "reliable" radiometric dates will cohere to the chronostratigraphy of their timescale. This assumes that the linear time progression of the geological timescale is itself valid—a proposition that has yet to be demonstrated. This demonstration seems *impossible* for the Precambrian, since the chronostratigraphy of those eras is itself now defined by arbitrary GSSAs—Global Standard Stratigraphic Ages (Gradstein et al, 2004). That sets up a circular argument, using unreliable radiometric dates and a questionable timescale to prove each other (Reed, 2008a). Furthermore, we see this new arrangement by the

Figure 1. Several lava domes have formed at Mount St. Helens since the May 1980 eruption. In June 1992, Austin collected and radiometrically dated a lava dome rock sample (Austin, 1996). The resulting analysis suggested a radiometric age range of 340 thousand to 2.8 million years for the six-year-old dome. Such studies demonstrate the inherent uncertainty in these methods. Photograph by Richard B. Waitt, Skamania County, Washington, 1982. Used courtesy of the U.S. Geological Survey. Accessed from: http://libraryphoto.cr.usgs.gov/cgi-bin/show_picture.cgi?ID=ID. Mount St. Helens – 53.

> International Commission on Stratigraphy (ICS) as a tacit admission of failure, since they could find no other criteria to accurately delineate the first 90% of Earth's supposed history. This circular arrangement rests on the uniformitarian belief that the perceptual rock record and the conceptual geologic column are one and the same—a tenet often assumed but logically unprovable. Thus, creation scientists advocating "relative" radiometric dating and the structure of the timescale appear to share these faults.

(3) It is not clear how a relative radiometric dating scheme coheres to Biblical chronology. There is no published algorithm for converting radiometric dates of billions of years into Biblical dates of thousands of years. Nor can we imagine one at present that would satisfy both Biblical and scientific scrutiny. Since we know that radiometric dates have proven unreliable—producing discrepant dates with rocks of known ages and discrepant dates for the same rock using different methods (Austin, 1994; 2005)—and since we know that the complete data set of dates has been winnowed to exclude those that do not agree with the timescale (Woodmorappe, 1999), then it seems that a compelling conversion factor is not possible. Even if one could be proposed, how could its reliability be demonstrated? Any attempt would be circular because there is no infallible, absolute dating method. It should be noted that an analysis into this possibility has recently been completed, and the results suggest that this approach does not appear to be straightforward (Hung, 2008).

As the questions in item (1) above suggest, this proposal devolves back to the role of the geological timescale in creationist thought (Reed and Oard, 2006). That timescale was initially set up in the early to mid 1800s to discredit the Bible (Mortenson, 2006) because it was the strategy of Enlightenment skeptics to deceive Christians by proposing a prehuman prehistory not explicitly described in the Bible, while giving lip service to the "recent" history of Genesis. It was wrong from the outset because it ignores the first three words in the Bible, but many Christians jumped on board. The past two centuries have unveiled the sorry trail of that compromise.

At a minimum, with the new GSSA method of defining Precambrian boundaries, this creationist approach cannot be applied to the vast majority of Earth's history, because the wall of separation between geochronology and chronostratigraphy—crucial to creationist advocacy of the timescale—has been breached:

> We consider that the practice of Chronostratigraphy today defines the time framework of Geochronology, because intervals of geological time are now being precisely defined within rock successions by GSSPs. The effect of this is that Chronostratigraphy and Geochronology should become one and the same discipline (Gradstein et al., 2004, p. 41).

Although the timescale of the Phanerozoic appears to rest on a wide variety of field data, the push by the ICS to define all stage boundaries by Global Stratotype Sections and Points—essentially glorified highway markers—illustrates the inherent unreliability of these

various stratigraphic methods (Reed, 2008c). If these are not sufficient to force a second look at the timescale by creation scientists, then its foundational assumptions should (Reed, 2008b).

Illustrating these problems, Dickens and Snelling (2008a) proposed that the transition from the Archean Era to the Paleoproterozoic Era occurred in unique lithologies, such as banded iron formations, which secular geologists have dated between 2.7 and 2.5 billion years ago (Ga). In contrast, the ICS defined the transition from the Archean Eon to the Paleoproterozoic Era exactly at 2.5 billion years (Gradstein et al., 2004), using radiometric dating, not the criteria of Dickens and Snelling. The changing ideas of secular geology make it difficult to adhere to even the chronostratigraphic interpretations, and, as noted above, the new geochronologic approach invalidates once-accepted methods such as lithology.

If creation scientists wish to keep up with the ICS and use radiometric dating to define the ages of rocks in a relative manner, they must address the inherent circularity of the secular system and present clear criteria for converting the confusing variety of secular dates into meaningful markers for a Biblical natural history. This begs the question of the relationship between "prehistory" and the Bible. Some creation scientists assume that the "Precambrian" is an actual period of the past that can be defined globally and empirically to the extent that specific Biblical events can be correlated to specific Precambrian subdivisions (Dickens and Snelling, 2008a; Hunter, 2008). However, Reed (2008c) noted that global correlative synchronous time is an assumption—not an empirically demonstrated conclusion. Demonstrating this "onion model" of stratigraphy is another burden for anyone wishing to use uniformitarian chronology as the basis for Biblical natural history (Reed and Froede, 2003). We may be forced to use labels such as "Precambrian" because of the monolithic dominance of the timescale, but we must not confuse semantic necessity with historical reality.

Logical problems eventually lead to empirical problems. If banded iron is an indicator of "Day Two" (boundary between the Archean and Paleoproterozoic), then how do we explain the presence of Precambrian banded iron in the Pikes Peak Iron Formation of central Arizona, which has been radiometrically dated to 1.75 Ga (early Proterozoic)—a discrepancy of nearly a billion years (Slatt et al., 1978)? As with any universal assertion, the Pikes Peak Iron Formation invalidates the use of banded iron formation as the criteria for the proposed boundary. Furthermore, a previous creationist investigation of these strata, in the context of their surrounding strata, interpreted them as products of the Flood (Froede et al., 1998; Figure 2), not of the Creation Week. Thus, we must conclude that banded iron formation is not a unique global time horizon.

This takes us back to the question of method: if we are to apply radiometric date conversions from billions to thousands of years, we need an algorithm that enjoys scientific and historical confidence. We are aware of no such proposed method. To anyone working on such a method, we ask the following questions: Do different methods of radiometric dating have different conversion factors? How will the algorithm handle discrepant dates for the same methods or for different methods of radiometric dating? By what means will the algorithm be validated?

It appears that the gap between theory and practice is still wide. We would suggest that anyone working on such a method address the suspicion of Woodmorappe (1999) that radiometric dates seldom rise above the level of statistical "noise," allowing researchers to arbitrarily select whatever date they wish.

Currently, there is no defined method for converting radiometric dates to Biblical history. Therefore proposals to apply the theory are incomplete. However, it is an intriguing idea and we look forward to the development of such an algorithm and its demonstration in an empirically convincing manner. It would certainly help tie parts of the rock record to the Biblical chronology. Until then, we suggest that creation scientists set aside the uniformitarian chronology and use of relative radiometric dating in favor of a stratigraphy based squarely on the chronology of the Bible (Froede, 2007; Reed et al., 2006).

References

CRSQ: Creation Research Society Quarterly

JoC: Journal of Creation

Austin, S.A. 1994. Are Grand Canyon rocks one billion years old? In Austin, S.A. (editor), *Grand Canyon: Monument to Catastrophe*, pp. 111–131. Institute for Creation Research, Dallas, TX.

Austin, S.A. 1996. Excess argon within mineral concentrates from the new dacite lava dome at Mount St Helens volcano. *JoC* 10(3):335–343.

Austin, S.A. 2005. Do radioisotope clocks need repair? Testing the assumptions of isochron dating using K-Ar, Rb-Sr, Sm-Nd, and Pb-Pb isotopes. In Vardiman, L., A.A. Snelling, and E.F. Chaffin (editors), *Radioisotopes and the Age of the Earth: Results of a Young Earth Creationist Research Initiative*, pp. 325–392. Institute for Creation Research, El Cajon, CA, and Creation Research Society, Chino Valley, AZ.

Dickens, H., and A.A. Snelling. 2008a. Precambrian geology and the Bible: a harmony. *JoC* 22(1):65–72.

Dickens, H., and A.A. Snelling. 2008b. Precambrian geology and the Bible, no dissonance or contradiction. *JoC* 22(3):47–50.

Froede, C.R., Jr. 2007. *Geology by Design: Interpreting the Rocks and Their Catastrophic Record*. Master Books. Green Forest, AR.

Froede, C.R., Jr., G.F. Howe, J.K. Reed, and

Figure 2. Exposure of the Pikes Peak Iron Formation. This iron-rich rock has been dated by radiometric methods at 1.75 billion years (Slatt et al., 1978). It is bounded by "Precambrian" volcanic strata of the Yavapai Formation and has been upturned by tectonism. The logic of relative radiometric dating suggests that it formed during the Creation Week. However, the Pikes Peak Iron Formation and bounding volcanic strata better fit emplacement during the Flood.

J.R. Meyer. 1998. A preliminary report on the Precambrian Pikes Peak Iron Formation Yavapai County, Arizona. *CRSQ* 35:15–22.

Gradstein, F., J. Ogg, and A. Smith (editors). 2004. *A Geologic Time Scale: 2004*. Cambridge University Press, New York, NY.

Hung, C.Y. 2008. A realistic simulation model for uranium series geochronological dating. *CRSQ* 45:40–52.

Hunter, M.J. 2008. The Pre-Flood/Flood boundary: early Precambrian sedimentary strata below the "Greatest Unconformity. *CRSQ* 46:56, 58–61.

Jones, F.N. 2005. *Chronology of the Old Testament*. Master Books, Green Forest, AR.

Mortenson, T. 2006. The historical development of the old-earth geological time-scale. In Reed, J.K., and M.J. Oard (editors), *The Geologic Column: Perspectives within Diluvial Geology*. Creation Research Society Books, Chino Valley, AZ.

Reed, J.K. 2008a. Toppling the timescale, part IV: assaying the golden (FeS2) spikes. *CRSQ* 45:81–89.

Reed, J.K. 2008b. Toppling the timescale, part I: evaluating the terrain. *CRSQ* 44:174–178.

Reed, J.K. 2008c. Toppling the timescale, part III: madness in the methods. *CRSQ* 45:6–17.

Reed, J.K., and C.R. Froede, Jr. 2003. The uniformitarian stratigraphic column—shortcut or pitfall for creation geology? *CRSQ* 40:90–98.

Reed, J.K., and M.J. Oard (editors). 2006. *The Geologic Column: Perspectives within Diluvial Geology*. Creation Research Society Books, Chino Valley, AZ.

Reed, J.K., P. Klevberg, and C.R. Froede, Jr. 2006. Interpreting the rock record without the uniformitarian geologic column. In Reed, J.K., and M.J. Oard (editors), *The Geologic Column: Perspectives within Diluvial Geology*, pp. 123–143. Creation Research Society Books, Chino Valley, AZ.

Rudwick, M.J.S. 1999. Geologists' time: a brief history. In Lippincott, K. (editor),

The Story of Time, pp. 250–253. Merrell Holbertin, London, UK.

Slatt, R.M., G.M. Heintz, P.H. Lowry, and P.F. O'Hara. 1978. Precambrian Pikes Peak Iron-Formation, Central Arizona. In Burt, D.M., and T.L. Péwé (editors), *Guidebook to the Geology of Central Arizona*, pp. 73–82. Geological Society of America 74th Cordilleran Section Meeting, Bureau of Geology and Mineral Technology Special Paper No. 2, Tucson, AZ.

Ussher, J., M. Pierce, and L. Pierce. 2003. *Annals of the World*. Master Books, Green Forest, AR.

Villeneuve, M., 2004. Radiogenic isotope geochronology. In Gradstein, F., J. Ogg, and A. Smith (editors), *A Geologic Time Scale: 2004*, pp. 87–95. Cambridge University Press, New York, NY.

Wise, K. 2008. Lucy was buried first. *Answers* 3(2):66–68.

Woodmorappe, J. 1999. *The Mythology of Modern Dating Methods*. Institute for Creation Research, Dallas, TX.

John K. Reed, Ph.D.
Evans, GA

Carl R. Froede Jr., PG
Snellville, GA

Geographic Information Systems: A Mapping Revolution

Introduction

Oard (2008) has pointed out the difficulty of doing geologic research within the young-earth-creation (YEC) model. Not only is it often impossible to apply the scientific method to age questions, but the data of geology are incomplete and can be interpreted in more than one way, and field work is costly and time consuming. Another problem is the relatively small amount of young-earth geologic research that has been done, a function of the relatively small number of creation geologists actively doing research.

A possible solution to this problem would be the leveraging and publication of YEC geoscience research through the widespread and shared use of geographic information systems (GIS). These are computer mapping and modeling techniques that have grown in use in the geoscience community since 1962, when Dr. Roger Tomlinson of the Canadian Department of Forestry and Rural Development first coined the term. GIS are widespread in government, academia, and industry, and many products have been developed to satisfy the needs of end users; but because they are geared towards institutions and companies, they are very expensive and have a steep learning curve.

The need in the YEC geoscience community is for a low-cost, easily learned platform that has the ability to generate easily interpreted maps and 3D models that can be readily shared among both investigators and the interested public. A combination of Google Earth (GE) with a few free or low-cost downloadable programs fills this need and has the potential to greatly increase the power and outreach of YEC research. While simple perusal of GE images can reveal features of interest, such as the two previously unknown meteor craters discovered in Australia (Ogle Earth, 2010; Universe Today, 2008), the true power of GE is that its keynote markup language (KML) files are easily generated and can be shared by e-mail among investigators without the need for everyone to own the same mapmaking software.

Capabilities of Google Earth and Geographic Information Systems

Google Earth Tours

One of the most useful features of GE for YEC investigators is the ability to create a movie-like tour, with balloon pops, image overlays, voiceovers, music and sound, and many other types of special enhancements (Google Earth Outreach, 2010). It would be easy to use GE to publish catalogs of tours of the different types of geological evidences for a young earth, such as water and wind gaps, canyons formed by rapid erosion, underfit rivers, etc. and to link photographs to the tours for more detailed examination. A model to follow in the secular field is that of "Outcropedia," an outcrop database proposed by the website Tectonique.net.

> The aim is to make a central, public database of all important and beautiful outcrops in the World. The main aim is to record where beautiful deformation structures are to be seen, but other outcrops can also be submitted. The setup will be similar to Panoramio and other sites to share photographs, but in this case the accent will be on structural geology only, and contain more detailed descriptions….
>
> The preferred medium for the Outcropedia is presently Google Earth. The Outcropedia will consist of one file in .kml or .kmz format for each region. The files can be downloaded from the TecTask

site and they will then open automatically in Google Earth on any computer. Each file will be marked with the date on which it was last updated….

We aim to present three types of data:

1. Outcrops; these will usually be in the form of marked points, i.e. a single coordinate. It is also possible, however, to present them as a polygon if the outcrop is large.
2. Excursions. If outcrops can be used as part of an excursion, or if they are best visited in a certain sequence, a track can be given that connects the outcrops. Tracks will be stored separately from outcrops and can be downloaded separately.
3. Facilities. If you know a cheap hotel or nice restaurant, a touristy attraction or nice beach, you can also add it to the database. Especially cheap hotels or campsites which can be used for excursions will be appreciated by all geologists. Facilities will be stored separately from outcrops and can be downloaded separately (Tectonique.net, 2010).

Overlays

The power of public GIS expands even more with the use of GE overlays generated by free downloadable mapmaking software like Map Maker (Mapmaker.com, 2010) and ArcGIS Explorer (ESRI.com, 2010) and public domain data sets such as those from the United States Geological Survey (USGS). Software also exists that can convert GIS shape files to Google Earth (Earth.google.com, 2010). One interesting project would be to overlay the USGS surficial geology of the United States layer with their National Geochronological Database of K/Ar and Ar/Ar age determinations (as of 1995). A wide-extent map of this sort would be useful for showing visually the percentage of dating done by relative methods versus that done by absolute methods, although there would have to be a lot of checking to determine the legitimacy of the underlying data. For example, examination of the K/Ar map shows the state of Florida having eight K/Ar dating locations, yet there are no igneous outcrops in the state. Clicking on the locations revealed that four were from sedimentary formations, two from surficial sediments, and two were from offshore locations that had no geologic unit information available! Obviously, the K/Ar dates here are from reworked material and not relevant to a query of this sort.

A powerful example of a Google Earth geology overlay is the one created by Utah Geological Survey geologist Kent Brown and coauthors and presented at the 2008 USGS Digital Mapping Techniques workshop. As Brown et al. (2008) noted,

> The concept of a virtual geologic field trip is very attractive to a geologist who wants a more interactive and visual method of telling a geologic story to others, especially non-geologists, than is possible using a traditional paper geologic map. This virtual field trip uses the popular internet virtual globe interface, Google Earth, in combination with a transparent geologic map overlay, photographs, illustrations, and descriptions of selected geologic features, to help users understand the geology of the greater St. George, Utah area.

YEC workers also can use GE in field mapping and research, following the example of geologists such as Dr. P. Kyle House of the Nevada Bureau of Mines and Geology, who authors the blog "Geologic Frothings: Digital Geology for Analog Geologists." On September 17, 2009, Dr. House posted about his use of GE in field mapping.

> I've said it before, and I am sure I will say it again. But this time Google Earth is really making a major difference in my approach to making a geologic map.

My mapping project on the Lower Walker River and the piedmont of the Wassuk Range, NV is taxing my skills as a geologist and as a mapper. It is an extremely complicated setting with active tectonics, catastrophic debris flows, rock avalanches, a wildly fluctuating terminal lake, and a river madly scrambling to keep up with the lake's rapid, historical decline (50 m in ~100 years). Documenting the ancient, historical, and recent shorelines along the lake is a key component of developing a fairly tight chronology of alluvial fans, abandoned delta lobes, and Quaternary fault activity. However, efficiently digesting all of this information is a far more laborious task with the 24k USGS base maps because the relief in the area is too extreme to accommodate small contour intervals. Air photos are certainly nice, and I do have access to some marginally good LiDAR data and scattered high-precision GPS points, but nothing brings the area into full focus as easily and as efficiently as Google Earth. On this project I have explicitly incorporated GE into my mapping and it has worked extremely well.

GE allows me to quickly and repeatedly pan and zoom my map area and evaluate all of these features of interest. With particular reference to the logistics of making a geologic map, I have used GE extensively to quickly trace mappable shorelines, tag key elevations, and decide how (or whether) to group them for mapping purposes. I have also marked some of the more flagrant fault traces to improve the frame of reference for the map. Of course, I have also linked my geotagged set of field photos so that I can get some clear reminders about key areas I am mapping. The map is being compiled in ArcGIS with good imagery (NAIP) and I can simply transfer my interpretations by

> visual inspection. Of course, I keep turning to GE to check things out in detail because, somehow, the clarity of the imagery far exceeds what I can force out of the NAIP. Likely I will turn the map of this intriguing area into a kml project. This is the best area yet for that (House, 2009).

GIS Mapping Software

The leading GIS mapping software is ESRI's ArcGIS, which is an integrated sophisticated program, but is also expensive and includes an annual licensing fee. Other less expensive GIS software applications such as Globalmapper or ArcGIS Explorer could be used to create databases that can be transformed into overlay maps, since GIS work by the use of overlays, like the transparent overlays found in old World Book encyclopedias for the human body. The website Geomax.com has an interesting comment on the relationship between maps and databases:

> You may never have thought about a geologic map as a database before, however, the information contained on a geologic map lends itself perfectly to cataloguing in database form. What a geologist can see with the sweep of an eye, combined with reading of a legend, can be transformed into a powerful digital data set. In fact, once properly transformed, the computing power of a GIS engine allows even more to be gleaned from a geologic map than that which readily meets the eye (Geomax.com, 2010).

The ability of GIS to query the data can help to clarify YEC hypotheses. For example, databases could be made of the fossil sites referenced in the extensive work done by Woodmorappe (1983) and represented in map form to visually test his thesis that fossil assemblages tend to shun each other. Databases and map layers also could be generated for each of the criteria established by Walker (1994) and Oard (2007) for determining pre-Flood and post-Flood boundaries, bringing into sharp focus any areas that are concentrated in pre- or post-Flood parameters. These GIS maps could then be converted to KML files and imported to Google Earth to be made available to other investigators.

There is also some mapping software available for sale that offers intriguing possibilities for ministries or individuals with the means and ability to use them. Penmap offers a wide range of handheld, GPS-enabled digital mapping solutions specifically geared toward geological field mapping, including the ability to integrate photos and field data onsite with digital topo maps (Penmap.com, 2010). Eighteen Software's TopoMorpher uses digital elevation models (DEMs) to synthesize stereoscopic three-dimensional (S3D) renderings. The website notes that one of the main strengths of TopoMorpher is its power "to specifically highlight and emphasize geomorphic irregularities. These features are often *not visible from aerial photographs or from ground searches*. The ability to enhance at will the S3D rendering (relief exaggeration, shading, orientation, scale) is unmatched" (Topomorpher.com, 2010). One of the more intriguing features of TopoMorpher for Flood geologists is the ability to use one click of the mouse to "paint a lake" or "fill a basin" and measure the area or the volume of water involved.

Google Earth Sketchup

In addition to 2D mapping, 3D representations can be created in GE by using Google Earth Sketchup. Originally intended to allow users to build 3D buildings, Sketchup can be used to model geological structures or to draw stratigraphic sections, such as the petroleum reservoir and stratigraphic sections created by Hrusunov (Hrusunov, 2010). Declan De Paor, Director of the Pretlow Planetarium and research professor of geophysics at Old Dominion University in Norfolk, VA, has used Sketchup to model plate tectonics, geophysics, atmospheric science, and to generate DEMs to represent the earth's landscape during previous geological periods (Raper, 2009; De Paor, 2009).

Online Resources

A complete description of the resources on the Web for both GE and GIS is beyond the scope of this note, and the technology changes almost daily, but here are just a few resources that might be of interest to the YEC community as of January 2010.

1. Three free downloadable software programs offer YEC investigators a suite of accessibility to GIS ranging from basic education to sophisticated mapmaking. The first two are from ESRI, and the third is from Mapmaker.com, which also offers a fuller-featured for-pay version.
   a) ESRI, one of the leading GIS companies, offers two free downloads of interest to the YEC community. ArcExplorer for Education and its associated tutorial are excellent for introducing GIS to those who are not acquainted with it. The book *Getting to Know ArcGIS Desktop: Basics of ArcView* (Ormsby et al., 2008) also gives an introduction to ESRI's GIS product. Once GIS basics are mastered, ESRI's ArcGIS Explorer can be downloaded as "an easy way to explore, visualize, and share GIS information. With ArcGIS Explorer, you can access ready-to-use ArcGIS Online basemaps and layers, fuse your local data with map services to create custom maps, add photos, reports, videos, and other information to your maps, perform spatial analysis (e.g., visibility, modeling, proximity search)" (ESRI.com, 2010). ArcGIS Explorer does not come with a tutorial, but ESRI has an online support

page (http://webhelp.esri.com/arcgisexplorer/900/en/index.html#welcome_page.htm).

b) ArcGIS Explorer can only view maps, not create them. Making maps is more of a technical challenge, but offers the ability for customization of research projects. One relatively low-cost, short learning curve program mapping program is Global Mapper, which has the ability to "directly access multiple online sources of imagery, topographical maps, and gridded terrain data. This includes access to worldwide high resolution color imagery from DigitalGlobe (watermarked access for free), detailed street maps from OpenStreetMap.org, and access to the entire TerraServer-USA database of USGS satellite imagery and topographical maps free-of-charge. Global Mapper also has the ability to easily access WMS data sources, including built-in access to elevation data and color imagery for the entire world, and to view elevation and vector data in true 3D with any loaded data draped on top of it" (http://www.globalmapper.com). The site includes a user's manual and several downloadable tutorials.

2. Google Earth Library has enabled 50,000+ of the 7.5-minute USGS topographic maps to be viewed in GE. Once a topo map is downloaded, one can "import and overlay GPS Tracks, adjust the transparency of the top maps, view GE's 3D buildings on top of the topo maps, output to your printer, and compare features on the topo maps to the GE imagery" (Google Earth Library, 2010). The site is part of an index that contains many links to things that can be done with GE.
3. San Diego State University and Old Dominion University are two academic institutions in the vanguard of using GE in geology education. (San Diego State University, Dept. of Geological Sciences, 2010; Raper, 2009). Other examples of GE geoscience educational activities can be found at the website "On the Cutting Edge—Professional Development for Geoscience Faculty" (Serc.carleton.edu, 2010).
4. The British Geological Survey has just made KML files of their maps available to the public (British Geological Survey: Natural Environment Research Council, 2010).
5. The OneGeology website is "an international initiative of the geological surveys of the world and a flagship project of the 'International Year of Planet Earth.' Its aim is to create dynamic geological map data of the world available via the web. This will create a focus for accessing geological information for everyone" (Onegeology.com, 2010).
6. The USGS has a large group of spatial data sets, though they are scattered around in different locations on the web. Some of these of interest to the YEC community include:
   a) The National Geologic Map Database, created to "1) give you a quick browse and query of our Nation's geologic maps, in a standardized format, and 2) link you to the source information found via the NGMDB Map Catalog and Geologic Names Lexicon. More than 80,000 maps and reports, by 370 publishers, are accessible" (USGS, 2010a).
   b) The National Map, "a collaborative effort among the USGS and other Federal, State, and local partners to improve and deliver topographic information for the Nation. It has many uses ranging from recreation to scientific analysis to emergency response. *The National Map* is easily accessible for display on the Web, as products and services, and as downloadable data. The geographic information available from *The National Map* includes orthoimagery (aerial photographs), elevation, geographic names, hydrography, boundaries, transportation, structures, and land cover. Other types of geographic information can be added within the viewer or brought in with *The National Map* data into a Geographic Information System to create specific types of maps or map views" (USGS, 2010b).
   c) The Earthquake Hazards Program has a number of Google Earth/KML files, including one of quaternary faults and folds in the US (USGS Earthquake Hazards Program, 2010).
   d) The Mineral Resources Program has a site dedicated to online spatial data, including individual geologic maps of each state, and a map of the K/Ar ages of materials in the US as of 1995 (USGS Mineral Resources Program, 2010).

Conclusion

YEC geological research is hampered by its expensive, time-consuming nature and the small number of researchers. The use of Internet-enabled applications can leverage the work that is being done by enhancing communication among workers and making the results easily available to the public in a visual form. It is a well-known fact that there are far more people who question the neo-Darwinian synthesis than question the conventional old age of the earth, partly because intelligent design is much more easily perceived in living systems than a young age for the earth is in geologic systems. By using widespread, easily available graphic modeling techniques such as Google Earth and GIS, not

only can YEC workers leverage their small numbers, but they also can bring their arguments to the public in a more intuitively obvious visual form.

References

British Geological Survey: Natural Environment Research Council. 2010. Browsing downloads in "KML." http://www.bgs.ac.uk/downloads/browse.cfm?sec=6&cat=80 (as of January 12, 2010).

Brown, K.D., L.B. Weaver, and R.F. Bick. 2008. Creating a virtual geologic map and field trip of the St. George 30'x60' Quadrangle, Washington County, Utah: an adventure in Google Earth. http://ngmdb.usgs.gov/Info/dmt/docs/DMT08_Draft_Brown.pdf (as of January 12, 2010).

Classon, F. 2007. GSI3D feeds Google Earth. http://www.geosum3d.de/cms/index.php?option=com_content&task=view&id=33&Itemid=98, (as of January 12, 2010).

De Paor, D.G. 2009. Using Google SketchUp with Earth for scientific applications. http://www.youtube.com/watch?v=J64kSF6JVuM (as of January 12, 2010).

Earth.google.com. 2010. Importing geographic information systems (GIS) data in Google Earth. http://earth.google.com/intl/tr/outreach/tutorial_import-gis.html#importshp (as of January 12, 2010).

ESRI.com. 2010. ArcGIS Explorer overview. http://www.esri.com/software/arcgis/explorer/index.html (as of January 12, 2010).

Geomax.com. 2010. Geology map as database: similar logic and parallel processes. http://www.geomax.com/page10.html (as of January 12, 2010).

Google Earth Library. 2010. USGS topographic maps for Google Earth. http://www.gelib.com/usgs-topographic-maps.html (as of January 12, 2010).

Google Earth Outreach. 2010. Tutorial: create narrated tours with KML Touring. http://news.earthoutreach.org/outreach-announcements/ge5/tutorial--narrated-tours (as of January 12, 2010).

House, P.K. 2009. Google Earth is indispensable for geologic mapping. http://geologicfroth.wordpress.com/2009/09/17/google-earth-is-indispensable-for-geologic-mapping/ (as of January 12, 2010).

Hrusunov, V. 2010. Geologic slices and maps in GE. http://blog.geoblogspot.com/2009/12/geological-slices-in-ge.html (as of March 16, 2010).

Mapmaker.com. 2010. http://www.mapmaker.com (as of January 12, 2010).

Oard, M.J. 2007. Defining the Flood/post-Flood boundary in sedimentary rocks. *Journal of Creation* 21:98–110.

Oard, M.J. 2008. The Eocene ice age–example of a geological challenge. *Creation Matters* 13(6):1–8.

Ogle Earth. 2010. Australia crater discovered via Aboriginal dreaming story, Google Earth. http://www.ogleearth.com/2010/01/australia_crate.html (as of January 12, 2010).

Onegeology.org. 2010. http://www.onegeology.org/ (as of January 12, 2010).

Ormsby, T., E. Napoleon, R. Burke, C. Groessl, and L. Bowden. 2008. *Getting to Know ArcGIS Desktop: Basics of ArcView, ArcEditor, and ArcInfo*. ESRI Press, Redlands, CA.

Penmap.com. 2010. Geology and mining. http://www.penmap.com/content.asp/cat/2/id/8/mining-geology.html (as of January 12, 2010)

Raper, J. (editor). 2009. Google Earth innovations of geophysicist win international competition. *Old Dominion University's QUEST* 12(1):31–32. http://www.odu.edu/ao/instadv/quest/Volume12-1.pdf (as of January 12, 2010).

San Diego State University, Department of Geological Sciences. 2010. KML geology: using Google in geology. http://www.geology.sdsu.edu/kmlgeology/kmz/baja140/baja140.html (as of January 12, 2010).

Serc.carleton.edu. 2010. Examples of Google Earth activities. http://serc.carleton.edu/NAGTWorkshops/teaching_methods/google_earth/examples.html?q1=sercvocabs__43%3A2&results_start=11 (as of January 12, 2010).

Taylor, F. 2006. Oil and geology in Google Earth. http://www.gearthblog.com/blog/archives/2006/04/oil_and_geology.html (as of January 12, 2010).

Tectonique.net. 2010. Outcropedia. http://www.tectonique.net/tectask/index.php?option=com_content&task=view&id=20&Itemid=66 (as of January 12, 2010).

TopoMorpher.com. 2010. Geomorphology, hydrogeology, and engineering geology in stereoscopic 3D. http://www.18software.com/topoMorpher.htm (as of January 12, 2010).

Universe Today. 2008. Geologist finds a meteorite crater in Google Earth. http://www.universetoday.com/2008/03/19/geologist-finds-a-meteorite-crater-in-google-earth/ (as of January 12, 2010).

USGS Earthquake Hazards Program. 2010. Google Earth/KML files. http://earthquake.usgs.gov/learn/kml.php (as of January 12, 2010).

USGS Mineral Resources Program. 2010. Mineral resources on-line spatial data. http://mrdata.usgs.gov/ (as of January 12, 2010).

USGS. 2010a. National geologic map database—data portal. http://maps.ngmdb.us/dataviewer (as of January 12, 2010).

USGS. 2010b. National Map. http://nationalmap.gov (as of January 12, 2010).

Walker, T.B. 1994. A biblical geological model. In Walsh, R.E. (editor), *Proceedings of the Third International Conference on Creationism, technical symposium sessions*, pp. 581–592. Creation Science Fellowship, Pittsburgh, PA.

Woodmorappe, J. 1983. A diluviological treatise on the stratigraphic separation of fossils. *Creation Research Society Quarterly* 20:133–185.

Jacqueline Lee
Vero Beach, FL
jleecrs@aol.com

Letters to the Editor

The policy of the editorial staff of CRSQ is to allow letters to the editor to express a variety of views. As such, the content of all letters is solely the opinion of the author, and does not necessarily reflect the opinion of the CRSQ editorial staff or the Creation Research Society.

The Demise of the Dinosaurs: Some Potential Objections

Dr. Klenck's thesis is quite interesting regarding the perception of the relative impacts of the Fall and the Flood and the possible effects on the demise of the dinosaurs [Joel D. Klenck, "Genesis and the Demise of the Dinosaurs," *CRSQ* 46:3]. However, several potential objections came to mind as I was reading it.

1. I would contend that portraying the majority Biblical (i.e., young earth) creationist view as minimalizing the Fall and maximalizing the Flood is a bit misleading. Certainly all such creationists view the Fall as devastating—especially to the human soul, but also physically insomuch as violence took hold, the land grew less accommodating, and at least some animals changed (e.g., the serpent). However, regarding geological effects, the portrayal would be a fair one—that most Biblical creationists maximalize the Flood. The Flood is generally considered to be hugely devastating geologically compared to the Fall. The effects of the curse, which was pronounced as a consequence of the Fall, are in some ways, I believe, thought to have developed in the process of time and not necessarily all of the sudden. One aspect of the curse is often portrayed as God removing His sustaining hand, implying that some changes resulted gradually. For example, the people before the Flood appear to have persistently lived 900 years, from Adam to Methuselah, and Noah as well, whereas after the Flood the life spans declined rapidly by an order of magnitude. Thus, geological changes are not the only ones that may have been maximalized by the Flood (as compared to the Fall). Of course, I recognize that while 90 years compared to 900 years seems dramatic, 900 years compared to infinity (had the Fall not occurred) dwarfs the relative effect of the Flood. But in the context of the article, this would not be a valid comparison.
2. While I accept the thesis that carnivory may indeed have been included in the post-Fall, pre-Flood violence, the explicit scriptural support cited in the article does not seem to be valid. Carnivory certainly began after the Fall, but Genesis 1:29-30; 9:3-4 seems to be used by Dr. Klenck as evidence that it began immediately after the Fall as opposed to over a millennium and a half after the Fall—i.e., after the Flood to which these passages, cited together like this, refer.
3. I would not be too keen on using Romans 8:22 as support for geologically maximalizing the Fall. Also, Dr. Klenck seems to have subtly misquoted this passage. It does not say that the creation groaned (as in only upon the pronouncement of the curse) but groans (as in still "today"). Prophetic passages seem to imply a magnifying effect as we approach the end times, as in the pains of childbearing getting worse as the time of deliverance approaches.
4. Certainly all disasters, catastrophes, etc., are a result of the Fall and the Curse. The Flood likewise is a result of the Fall, and the Flood significantly "enhanced" the travail, the groaning, the curse on the ground, and even the death that was pronounced upon mankind as evidenced in the rapid decline in human longevity that did not occur beforehand (as noted above). Also, modern disasters are mentioned as causing rapid formation of stratigraphy "in an era when God does not curse the ground." But in light of God's curse continuing to this day, I don't know what is meant here. God's curse certainly had an initiating effect at the time of its pronouncement, but again, some effects were a longer time developing. The accumulation of deleterious mutations in the human genome, with its effect on disease and aging is an example, with the obvious correspondence (at least in part) to the aforementioned changes in longevity. The idea that we're living in an era when God doesn't curse the ground, implying that the era from the Fall to the Flood was one when God was cursing the ground, seems to be a false premise for the possibly faulty speculation that catastrophes were likely more pronounced then than they are today. I believe an actual Biblical case could be made for the opposite, especially in light of Biblical prophecy.
5. Regarding the decline in the Bible's mention of beasts of the earth/field, I would be wary of using absence of evidence (absence of mention in this case) as evidence of absence, or arguing from silence. Less mention could be the result of nothing more than a decline in interaction

between them and humans, either before the Flood or after. They may have merely avoided each other for the most part. The assumption that dinosaurs would have posed a severe threat to the survival of humanity seems to be a tacit acceptance of a Jurassic Park view of them, which the Bible certainly does not imply. It seems clear from Genesis chapter 9 that enmity between people and animals was greatly enhanced after the Flood, implying that it was less of an issue before the Flood.

6. I found the Hebrew word study to be very informative and enlightening. The lack of mention of the beasts of the earth/field entering or leaving the ark is quite remarkable. However, if some dinosaurs survived the Flood, I wonder how that would be explained. Were representatives taken on the ark but just not mentioned? Or, would a more minimalized view of the Flood lead one to believe that some dinosaurs were able to survive it on their own, because the Flood wasn't devastating enough to kill them all (i.e., did the Bible exaggerate a bit when saying that nothing with the breath of life survived)?

I would contend that the majority Biblical (young-earth) creationist view ("maximalizing" the effect of the Flood on geology) is the more Biblically-supported view. But I am open to further investigation into the view of the "persistent few" who object. I would be very interested in how Dr. Klenck would address the potential objections above.

Respectfully,
David Guyon
North Huntingdon, PA

The Demise of the Dinosaurs

Joel Klenck's article (Klenck, 2010) was a very interesting study of the minority view of creationists regarding the Fall and Flood. Although the article is well researched, several points in it are not entirely accurate and seem to miss major pieces of evidence.

I do agree with the taxonomic classifications listed and the evidence they produce. However, when it comes to the evidence outside of the Bible, very little is given. Klenck also seems to miss the evidence from history that strongly suggests a large post-Flood population of dinosaurs.

He states that "legends concerning the slaying of dragons and dinosaur-like creatures are relatively few in number." Although the legends of dragon slaying may indeed be few, evidence (both in writing and in archeological finds) for dinosaurs after the Deluge is not such a small amount as would be convenient for the pre-Flood destruction of these giants.

First of all, the evidence from archeology. There are many hundreds of pieces of pottery, cliff and cave drawings, etc. depicting dinosaurs, a sample of which is found in Swift (1990). For example, a bipedal dinosaur-like petroglyph was found on the side of Grand Canyon, Arizona (Morris, 2008). A carving of a creature that looks identical to a stegosaurus was discovered in the jungles of Cambodia on a temple built between the ninth and twelfth centuries (Swift, 2005, p. 81). Other drawings depicting dinosaurs have been found all over the world (Hovind, 2005).

In Inca, Peru, hundreds of stones were found, drawn on them with incredible accuracy (Swift, 2005). These stone engravings show a wide variety of these amazing creatures and were first mentioned by a Spanish priest in 1535. To say that the dinosaurs were mostly extinct after the Genesis Flood does not seem to make sense.

In Acambaro, Mexico, thousands of clay images were found, many of which look much too similar to dinosaurs to be a coincidence (Hapgood, 1973). All of this goes against Klenck's theory.

As far as legends go, Klenck gives the impression that dragon stories are relatively few in number. But legends of dinosaur-like creatures (land-dwelling, flying, or sea-dwelling) are found all over the globe, with some of them occurring as late as the seventeenth century (Cooper, 1995, pp.130–161; Gibbons and Hovind, 1999, pp. 18–28; Gibbons, 2006, p. 52; Goertzen, 1998).

Also in his article, Klenck writes that Beowulf killed only one dragon. However, the *Beowulf* manuscript clearly says that he slew nine sea monsters (*Beowulf*, 1992, p. 11). After that, he killed Grendel (pp. 14–15) and Grendel's mother (pp. 27–29), and Beowulf himself was killed by the third dragon he tried to slay (p. 49). Klenck also states that dinosaur-like creatures are mentioned a few times in the Bible, in comparison to the other animal groups. The word "dragon," or "dragons," however, occurs a total of 22 times in the Old Testament. Scriptures also include the two very descriptive accounts of creatures in Job 40–41 that can only be explained logically to be dinosaurs (Gibbons, 2006, pp.50–52; Ham, 2006, p.160).

Klenck states the fact that sheep are mentioned 145 times in the Old Testament. This, he says, is an example of the fact that the dinosaur kind was

relatively few after the Flood because their mention in Scripture is much lower in comparison. However, couldn't it be that sheep are mentioned so frequently because they played a more major role in everyday life in Bible times? This would seem like a reasonable conclusion because sheep were likely to have been much more plentiful in the post-Flood world than dinosaurs/dragons were.

Although I do think Klenck made some very good points in his article, I am not convinced. How does his theory explain the evidence given above? I would be greatly interested in hearing his response to these facts.

Reagan Shcrock
Athens, TN
Dino_nut94@yahoo.com

References

Cooper, B. 1995. *After the Flood*. New Wine Press, Chichester, UK.

Gibbons, W.J. 2006. *Missionaries and Monsters*. Coachwhip Publications, Landisville, PA.

Gibbons, W.J., and K. Hovind. 1999. *Claws, Jaws and Dinosaurs*. CSE Publications, Pensacola, FL.

Goertzen, J. 1998. The Rhamphorhynchoid Pterosaur Scaphognathus Crassirostris: a "living fossil" until the 17th century? In Walsh, R.E. (editor), *Proceedings of the Fourth International Conference on Creationism*, pp.253–269. Creation Science Fellowship, Pittsburgh, PA.

Beowulf. 1992. (R.K. Gorden, translator). Dover Publications, Mineola, NY.

Ham, K. 2006. *The New Answers Book 1*. Master Book, Green Forest, AR.

Hapgood, C.H. 1973. *Mystery in Acambaro*. Repr., Adventures Unlimited Press, Kempton, IL, 2000.

Hovind, K. 2005. Dinosaurs and the Bible (DVD). CSE Publications, Pensacola, FL.

Klenck, J.D. 2010. Genesis and the Demise of the Dinosaurs. *Creation Research Society Quarterly* 46:159–166.

Morris, J.D. 2008. The dinosaur next door. *Acts and Facts* 34 (6):13.

Swift, D.L. 1990. The rocks begin to speak. In Walsh, R.E. (editor), *Proceedings of the Second International Conference on Creationism*, Creation Science Fellowship, Pittsburgh, PA. 1:217–220.

Swift, D. 2005. *Secrets of the Ica Stones and Nazca Lines*. Self-published.

The Fall: Impact on the Demise of the Dinosaurs and Geological Stratigraphy (response)

I am somewhat surprised about the responses, both critical and congratulatory, after publishing "Genesis and the Demise of the Dinosaurs" in the *Creation Research Society Quarterly* (Klenck, 2010). It is apparent to me after the correspondence I received, the alleged "minority view," which states that most dinosaurs and possibly other taxa perished after the Fall and before the Flood, has much more adherents than I previously thought, many in significant positions in the creationist community.

Creation science values discourse, first with regard to the Biblical support for theories and hypotheses and second in consideration of observed phenomena, in this case, archaeological and paleontological studies. David Guyon's objections are based on scriptural arguments; Reagan Shcrock's critique is based on alleged extra-Biblical evidence. I will answer both in turn.

Guyon critiques the notion that after the Fall most dinosaurs were affected by God's judgments and that these impacted geological stratigraphy. In opposition to Guyon's statement, no Scriptures state the Fall *did not* have a geological impact. Furthermore, it should be clear to Mr. Guyon that the Curse did not affect only the individual serpent—just as God's judgments after the Fall did not affect only Eve (Genesis 3:16) or Adam (Genesis 3:17–19) but all men and women. Unlike the judgments against Adam and Eve, where God did not directly curse Adam, Eve, or their descendents; God's judgment of the serpent entailed a curse by God leveled directly at the serpent and its future generations (Genesis 3:14–15). That God cursed the serpent, or *nachash*, above all livestock, or *behemah*, and above (or from all) beast of the field, or *chayat ha'sadeh*, is insightful. Scripture shows that *behemah* were indigenous to the Garden of Eden (Genesis 2:19–20), belonged to a different created group at creation (Genesis 1:25), and comprise mammals equal to or larger than a hare (Leviticus 11:3–8; Klenck, 2009; 2010). That God also cursed the *nachash* above other beasts of the field, or *chayat ha'sadeh*, is more revealing with regard to paleontology and their deposition in geological stratigraphy.

The group "beast of the earth," or *chayat-ha'aretz*, is mentioned rarely after the Fall, is not equated with specific animal kinds throughout the Bible, and is plausibly the overarching group of which *chayat ha'sadeh* is a subset (Klenck, 2010; Thallon, 1984).

Beast of the field, or *chayat-ha'sadeh*, is an animal group associated with dinosaur-like animals, snakes, crocodiles, and similar kinds. Genesis 3:1 equates *nachash* with an upright, walking serpent not near the ground. Genesis 3:1 states that this *nachash* was from the beasts of the field, or *chayat ha'sadeh*. Isaiah 27:1 equates *nachash* with the very large Leviathan, a marine creature with reptilian qualities. Isaiah 27:1 asso-

ciates *nachash* with *tannin*. Isaiah 43:20 associates terrestrial *tannin*, translated as dragon or serpent, with the beasts of the field, or *chayat ha'sadeh*. Each verse is important to this discussion.

Genesis 3:1 describes the serpent, or *nachash*, as being the wisest *from* all the beasts of the field, or *chayat-ha'sadeh*. After the Fall, God cursed the serpent, stating that it would in the future move on its belly and eat dust all the days of its life (Genesis 3:14). The verse suggests that before the Fall, the serpent stood upright and was not near the ground. After the Fall, the term *nachash* is mostly associated with snakes, specifically vipers or *sh'feefone* (Genesis 49:17; Psalm 140:3; Isaiah 14:29). However, in Isaiah 27:1 *nachash* is associated with *tannin* to describe *Leviathan*. In Job 41, *Leviathan* is depicted as a very large animal with terrible teeth (v. 14), scales (v. 15), moving in the deep sea (v. 31), whose exterior cannot be penetrated by spears, arrows, or swords (vv. 26–29). Therefore, Biblical passages indicate that *nachash* can describe snakes, much larger marine animals with Reptilian attributes (from Isaiah 27:1), and upright, walking terrestrial serpents not near the ground (from Genesis 3:1).

In Isaiah 27:1 *nachash* is associated with *tannin* in the description of *Leviathan*. Although terrestrial *tannin* are different from marine *tannin*, there are similarities. In Isaiah 43:20 terrestrial *tannin* are associated with the beasts of the field, or *chayat ha'sadeh*, during the earthly reign of the Messiah. During this age, God may simply recreate the *tannin* or replenish their numbers since like former predators they no longer will be hostile, carnivorous, or dangerous. Similar to *nachash*, terrestrial *tannin* refer to a range of animals including shallow-water crocodiles (Ezekiel 29:3; Ezekiel 32:2), snakes (Exodus 7:9–10, 12; Deuteronomy 32:33; Psalm 91:13), and terrestrial dinosaur-like dragons (Isaiah 35:7; Jeremiah 9:11; 10:22; 49:33; 51:37).

Hence, the totality of the Biblical evidence mentions an association between the group "beasts of the field," or *chayat-ha'sadeh*, and specific kinds or subsets belonging to *tannin* and *nachash*. The later references denote a connection to both (1) dinosaur-like, upright moving, and not-near-the-ground serpents (*nachash*) or terrestrial dragons (*tannin*) and (2) animals that are not dinosaurs, including ordinary snakes (also described as *nachash* and *tannin*) and crocodile-like animals (also denoted as *tannin*).

Since God created all marine and terrestrial animals during the Creation week, it should be apparent that crocodile-like animals were already crawling on the ground and snakes were already licking the dust of the earth. Therefore, God's judgments after the Fall affected those *nachash* and *tannin* that were larger than snakes, not crawling on the ground, not licking the dust of the earth, and dinosaur-like in appearance, or, simply stated, the dinosaurs. To reiterate, the totality of Biblical evidence indicates the judgments after the Fall caused the demise of the dinosaurs while enabling the large-scale survival of snakes, crocodiles, alligators, and other animals belonging to the beasts of the field (*chayat ha'sadeh*) or beasts of the earth (*chayat ha'aretz*) that crawled on the ground and licked the dust of the earth.

With regard to Guyon's comment that carnivory began after the Flood or just before the Flood ("a millennium and a half after the Fall"), this unique notion has been firmly countered by Woodmorappe (2001), who mentions evidence of carnivory as shown by tooth and claw marks on bones, the consumption of living animals, and predation (see also Carpenter, 1998; Hu et al., 2005). If the Paleozoic or Mesozoic plant-animal assemblages are derived from pre-Flood "biogeographical zones," "ecological zones," or "ecosystems," as purported by most creationists, this strengthens the argument for the onset of carnivory after the Fall (Wise, 2004; 2002; Gentet, 2000; Scheven, 1996; Woodmorappe, 1983; Clark, 1977; 1971; 1968). That dinosaurs and gymnosperm assemblages represent pre-Flood deposits also suggests their deposition could have occurred during or before the Flood. In addition, Guyon's comment on Romans 8:22 is polemical. If creation *groans* because of the Fall, creation *groaned* after the Fall.

Guyon states, "*The idea that we're living in an era when God doesn't curse the ground, implying that the era from the Fall to the Flood was one when God was cursing the ground, seems to be a false premise.*" This suggestion is firmly refuted by Scripture. After the Fall, God definitively cursed the ground—"*cursed is the ground*" (Genesis 3:17). Before the Flood, Lamech noted "*the ground which the Lord has cursed*" (Genesis 5:29). Finally, after the Flood, God specifically declares, "*I will never again curse the ground*" (Genesis 8:21). These Biblical references clearly state that God began His curse of the ground after the Fall and ended this curse after the Flood.

Guyon also comments that my article's arguments for the demise of the dinosaurs after the Fall and before the Flood are not strong in that they merely reflect an "argument from silence," "absence of evidence," or "absence of mention." If Mr. Guyon hears his neighbor curse his eldest child "Johnny" above all other children and then the little fellow is not seen, mentioned, or noted as going in or out of the family's car during a vacation, I can only hope Mr. Guyon will not spend excessive time debating about "the absence of evidence" but will instead call the authorities. Similarly, God cursed the serpent after the Fall that was possessed by Satan (Genesis 3:14–15). God also cursed the ground (Genesis 3:17). Afterwards, two major groups of animals that are so prevalent during Creation are *not* mentioned going on or coming off the ark, even though every other major created group is mentioned (Genesis 6:7, 18–20; 7:2–3,

7–8, 13–14, 21, 23; and 8:16–19). This is an ominous sign for these taxa, especially because this decline occurred after God cursed the serpent and its generations and stated this curse would have a physical impact on *nachash*. Also, there is no "absence of evidence" with regard to God cursing the ground or the serpent after the Fall.

The "absence of evidence" critique is arguably more appropriate for the Flood geologists who deny that the Fall impacted geological stratigraphy. No Scriptural references state that the Fall *did not* affect geological stratigraphy. That the Flood was a worldwide catastrophe is Biblically clear. However, the reality of the Flood does not confirm that the Fall did *not* affect major animal groups, their deposition, or geological stratigraphy. Furthermore, those who assert that the Fall affected the dinosaurs (and potentially other taxa) and geological stratigraphy are in a Biblically comfortable position (Gentet, 2000; Watts, 1984). Their position is supported in that after the Fall, God overtly cursed the serpent (Genesis 3:14–15) and the ground (Genesis 3:17). Furthermore, after the Fall and before the Flood, there is a dramatic and statistically significant decrease in the mention of beasts of the field (*chayat ha'sadeh)* and beasts of the earth (*chayat ha'aretz*) with a corresponding rise in references to medium and large mammals as denoted by more frequent mentions of the *behemah* (Klenck, 2010, p. 164).

That events affected the deposition of dinosaur remains and related plant life before the subsequent internment of mammals in geological strata is also supported by a vast deluge of secular studies in geology and paleontology that are too numerous to cite (for summaries see Benton 1986; 1991; 1994; Balme, 1970; Olsen and Sues, 1986; Fowell and Olsen, 1993; MacLeod and Keller, 1996; Hallam, 1989; Glen, 1994; Sharpton and Ward, 1990; and Padian and Clemens 1985).

Lastly, I reject Guyon's suggestion, "*Did the Bible exaggerate a bit when saying that nothing with the breath of life survived?*" I firmly posit that the Bible never exaggerates or lies. As I stated in my article, the decrease in mention of the beasts of the earth/field relates to their sharply diminished numbers. By the time of the Flood, the animals belonging to these latter taxonomic groups were so devastated that it negatively affected their mention by God, Noah, and later Solomon (Genesis 6:7, 18–20; 7:2–3, 7–8, 13–14, 21, 23; 8:16–19; and 1 Kings 4:33).

Shcrock's letter differs from Guyon as she agrees with my "taxonomic classifications listed and the evidence they produce" and then states, "When it comes to the evidence outside of the Bible, very little is given." I limited the scope of my article to focus on Biblical passages and terrestrial animals, except in the clarification of the serpent kind, to form a succinct argument and article. I hoped others would request the production of extra-Biblical evidence in a future manuscript. Shcrock has more than obliged my wishes.

Her next statement is surprising to me: "Klenck also seems to miss the evidence from history that strongly suggests "*a large post-flood population of dinosaurs*" (emphasis added). I suggest this statement is not accurate.

Having analyzed animal bone material and excavated sites from a variety of Holocene deposits, ranging from Medieval to Neolithic periods in the Old World and Desert Archaic to Late Mississippian in the New World, I have not come across any bone that remotely resembles a dinosaur in any archaeological context.

Zooarchaeologists, or those who analyze faunal remains from archaeological sites, have analyzed millions of bones from Holocene sites throughout the world. Reams of studies from general surveys to in-depth analyses have been published in hundreds of archaeological journals, site reports, and conferences. There has not been a single mention of a single dinosaur bone in any Holocene context throughout the entirety of the world.

Furthermore, no dinosaur bones have been found in any indisputable Cenozoic or Tertiary assemblages. The sites where researchers have claimed dinosaur bones in Cenozoic contexts, such as the Hell Creek site in Montana, are fiercely disputed (Sheehan et al., 1991; Archibald and Bryant, 1990; Sheehan and Fastovsky, 1992; Hurlbert and Archibald, 1995). The lack of dinosaurs in Cenozoic contexts contrasts with the prevalence of at least 310 mammal genera in Mesozoic contexts (Luo, 2007).

Archaeologists and paleontologists, both creationists and evolutionists, have excavated hundreds of sites with human remains or artifactual assemblages and surveyed thousands of archaeological assemblages. Yet, not one dinosaur bone has been identified from any survey or mitigation (excavation) phase anywhere throughout the globe.

Lest the lay person suggest that there is an international conspiracy to cover up dinosaur bones in archaeological contexts, amongst the evolutionary cadre, I answer thus: As a zooarchaeologist, to find any bone that is unique or "a first" would create a guaranteed publication in a major journal, or, better yet, a book deal. Zooarchaeologists have been extremely excited about finding horses in Chalcolithic sites, pigs in the Negev desert, or puppies and ravens in a Canaanite temple (Clutton-Brock, 1992; Grigson, 1987; Klenck, 2002). If a zooarchaeologist correctly found a dinosaur bone in any human archaeological context, even a permineralized bone, the discovery would be described as a significant report in the discipline of zooarchaeology, and the identification would bring notoriety and, if handled correctly, a tenure track or director of research position to its discoverer. How-

ever, no archaeologist or paleontologist has come forward with any dinosaur bone from any archaeological context anywhere in the world.

This is not an issue of preservation. Reptile bones preserve very well in archaeological contexts, and big bones are both preserved and retrieved in a greater capacity compared to small bones. A dinosaur bone would be big, well-preserved, and unique looking—which would prompt immediate further study. The presence of a dinosaur bone would be readily apparent amidst the expected cattle, sheep, goat, deer, hare, pig, equid, camelid, canid, and avian fauna of archaeological sites and given special priority by any archaeologist.

Outside Shcrock's letter, others have e-mailed me referencing cryptozoology studies. With regard to these reports, they are both exciting and thought provoking but have resulted in no definitive data. With the exception of alleged accounts, no photographs, hair, bones, skin, egg shells, blood, saliva, claw marks, coprolites, nests, or dwelling locales of any dinosaur has been identified or produced in contemporary times or associated with human cultural deposits.

With regard to iconography of alleged dinosaurs in post-Flood contexts, I am hesitant to quickly assume these caricatures represent living dinosaurs. It is likely that ancient cultures were aware of sauropod permineralized remains. Recently, Brian Thomas (2010) takes exception to a similar outlook proposed by Adrienne Mayor (2005), who describes American Indian accounts of dinosaur-like animals, which she states are derived from observations of their deposited remains. Of note is Swift's (1990, p. 219) mention of Zuni Indians and their description of animals resembling dinosaurs. Here, the tradition states: "*Ye shall all be changed into stone…thus, have we changed ye into everlasting stone*." This tradition sounds remarkably like the discovery of permineralized dinosaur remains or an attempted explanation for these fossilized remains—not observations of living dinosaurs.

Shcrock states, "There are *many hundreds* of pieces of pottery, cliff and cave drawings, etc. depicting dinosaurs." However, her references do not support this argument. With the exception of Swift's (2005) self-published report, which appears unavailable to the public, the other references show around a dozen depictions, not *many hundreds*. And some of these alleged depictions, such as the Indian "thunderbird," are described by native chroniclers as great eagles, not flying sauropods. With regard to descriptions of living dinosaurs, Swift (1990) cites 7 examples, including the eagle-like thunderbird; Morris (2008) mentions 6 references; and Goertzen's (1998) article suggests an equation between depictions of "flying serpents" and the still living genus *Draco*, or flying lizards. That the latter's citations note these serpents flew from trees, were small, and readily consumed by the less-than-fearsome ibis (similar to a flamingo) does not support his notion of Pterosaur-like dinosaurs soaring through the skies in post-Flood ancient history.

Shcrock's citation of Hapgood (1973) is surprising. Although she apparently does not know this, the Acambaro figurines are well-known forgeries. Pezatti (2005) details the telling indications of these fakes: "*Surfaces displayed no signs of age; no dirt was packed into their crevices; and though some figurines were broken, no pieces were missing and no broken surfaces were worn. Furthermore, the excavation's stratigraphy clearly showed that the artifacts were placed in a recently dug hole filled with a mixture of the surrounding archaeological layers*." Furthermore, Pezatti (2005, p. 8) also remarks that the archaeologist sent to evaluate the authenticity of the Acambaro figures, Charles Corradino Di Peso, discovered that a local family had been crafting and selling similar figurines since 1944, most likely emulating the creatures they observed from their day trips to the Museo Nacional in Mexico City.

Shcrock's argument then turns to famous dragon-slaying legends. Similar to Morris (2008, p. 13), I am cautious in ascribing too much efficacy to these reports since these stories "*would be embellished by added details*." The Beowulf account is popularized even today, but the equation of medieval Scandinavians with large populations of dinosaurs is suspect. Again, much archaeology has been completed in Scandinavia, from the first Ahrensburg cultures to the periods of Norse sagas. In Battle Axe culture burials, with contexts that allegedly date to 2800 B.C., more than 3000 graves were excavated. Still, not one dinosaur bone has been retrieved from any site, in any context associated with human skeletons or cultural deposits, from any time period, throughout the entirety of Scandinavia. This is noteworthy since Scandinavian burials commonly feature the bones of hunted or predatory animals, such as bears (Schibler, 2006).

We must be careful to evaluate what God considered dinosaurs to be in His classification system (Klenck, 2009; 2010). Small lizards, larger kinds such as the monitor lizard, and perhaps even flying lizards from the genus *Draco*, appear to be ascribed by God to *remes* or *sheretz*, or the creeper/swarmer group. Conversely, God and Biblical authors associate dinosaur-like animals with the beasts of the field (*chayat ha'sadeh)* or beasts of the earth (*chayat ha'aretz)*.

I clearly stated in my manuscript that a few dinosaur kinds survived the Flood (Klenck, 2010, pp. 164–165). The mentions of *tannin* and the *behemoth*, which are from the beasts of the field or correlate with the beasts of the earth, respectively, attest to their survival after the Flood. In addition, the reference to *Leviathan*, which is both a *nachash* (serpent/monster) and *tannin* (dragon/monster/serpent/crocodile-like animal) with obvious reptilian qualities, also suggests the survival of this kind in the

open ocean throughout the Deluge to the post-Flood period (Isaiah 27:1; Job 41). However, my contention based on Scripture is that beasts of the field (*chayat ha'sadeh*) or beasts of the earth (*chayat ha'aretz*), which comprised *Dinosauria*, were largely destroyed after the Fall and before the Flood.

Shcrock notes, *"The word 'dragon,' or 'dragons,' however, occurs a total of 22 times in the Old Testament."* Actually, *tannin* occurs 27 times in the Old Testament; however, few of these verses refer to living terrestrial sauropods in the post-Flood period. Of these 27 mentions, one verse refers to deep-water sea kinds during the Creation week (Genesis 1:21); six passages denote deep-water marine kinds (Job 7:12; Psalm 74:13; 148:7; Isaiah 27:1, 51:9, Jeremiah 51:34); two citations most likely refer to shallow-water crocodiles (Ezekiel 29:3; Ezekiel 32:2); five references represent snakes (Exodus 7:9–10, 12; Deuteronomy 32:33; Psalm 91:13); one citation has *tannin* in the name of an architectural structure (Nehemiah 2:13); and four mentions are clearly figurative (Job 30:29; Psalm 44:19; Jeremiah 14:6; Micah 1:8). Another three citations (Isaiah 13:22; 34:13; 43:20) refer to *tannin* during the earthly reign of the Messiah. Hence, from the 27 mentions of *tannin*, only 5 verses reference living kinds that could denote terrestrial sauropods existing after the Deluge in ancient times (Isaiah 35:7; Jeremiah 9:11; 10:22; 49:33; 51:37). The paucity of the mention of beasts of the field, beasts of the earth, and *tannin* after the Fall, throughout the Flood, and in the post-Flood milieu suggest their populations were small, largely inconsequential, and for those that observed or dispatched these rare creatures, an event of considerable notoriety.

To sum, that there was "*a large post-Flood population of dinosaurs*" seems untenable. When considering the totality of Biblical references and extra-Biblical evidence, the latter hypothesis has little support. Rather, Biblical and extra-Biblical evidence suggests most dinosaurs perished during the period after the Fall and before the Flood, this period impacted geological stratigraphy, and few terrestrial dinosaurs survived the Deluge.

Dr. Joel D. Klenck
Arlington, VA
jklenck@paleorc.com

References

Archibald, J.D., and L.J. Bryant. 1990. Differential Cretaceous/Tertiary extinctions of nonmarine vertebrates; evidence from northeastern Montana. *Geological Society of America Special Paper* 247:549–562.

Balme, B.E. 1970. Palynology of Permian and Triassic strata in the Salt Range and Surghar Range, West Pakistan. In B. Kummel and C. Teichert (editors), *Stratigraphic Boundary Problems: Permian and Triassic of West Pakistan*, pp. 305–453. University of Kansas "Special Publication" 4, Lawrence, KS.

Benton, M.J. 1986. More than one event in the late Triassic mass extinction. *Nature* 321:857–861.

Benton, M.J. 1991. What really happened in the Late Triassic? *Historical Biology* 5:263–278.

Benton, M.J. 1994. Late Triassic to Middle Jurassic extinctions among continental tetrapods: testing the pattern. In N.C. Fraser and H.D. Sues (editors), *In the Shadow of Dinosaurs*, pp. 366–397. Cambridge University Press, Cambridge, UK.

Carpenter, K. 1998. Evidence of predatory behavior by theropod dinosaurs. *Gaia* 15:135–144.

Clark, H.W. 1968. *Fossils, Fire, and the Flood.* Outdoor Pictures, Escondido, CA.

Clark, H.W. 1971. Paleoecology and the Flood. *Creation Research Society Quarterly* 8:19–23.

Clark, H.W. 1977. Fossil Zones. *Creation Research Society Quarterly* 14:88–91.

Clutton-Brock, J. 1992. *Horse Power: A History of the Horse and the Donkey in Human Societies.* Harvard University Press, Cambridge, MA.

Fowell, S.J., and P.E. Olsen. 1993. Time calibration of Triassic-Jurassic microfloral turnover, eastern North America. *Tectonophysics* 222:361–369

Gentet, R.E. 2000. The CCC model and its geological implications. *Creation Research Society Quarterly* 37:10–21.

Glen, W. 1994. What the impact/volcanism/mass extinction debates are about. In Glen, W. (editor), *The Mass Extinction Debates: How Science Works in a Crisis*, pp. 7–38. Stanford University Press, Palo Alto, CA.

Goertzen, J. 1998. The Rhamphorhynchoid Pterosaur Scaphognathus Crassirostris: a "living fossil" until the 17th century? In Walsh, R.E. (editor), *Proceedings of the Fourth International Conference on Creationism*, pp.253–269. Creation Science Fellowship, Pittsburgh, PA.

Grigson, C. 1987. Shiqmim: pastoralism and other aspects of animal management in the Chalcolithic of the northern Negev. In Levy, T.E. (editor), *Shiqmim I: Studies Concerning Chalcolithic Societies in the Northern Negev Desert, Israel (1982–1984)*. Archaeopress, Oxford, UK.

Hallam, A. 1989. *Great Geological Controversies*, 2nd edition. Oxford University Press, Oxford, UK.

Hapgood, C.H. 1973. *Mystery in Acambaro*. Repr., Adventures Unlimited Press, Kempton, IL, 2000.

Hu, Y-M., J. Meng, C.K. Li, and Y-Q. Wang. 2005. Large Mesozoic mammals fed on young dinosaurs. *Nature* 433:149–152.

Hurlbert, S.H., and J.D. Archibald. 1995. No statistical support for sudden (or gradual) extinction of dinosaurs. *Geology* 23:881–884.

Klenck, J.D. 2002. *The Canaanite Cultic Milieu: The Zooarchaeological Evidence from Tel Haror, Israel*. Archaeopress, Oxford, UK.

Klenck, J.D. 2009. Major terrestrial animal taxonomic classifications as defined by God. *Journal of Creation* 23(2):118–123.

Klenck, J.D. 2010. Genesis and the demise of the dinosaurs. *Creation Research Society Quarterly* 46:159–166.

Luo, Zhe-Xi. 2007. Transformation and diversification in the early mammalian evolution. *Nature* 450:1011–1019.

MacLeod, N., and Keller. G (editors). 1996. *Cretaceous-Tertiary Mass Extinctions*. Norton Press, London, UK.

Mayor, A. 2005. *Fossil Legends of the First Americans*. Princeton University Press, Princeton, NJ.

Morris, J.D. 2008. The dinosaur next door. *Acts & Facts.* 37 (6):13.

Olsen, P.E., and H.D. Sues. 1986. Correlation of continental Late Triassic and Early Jurassic sediments and patters of the Triassic-Jurassic tetrapod transition. In Padian, K. (editor), *The Beginning of the Age of the Dinosaurs*, pp. 321–351. Cambridge University Press, Cambridge, UK.

Padian, K., and W.A. Clemens. 1985. Terrestrial vertebrate diversity: episodes and insights. In Valentine, J.W. (editor), *Phanerozoic diversity patterns*, pp. 41–96. Princeton University Press, Princeton, NJ.

Pezatti, A. 2005. Mystery at Acambaro, Mexico. *Expedition Magazine, University of Pennsylvania Museum* 47(3):7–8.

Scheven, J. 1996. The carboniferous floating forest—an extinct pre-Flood ecosystem. *Creation ex nihilo Technical Journal* 10(1):70–91.

Schibler, J. 2006. The economy and environment of the 4th and 3rd millennia BC in the northern Alpine foreland based on studies of animal bones. *Environmental Archaeology* 11(1):49–64.

Sharpton, V.L., and P.D. Ward. 1990. Global catastrophes in earth history. *Geological Society of America Special Paper* 247.

Sheehan, P.M., and D.E. Fastovsky. 1992. Major extinctions of land-dwelling vertebrates at the Cretaceous. *Geology* 14:868–870.

Sheehan, P.M., D.E. Fastovsky, R.G. Hoffman, C.B. Berghaus, and D.L. Gabriel. 1991. Sudden extinction of the dinosaurs: latest Cretaceous, upper Great Plains, U.S.A. *Science* 254:835–839.

Swift, D.L. 1990. The rocks begin to speak. In Walsh, R.E. (editor), *Proceedings of the Second International Conference on Creationism*, Creation Science Fellowship, Pittsburgh, PA. 1:217–220.

Swift, D. 2005. *Secrets of the Ica Stones and Nazca Lines.* Self-published.

Thallon, J. 1984. The Question Box. *Creation Ex Nihilo Technical Journal* 6(3):35–36.

Thomas, B. 2010. Oblivious to the obvious: dragons lived with American Indians. *Journal of Creation* 23(2):118–123.

Watts, D.C. 1984. Fossils and the Fall. *Biblical Creation* 7(18):20–21.

Wise, K. P., 2002. *Faith, Form, and Time: What the Bible Teaches and Science Confirms about Creation and the Age of the Universe*. Broadman & Holdman Publishers, Nashville, TN. See pages 170–174.

Wise, K. P., 2004. Pre-Flood Biogeography. *Discovering the Creator: Proceedings of the Third BSG Conference (Plenary Abstract)*: 10–11.

Woodmorappe, J. 1983. A diluviological treatise on the stratigraphic separation of fossils. *Creation Research Society Quarterly* 20:133–185.

Woodmorappe, J. 2001. Clarification on carnivory. *Creation Ex Nihilo Technical Journal* 15(3)51–53.

Instructions to Authors

Submission

Electronic submissions of all manuscripts and graphics are preferred and should be sent to the editor of the *Creation Research Society Quarterly* in Word, WordPerfect, or Rich Text Format (see the inside front cover for address). Printed copies also are accepted. If submitting a printed copy, an original plus two copies of each manuscript should be sent to the editor. The manuscript and copies will not be returned to authors unless a stamped, self-addressed envelope accompanies submission. If submitting a manuscript electronically, a printed copy is not necessary unless specifically requested by the *Quarterly* editor. Manuscripts containing more than 35 pages (double-spaced and including references, tables, and figure legends) are discouraged. An author who determines that the topic cannot be adequately covered within this number of pages is encouraged to submit separate papers that can be serialized.

All submitted manuscripts will be reviewed by two or more technical referees. However, each section editor of the *Quarterly* has final authority regarding the acceptance of a manuscript for publication. While some manuscripts may be accepted with little or no modification, typically editors will seek specific revisions of the manuscript before acceptance. Authors will then be asked to submit revisions based upon comments made by the referees. In these instances, authors are encouraged to submit a detailed letter explaining changes made in the revision, and, if necessary, give reasons for not incorporating specific changes suggested by the editor or reviewer. If an author believes the rejection of a manuscript was not justified, an appeal may be made to the *Quarterly* editor (details of appeal process at the Society's web site, www.creationresearch.org).

Authors who are unsure of proper English usage should have their manuscripts checked by someone proficient in the English language. Also, authors should endeavor to make certain the manuscript (particularly the references) conforms to the style and format of the *Quarterly*. Manuscripts may be rejected on the basis of poor English or lack of conformity to the proper format.

The *Quarterly* is a journal of original writings, and only under unusual circumstances will previously published material be reprinted. Questions regarding this should be submitted to the Editor (CRSQeditor@creationresearch.org) prior to submitting any previously published material. In addition, manuscripts submitted to the *Quarterly* should not be concurrently submitted to another journal. Violation of this will result in immediate rejection of the submitted manuscript. Also, if an author uses copyrighted photographs or other material, a release from the copyright holder should be submitted.

Appearance

Manuscripts shall be computer-printed or neatly typed. Lines should be double-spaced, including figure legends, table footnotes, and references. All pages should be sequentially numbered. Upon acceptance of the manuscript for publication, an electronic version is requested (Word, WordPerfect, or Rich Text Format), with the graphics in separate electronic files. However, if submission of an electronic final version is not possible for the author, then a cleanly printed or typed copy is acceptable.

Submitted manuscripts should have the following organizational format:

1. Title page. This page should contain the title of the manuscript, the author's name, and all relevant contact information (including mailing address, telephone number, fax number, and e-mail address). If the manuscript is submitted by multiple authors, one author should serve as the corresponding author, and this should be noted on the title page.

2. Abstract page. This is page 1 of the manuscript, and should contain the article title at the top, followed by the abstract for the article. Abstracts should be between 75 and 200 words in length and present an overview of the material discussed in the article, including all major conclusions. Use of abbreviations and references in the abstract should be avoided. This page should also contain at least five key words appropriate for identifying this article via a computer search.

3. Introduction. The introduction should provide sufficient background information to allow the reader to understand the relevance and significance of the article for creation science.

4. Body of the text. Two types of headings are typically used by the *CRSQ*. A major heading consists of a large font bold print that is centered in column, and is used for each major change of focus or topic. A minor heading consists of a regular font bold print that is flush to the left margin, and is used following a major heading and helps to organize points within each major topic. Do not split words with hyphens, or use all capital letters for any words. Also, do not use bold type, except for headings (italics can be occasionally used to draw distinction to specific words). Italics should not be used for foreign words in common usage, e.g., "et al.", "ibid.", "ca." and "ad infinitum." Previously published literature should be cited using the author's last name(s) and the year of publication (ex. Smith, 2003; Smith and Jones, 2003). If the citation has more than two authors, only the first author's name should appear (ex. Smith et al., 2003). Contributing authors should examine this issue of the *CRSQ* or consult the Society's web site for specific examples as well as a more detailed explanation of

manuscript preparation. Frequently-used terms can be abbreviated by placing abbreviations in parentheses following the first usage of the term in the text, for example, polyacrylamide gel electrophoresis (PAGE) or catastrophic plate tectonics (CPT). Only the abbreviation need be used afterward. If numerous abbreviations are used, authors should consider providing a list of abbreviations. Also, because of the variable usage of the terms "microevolution" and "macroevolution," authors should clearly define how they are specifically using these terms. Use of the term "creationism" should be avoided. All figures and tables should be cited in the body of the text, and be numbered in the sequential order that they appear in the text (figures and tables are numbered separately with Arabic and Roman numerals, respectively).

5. Summary. A summary paragraph(s) is often useful for readers. The summary should provide the reader an overview of the material just presented, and often helps the reader to summarize the salient points and conclusions the author has made throughout the text.

6. References. Authors should take extra measures to be certain that all references cited within the text are documented in the reference section. These references should be formatted in the current *CRSQ* style. (When the *Quarterly* appears in the references multiple times, then an abbreviation to *CRSQ* is acceptable.) The examples below cover the most common types of references:

Robinson, D.A., and D.P. Cavanaugh. 1998. A quantitative approach to baraminology with examples from the catarrhine primates. *CRSQ* 34:196–208.

Lipman, E.A., B. Schuler, O. Bakajin, and W.A. Eaton. 2003. Single-molecule measurement of protein folding kinetics. *Science* 301:1233–1235.

Margulis, L. 1971a. The origin of plant and animal cells. *American Scientific* 59:230–235.

Margulis, L. 1971b. *Origin of Eukaryotic Cells*. Yale University Press, New Haven, CT.

Hitchcock, A.S. 1971. *Manual of Grasses of the United States*. Dover Publications, New York, NY.

Walker, T.B. 1994. A Biblical geologic model. In Walsh, R.E. (editor), *Proceedings of the Third International Conference on Creationism* (technical symposium sessions), pp. 581–592. Creation Science Fellowship, Pittsburgh, PA.

7. Tables. All tables cited in the text should be individually placed in numerical order following the reference section, and not embedded in the text. Each table should have a header statement that serves as a title for that table (see a current issue of the *Quarterly* for specific examples). Use tabs, rather than multiple spaces, in aligning columns within a table. Tables should be composed with *14-point type* to insure proper appearance in the columns of the *CRSQ*.

8. Figures. All figures cited in the text should be individually placed in numerical order, and placed after the tables. Do not embed figures in the text. Each figure should contain a legend that provides sufficient description to enable the reader to understand the basic concepts of the figure without needing to refer to the text. Legends should be on a separate page from the figure. All figures and drawings should be of high quality (hand-drawn illustrations and lettering should be professionally done). Images are to be a minimum resolution of 300 dpi at 100% size. Patterns, not shading, should be used to distinguish areas within graphs or other figures. Unacceptable illustrations will result in rejection of the manuscript. Authors are also strongly encouraged to submit an electronic version (.cdr, .cpt, .gif, .jpg, and .tif formats) of all figures in individual files that are separate from the electronic file containing the text and tables.

Special Sections

Letters to the Editor:

Submission of letters regarding topics relevant to the Society or creation science is encouraged. Submission of letters commenting upon articles published in the *Quarterly* will be published two issues after the article's original publication date. Authors will be given an opportunity for a concurrent response. No further letters referring to a specific *Quarterly* article will be published. Following this period, individuals who desire to write additional responses/comments (particularly critical comments) regarding a specific *Quarterly* article are encouraged to submit their own articles to the *Quarterly* for review and publication.

Editor's Forum:

Occasionally, the editor will invite individuals to submit differing opinions on specific topics relevant to the *Quarterly*. Each author will have opportunity to present a position paper (2000 words), and one response (1000 words) to the differing position paper. In all matters, the editor will have final and complete editorial control. Topics for these forums will be solely at the editor's discretion, but suggestions of topics are welcome.

Book Reviews:

All book reviews should be submitted to the book review editor, who will determine the acceptability of each submitted review. Book reviews should be limited to 1000 words. Following the style of reviews printed in this issue, all book reviews should contain the following information: book title, author, publisher, publication date, number of pages, and retail cost. Reviews should endeavor to present the salient points of the book that are relevant to the issues of creation/evolution. Typically, such points are accompanied by the reviewer's analysis of the book's content, clarity, and relevance to the creation issue.

Creation Research Society Membership/Subscription Application and Renewal Form

The membership/subscription categories are defined below:

1. **Voting Member** .....Those having at least an earned master's degree in a recognized area of science.
2. **Sustaining Member** .....Those without an advanced degree in science, but who are interested in and support the work of the Society.
3. **Student Member** .....Those who are enrolled full time in high schools, undergraduate colleges, or postgraduate science programs (e.g., MS, PhD, MD, and DVM). Those holding post-doctoral positions are not eligible. A graduate student with a MS degree may request voting member status while enrolled as a student member.
4. **Senior Member** .....Voting or sustaining members who are age 65 or older.
5. **Life Member** .....A special category for voting and sustaining members, entitling them to a lifetime membership in the Society.
6. **Subscriber** .....Libraries, churches, schools, etc., and individuals who do not subscribe to the Statement of Belief.

All members (categories 1–5 above) must subscribe to the Statement of Belief as defined on the next page.

Please complete the lower portion of this form and mail it with payment to CRS Membership Secretary, P.O. Box 8263, St. Joseph, MO 64508-8263, or fax for credit card payment to (816) 279-2312. Applications may also be completed online at creationresearch.org.

✂ ----------

This is a ❑ new ❑ renewal application for the subscription year beginning Summer ❑ 2008 ❑ _____. *(Please type or print legibly.)*

Name _____ Address _____

City _____ State _____ Postal/Zip code _____ Country _____

Phone (optional) _____ Email _____

Degree _____ Field _____

Year granted _____ Institution _____

Presently associated with _____

I have read and subscribe to the CRS Statement of Belief. Signature _____

For foreign orders, including Canadian, payment must be made in U.S. dollars by a check drawn on a U.S. bank, international money order, or credit card. *Please do not send cash.*

Indicate applicable category ❶	*Indicate payment* ❶			
	Paper**			
❑ Voting ❑ Sustaining	USA	Canada Mexico	Other countries	**Paper-less**‡**
❑ Regular [per year]	❑ $35	❑ $53	❑ $70	❑ $31
❑ Senior [per year]	❑ $30	❑ $48	❑ $65	❑ $26
❑ Life member	❑ $500	❑ $500	❑ $500	❑ $500
❑ Student* [one year; multi-year not permitted]	❑ $30	❑ $48	❑ $65	❑ $26
❑ Subscriber [per year]	❑ $38	❑ $56	❑ $73	❑ $34

* Student members are required to complete the bottom portion of this form.
** Rates for the paper option include postage for First Class Mail International (FCMI), which is equivalent to airmail. Surface mail delivery is no longer available.

‡ **New PAPERLESS option:** You may now opt out of receiving paper copies of the CRS periodicals (*CRS Quarterly* and *Creation Matters*). By choosing this option you may register for access to the Premium Area of the website, where you may view or download electronic (PDF) versions of these publications. Of course, regular members and subscribers may also have access to the Premium Area. Only members, however, will access to the Members Exclusive Area of the website.

Member/Subscriber (multi-year not permitted for students)	$_____ per year x _____ years
SUBTOTAL	$_____
Optional contribution	+ $_____
Life membership	+ $_____
TOTAL	$_____

❑ Visa ❑ MasterCard ❑ Discover
❑ American Express ❑ Check/money order

Card number _____
Expiration date (mo/yr) _____
Phone number (_____) _____
Signature _____

***Student Members* are required to complete the following:**

School or institution now attending _____

_____

Your current student status: ❑ high school; ❑ undergraduate; graduate program ❑ MS ❑ PhD; ❑ other _____

Year you expect to graduate or complete your degree _____

Major, if college or graduate student _____

Signature _____

Order Blank for Past Issues

Cost of complete volumes (per volume): .....members (all categories) – $18.00 + S/H
nonmembers and subscribers (libraries, schools, churches, etc.) – $25.00 + S/H

Cost of single issues (per issue): .....members (all categories) – $5.00 + S/H
nonmembers and subscribers (libraries, schools, churches, etc.) – $7.00 + S/H

	Number			
Volume	1	2	3	4
21	☐	☐	☐	☐
22	☐	☐	☐	☐
23	☐	☐	☐	☐
24	☐	☐	☐	☐
25	☐	☐	☐	☐
26	☐	☐	☐	☐
27	☐	☐	☐	☐
28	☐	☐	☐	☐
29	☐	☐	☐	☐
30	☐	☐	☐	☐
31	☐	☐	☐	☐
32	☐	☐	☐	☐
33	☐	☐	☐	☐
34	☐	☐	☐	☐

	Number			
Volume	1	2	3	4
35	☐	☐	☐	☐
36	☐	☐	☐	☐
37	☐	☐	☐	☐
38	☐	☐	☐	☐
39	☐	☐	☐	☐
40	☐	☐	☐	☐
41	☐	☐	☐	☐
42	☐	☐	☐	☐
43	☐	☐	☐	☐
44	☐	☐	☐	☐
45	☐	☐	☐	☐
46	☐	☐	☐	☐
47	☐			

CRSQ on CD, version 2.0
Members, $75; nonmembers and subscribers, $100.
Upgrade: Members, $40; nonmembers and subscribers, $55. (Prices on this item include postage and handling.)

Two-set CD contains volumes 1–41 (through March, 2005) of the *Creation Research Society Quarterly* and volumes 1–9 (through December, 2004) of *Creation Matters* in Adobe Acrobat format.

Volumes 1–20 are available on CD. See "CRSQ on CD" advertisement on right for details.

Add 20% for postage (**for U.S. orders:** min. $5, max. $25; **for Canadian orders:** min. $10, no max.; **for other foreign orders:** min. $15, no max.) **Total enclosed:** $_____

Make check or money order payable to Creation Research Society. Please do not send cash. For foreign orders, including Canadian, please use a check in U.S. funds drawn on a U.S. bank, an international money order, or a credit card.

(Please type or print legibly)

Name _____ Address _____

City _____ State _____ Zip _____ Country _____

❏ Visa ❏ MasterCard ❏ Discover ❏ American Express Card number _____

Expiration date (mo/yr) _____ Signature _____

Mail to: Creation Research Society, 6801 N. Highway 89, Chino Valley, AZ 86323, USA

Creation Research Society

History—The Creation Research Society was organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a need for an association devoted to research and publication in the field of scientific creation, with a current membership of over 600 voting members (graduate degrees in science) and about 1000 non-voting members. The *Creation Research Society Quarterly* is a peer-reviewed technical journal. It has been gradually enlarged and modified, and is currently recognized as one of the outstanding publications in the field. In 1996 the *CRSQ* was joined by the newsletter *Creation Matters* as a source of information of interest to creationists.

Activities—The Society is a research and publication society, and also engages in various meetings and promotional activities. There is no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund and research center are maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible. As part of its vigorous research and field study programs, the Society operates The Van Andel Creation Research Center in Chino Valley, Arizona.

Membership—Voting membership is limited to scientists who have at least an earned graduate degree in a natural or applied science and subscribe to the Statement of Belief. Sustaining membership is available for those who do not meet the academic criterion for voting membership, but do subscribe to the Statement of Belief.

Statement of Belief—Members of the Creation Research Society, which include research scientists representing various fields of scientific inquiry, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution) both of the universe and the earth with its complexity of living forms. We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. *All members of the Society subscribe to the following statement of belief:*

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.
2. All basic types of living things, including humans, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.
3. The Great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event worldwide in its extent and effect.
4. We are an organization of Christian men and women of science who accept Jesus Christ as our Lord and Savior. The act of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Savior for all people. Therefore, salvation can come only through accepting Jesus Christ as our Savior.

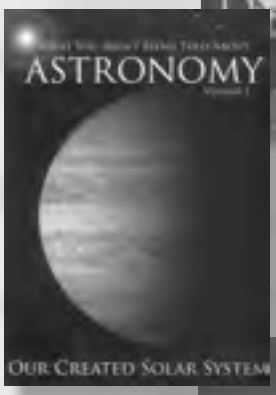
CREATION RESEARCH SOCIETY Resources

The Heavens Declare: The Solar System

DVD (52 Min)

Regular Price: $15.00 / Member Price: $13.00

This DVD presents all the wonderful discoveries of our solar system. Secular astronomers think that life may be found elsewhere in the solar system, but each of the solar system's planets and moons are unique from the Earth. Only Earth is specially made for life.



What You Aren't Being Told about Astronomy Vol. 1: Our Created Solar System

DVD (106 min)

Regular Price: $15.00 / Member Price: $13.00

In this video the viewer is given a tour of our magnificent solar system with amazing photographs and graphics from NASA and other sources. The viewer is shown how the planets and their moons defy evolutionary speculations of their origin. Some planets should not even exist, according to evolutionary models. There are so many problems with the origin of the solar systems bodies that creation is the most viable option of their origin.

The Young Sun: Is the Sun Really Billions of Years Old?

DVD (44 min)

Regular Price: $15.00 / Member Price: $13.00

In this DVD, a documentary style exploration takes a closer look into the known processes of the workings of the sun. It explores the most popular theories about the origin of the sun and shows why it is impossible that any of these theories of star formation explain the origin of the sun.

The Message of the Grand Canyon: Does It Support God's Word?

DVD (60 min)

Regular Price: $13.00 / Member Price: $11.00

In this video, noted creationist and river rafter, Tom Vail, offers his insights and experience on the geology of Grand Canyon. He discusses some of the canyon's unusual formations, such as dramatic bends in multiple layers of rock. Mr. Vail explains how he thinks the canyon provides excellent support of a global flood and a young earth. Presented at a layman's level, this video offers a very informative creationist perspective of Grand Canyon; its age, formation, and Biblical significance.

Orders can by placed through
Creation Research Society, 6801 N. Highway 89, Chino Valley, AZ 86323-9186
Phone: 1-877-CRS-BOOK (1-877-277-2665); Fax: (928) 636-9921
www.creationresearch.org

For U.S. orders, add 20% for S/H (min $5, max $15)
For Canadian orders, add 20% for S/H (min. $5, no max.)
For foreign orders, add 25% for S/H (min. $15, no max.)
Orders must be pre-paid.

For credit card payments, (Visa, MasterCard, Discover, and American Express), please include the card number, expiration date (month/year), and your phone number.