

# CRSQ

CREATION RESEARCH SOCIETY QUARTERLY



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### 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

## Editor's Comments

The CRS Board of Directors recently met in the Atlanta area for their annual meeting. We had a workshop on creation vs. evolution presented by Duane Gish. After the business meetings, three field trips were scheduled: Stone Mountain, Georgia; Providence Canyon, Georgia; and Little River Canyon, Alabama. It was a busy, but enjoyable time. We met many members of the Society for the first time at a barbecue and listened to short talks on creationist topics by Don DeYoung, John Meyer, Carl Froede and Jerry Akridge later in the evening. This old editor is exhausted, but pleased, over the events.

Now to the June *Quarterly*, as it is a pleasure to discuss its contents briefly. Gene Chaffin offers a theoretical mechanism for the possibility of accelerated nuclear decay during the creation week (Genesis 1). If the model is viable, it would explain why many so-called radioactive dating methods yield an old age for the earth when in fact the earth is very young. Robert Gentet offers a new young earth-Flood model drawing heavily on the concept of ecological zonation. In 1976 Clifford Burdick wrote a short note on the zonation theory (CRSQ 13:37-38) which may be of interest as you read the article by Gentet.

In recent years it has been found that many subaqueous lava flows have identical features to subaerial flows. This interesting circumstance could lead creationist geologists to examine basalt and lava flows in a new light. Possibly many volcanic features described as forming under subaerial conditions actually may have developed under

water during the Flood! Carl Froede discusses this information in his article on submarine volcanism. Peter Klevberg continues his series on sequence stratigraphy. He shows that much of uniformitarian geological conclusions are based on naturalistic philosophy and not on unbiased observation in the field.

The editor offers some comments on a difference of opinion of creationists concerning star formation. The disagreement involves a thermodynamic model for "contracting" stellar gases. Some errors in a Chinese dinosaur display are noted by Carl Froede. The problems with possible dinosaur evolution also are examined.

There are several noteworthy letters to the editor in this issue. Genesis kinds, baraminology and limits to variation are discussed. The origin of flowering plants is briefly examined as well as another look at the Piltdown hoax. A doctored fossil is humorously "counted out." Continuing geological debates on creationist stratigraphy are presented. If you disagree with any article in the *Quarterly*, you are welcome to present your views in a letter to the editor. These discussions are generally of interest to our readers.

Last but not least, as the cliché goes, at the very back you will find a Copy 'n' Share article "The Cambrian Explosion." This is formatted to be copied and distributed both free and freely.

I hope you enjoy reading the subject matter.

Emmett L. Williams

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## Magazine Article Review

### Was There a Big Bang? by David Berlinski *Commentary Magazine*, February 1998

David Berlinski has a Ph.D. from Princeton University in mathematics and has written several easy to read mathematics books besides three novels. *Commentary Magazine* is a neoconservative Jewish monthly publication with a 50-year history of publishing clear and unflinching critiques of contentious social and political issues. This article focuses on the Big Bang and presents Dr. Berlinski's reasons for saying there is no proof that it ever happened.

In a brief introduction he gives a historical sketch of modern cosmology for the past 100 years as it evolved from Einstein's time to the present day practitioners. After this introduction he provides headings for the following sections of his article. In the first section titled *The Great Cause* he reveals he is not a Christian or a young Earth creationist by relegating the Genesis account to the broad category of creation myths. He also describes the other

competing category of myths about a universe without beginning or end.

In the section titled *The Cosmic Archaeologist* he sets up the pillars of conventional Big Bang theory following backwards the stages of expansion which started 14 billion years ago from nothing but a singularity in space and time. He points out cosmologists assume that the universe is always expanding and that its past progression can be followed backwards in time without encountering discontinuities. At the end of this section he states that the cosmologists Big Bang scenario always neglects to account for how it got started in the first place.

In the next section titled *Blow-Up* he begins to present his reasons for not believing that the Big Bang has taken place. He begins an attack on the theory with the cosmic background radiation (CBR) evidence for the Big Bang.

This radiation has been found nearly uniform in direction and temperature. Dr Berlinski points out that a CBR this uniform requires thorough mixing by some physical agency (i.e. interaction with matter) over a long period of time. In a uniformly expanding universe this could not physically happen. Cosmologists introduce a Higgs field (gravitational potential energy field) to provide the “inflationary period” for the mixing. However, they do not supply an explanation for how this field originated, why it acted at that particular time in history or how it could exist without a physical medium.

In the *Red Stars at Night* section Dr Berlinski recounts the discovery of the relationship between the red shift of light from galaxies and their distance from us. Edwin Hubble reported finding in data from a small sample of galaxies (20) that the redshift was larger for the galaxies that appeared to be further away (i.e. less bright). He proposed a linear relationship that implies a uniformly expanding universe, as cosmologists require for the Big Bang theory. Dr. Berlinski points out two recent discoveries that lead some astronomers to question Hubble’s law. One discovery is that there are individual stars (quasars) in nearby galaxies that have much larger redshifts in the radio spectrum than the most distant galaxies. Another discovery is that statistical analysis of the measurements of all known galaxies (10,000) results in a quadratic relationship between redshift and distance. Dr. Berlinski states, “Indifference to its (the new evidence) implications amounts to a decision to place Big Bang cosmology beyond rational inquiry” (p. 10).

In the section titled *Monlam Chemno* he addresses Einstein’s theory for general relativity, which is fundamentally an account of gravity. To find solutions to Einstein’s equations cosmologists are forced to make the assumptions that the universe is homogeneous and isotropic (i.e. the same everywhere). Dr. Berlinski points out that both assumptions are not representative of the known universe because its mass and energy sources are concentrated at specific points.

In *Specification in the Dark* he discusses how Einstein introduced an arbitrary cosmological constant to generate a static solution to his gravitational field equations, which met his aesthetic sensibilities. Others, however, found the solutions without this constant, which describe an expanding or contracting universe, more to their liking. The Big Bang requires the expanding universe option so cosmologists have ever since sought to prove that this is the path the universe has taken. It is called the Friedmann-Lemaitre (FL) cosmology after its two independent discoverers. In the general case Einstein’s theory can not be used to predict any physical phenomena and therefore leaves the cosmologist free to make up any universe he decides fits his observations. Dr. Berlinski calls these constructs “purely a mathematician’s world”.

In *At Time Zero* Dr. Berlinski points out another problem with Einstein’s theory. Any attempt to use the equations to follow the path back in time eventually reaches a time in which the universe cannot be described by the equations. Factors include how dense can matter become, where do laws of physics break down, and space/time non-uniformity’s set limits on how close to time zero the equations remain valid. Berlinski states that cosmologists arbitrarily use a mathematician’s concept of the singularity to circumvent the physics at these points. If the singularities are correctly defined the equations will have solutions. But there is no way to prove or disprove that a singularity ever existed because they are purely a mathematical concept and have no physical characteristics that can be measured. Because of singularities arbitrarily introduced, the theory never reaches time zero and cannot model the events happening at that time.

Berlinski’s conclusions are presented in the section titled *The Closing Circle*. He finds the Big Bang cosmology “circular in the progression of its ideas and circular thus in its deepest nature”. He points out that the first law of thermodynamics has been violated in that cosmologists claim energy for the Big Bang came from nowhere. Next he emphasizes that something as imposing as the universe cannot organize itself from nothing. He points to physicists who claim the universe switched itself on but are contradicting themselves because switching is a concept that is in time and before the universe began there was no time. He then relegates the Big Bang theory to the familiar realm of mythology.

The final section titled *The Contract* is used to expound on how cosmologists have broken the underlying contract between scientists and the general public. He sums it up in this single sentence: “The result has been the calculated or careless erasure of the line separating disciplined physical inquiry from speculative metaphysics”. He goes on to point out that “Like Darwin’s theory of evolution, the Big Bang cosmology has undergone that social process in which a scientific theory is promoted to a secular myth”.

Dr Berlinski avoids bringing into this article his personal worldview. What he does to the Big Bang/evolutionist view is to show how it is a myth masquerading as scientific truth. The task for all cosmologists, creationary or evolutionary, remains to develop a theory that explains the true physical world and is not based on unrealistic assumptions or use of unjustified mathematical concepts. Only then should cosmology be considered science rather than mythology. This article can be found online at [www.commentarymagazine.com/9802/berlinski.html](http://www.commentarymagazine.com/9802/berlinski.html).

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# A Mechanism for Accelerated Radioactive Decay

Eugene F. Chaffin\*

## Abstract

Kaluza-Klein theory, originally proposed in 1921 to 1926, has been described as a miraculous synthesis of Einstein's gravitation theory with Maxwell's equations of electricity and magnetism. In an approach which anticipated modern string theory, Kaluza and Klein added a fifth dimension of space to the three familiar spatial dimensions and one time dimension. The extension of Einstein's theory to this fifth dimension then led naturally to Maxwell's equations. The theory also naturally leads to a relation between the constant  $G$  of Newton's law of gravitation

and the fine structure constant  $\alpha = e^2/\hbar c$ . This relation depends on the circumference of the compactified fifth dimension, so that variation in this circumference over the history of the universe could be viewed as variation in physical constants, such as the fine structure constant. If, during early creation week, say before the creation of man, such variations were to occur, they could lead to accelerated nuclear decay, thus adjusting isotopic abundances, without giving humans an unacceptable dose of radiation.

## Introduction

Undergraduate students of physics often have never heard of the Kaluza-Klein theory. While the nuclear forces were unknown until the 1930's, physicists nevertheless were trying to unify the known forces of physics, electromagnetism and gravity, in one theory. Hermann Weyl had investigated one such theory prior to 1921 (Chaffin, 1986). Kaluza (1921) and Klein (1926a,b) worked on another somewhat successful theory which regarded the universe as having an extra fifth dimension besides the usual three space plus one time dimensions. Kaluza was a contemporary of Albert Einstein, and in fact Kaluza's paper on this subject was presented to the Prussian Scientific Academy in Berlin by Einstein himself. Klein, at the time he did his original work on this subject, was at the Niels Bohr Institute in Copenhagen as well as at the University of Michigan, Ann Arbor. English translations of the original German articles of Kaluza and Klein have been published in Sabbata and Schmutzer (1983) and Appelquist, Chodos, and Freund (1987). While Kaluza required that physical quantities of ordinary spacetime should have zero or vanishingly small derivatives with respect to the fifth coordinate, Klein wanted to replace this assumption by the requirement that physical quantities be periodic with respect to this coordinate. This is equivalent to the condition that the fifth dimension

is "rolled up." The metric components (the doubly-subscripted quantities used to specify the geometry in general relativity theory) connecting the fifth coordinate to the four coordinates of the usual spacetime are interpreted as the potential and the three components of the vector potential of electromagnetic theory. The amazing result is that the field equations for these potentials reduce to the usual Maxwell equations. While early work on this approach essentially ran into a dead end (Einstein and Bergman, 1938; Jordan, 1947; Bergman, 1948), modern superstring theories may be viewed as extensions of the Kaluza-Klein idea (Witten, 1981; Weinberg, 1983; Thomsen, 1984; Kolb, Perry, and Walker, 1986), and enthusiasm is running high (Chown, 1998; Raiford, 1999). It may be that the Kaluza-Klein theory will soon become much better known to physics students.

How could a dimension be viewed as "rolled up"? One must first realize that in general relativity theory, the presence of matter causes a curvature of space (Figure 1). This curvature is a "curvature" of four dimensional spacetime. But visualization is aided by suppressing all but two space dimensions and the time dimensions. Then the curvature can be regarded as positive when it is like the surface of a sphere or negative when it is like a saddle shape. The fifth dimension's "rolling up" is a description of the topology of the model being proposed (Figure 2). If a long piece of paper is rolled up and two edges glued together, one gets a cylinder. If we imagine two dimensional beings who can only move and see inside the two dimensional surface thus formed, one gets the idea of this curvature. In superstring

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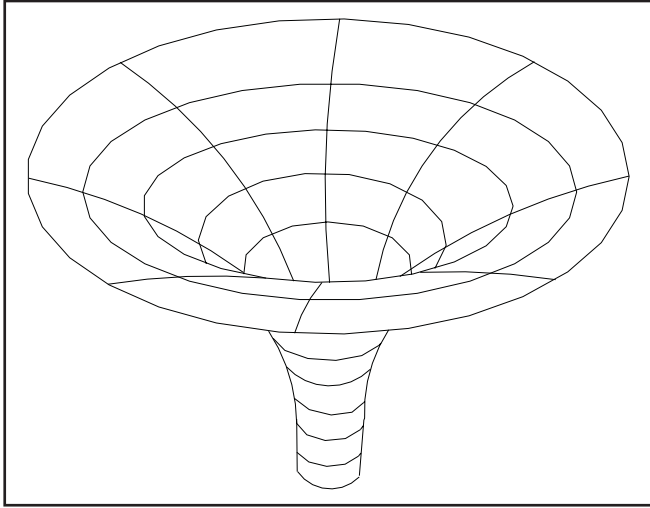


Figure 1. A two dimensional space with curvature caused by the presence of a large mass.

theory there are six or more finitely long dimensions which are “rolled up.” In the simplified Kaluza-Klein idea, there is only one rolled up dimension. Mathematicians call an object with the topology of a circle as  $S^1$ . The cylinder is then the *direct product space*  $R \times S^1$ , where  $R$  is the topology of a straight, infinite line. Then our universe, according to the Kaluza-Klein idea, and assuming that spacetime is “flat,” is the direct product of three spatial  $R$ ’s, one time coordinate  $R$ , and the  $S^1$ .

Biblical evidence, when interpreted straightforwardly according to the original meanings of the language in which the Bible was written, points toward an earth with an age measured in thousands rather than millions or billions of years. On the other hand, scientific evidence from radioisotopes seems at first sight to indicate a history of billions of years of radioactive decay, if half lives have been relatively constant over the history of our world. Hence, scientists who believe the biblical creation account have wondered from time to time whether half lives and the associated decay “constants” might not be “constants” but variables (Chaffin, 1994). The purpose of this paper is to initially examine the Kaluza-Klein idea to see if it might provide a useful model in this regard. Besides the usual references, a bibliography of relevant literature is provided to assist in this venture.

## The Relation Between $G$ and $\alpha$

Although Klein (1926a,b) had the essential equations in his early papers, the relationship between  $G$  and  $\alpha$  was most clearly explained by Souriau (1963). It has been noted by various authors in recent years, for example Li and Gott (1998), Salam (1989, p. 487), Marciano (1984), Appelquist and Chodos (1983), Freund (1982) and

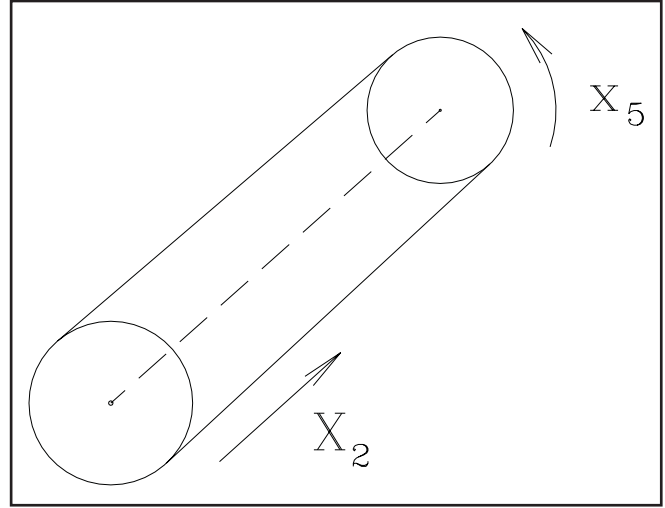


Figure 2. A rolled up dimension added to a flat dimension forms a cylinder as shown. The values of  $x^5$  and  $x^5 + b$ , where  $b$  is the circumference  $2\pi r(g_{55})^{1/2}$ , are identified as the same point.

Chodos and Detweiler (1980). Souriau began with the linear invariant equation in five dimensions:

$$D_5 \varphi + a\varphi = 0 \quad (1)$$

where  $D_5$  is the d’Alembertian in five dimensions,  $\varphi$  denotes a real wave function, and  $a$  is a real constant. The four dimensional version of this equation is known in quantum physics as the Klein-Gordon equation (Kragh, 1984), and is applied to particles of spin zero. In a curved spacetime, the constant “ $a$ ” could include a contribution from the Riemannian curvature scalar  $R$  (Anderson, 1971; Bicknell, 1976; Penrose and Rindler, 1984, Vol. 2, p. 369), but Souriau restricted his considerations to the case where it does not.

The quantity  $D_5 \varphi$  is given by (Adler, Bazin, and Schiffer, 1965, p. 75):

$$D_5 \varphi = \frac{1}{\sqrt{|g|}} \frac{\partial}{\partial x^i} \left[ \sqrt{|g|} g^{ik} \frac{\partial}{\partial x^k} \varphi \right]. \quad (2)$$

Choosing the coordinate of the compactified fifth dimension so that it varies from 0 to  $2\pi$ , then the wave-function  $\varphi$  has the period  $2\pi$  in the fifth-dimension coordinate  $x^5$ , we can then expand  $\varphi$  in a Fourier series

$$\varphi = \sum_Z \varphi_Z e^{iZx^5} \quad (3)$$

where  $Z$  denotes either a positive, negative or zero integer, the  $\varphi_Z$  are complex functions of  $x^\mu$ ,  $\varphi_Z$  and  $\varphi_{-Z}$  are complex conjugates, and  $\varphi_0$  is real. We next make the approximation that the gravitational field is small and the motion is not relativistic, then the metric tensor is reduced to the metric of a flat spacetime of four dimensions plus the “rolled-up” fifth dimension. Furthermore, according to the Kaluza-Klein results (Kaluza, 1921; Klein, 1926a;

Souriau, 1963, p. 572) the  $g^{\mu 5}$  components are related to the electromagnetic vector potential  $A^\mu$  via the equation

$$g^{\mu 5} = -\frac{1}{\xi} \sqrt{2\chi} A^\mu \quad (4)$$

[In order to conform to the usual definition of the vector potential as in Klein (1926) and Chodos and Detweiler (1980), I multiply Souriau's vector potential by a factor of  $1/\sqrt{4\pi}$ .] and the  $g^{55}$  component is given by

$$g^{55} = \frac{1}{\xi^2} [-1 + 2\chi A_\mu A^\mu] \quad (5)$$

where  $\chi$  is the universal gravitation constant and  $\xi$  is the "radius of the cylinder" for the fifth dimension.

At this point Souriau introduced what he called *the transverse variables*. These variables are defined as shown in Figure 3. To describe the five dimensional view of the universe  $U$ , we consider functions or *maps* which map the five coordinates  $x^1, x^2, x^3, x^4$ , and  $x^5$ , to a point  $M$  of  $U$ . *Standard maps* are defined to be those for which  $x^5$  has the period  $2\pi$ , and they are the only ones we use.  $M$  being a point of  $U$ , a *fibre*  $M$  passing through  $M$  is the closed curve obtained when  $x^5$  alone varies (see Figure 3). Then the set of these fibres is denoted  $U$ , and this set is interpreted as the "points" of ordinary space time. Now for each *standard map* we define a corresponding map which is *transverse*, which means that the fibres are orthogonal to the hypersurfaces  $x^5 = \text{constant}$ . In terms of these *transverse variables* defining this map, we have for the determinant of the metric as related to the metric determinant for transverse variables:

$$|g| = \xi^2 |\tilde{g}|, \quad (6)$$

and for the metric components related to the metric components for transverse variables:

$$g^{\mu\nu} = \tilde{g}^{\mu\nu}. \quad (7)$$

Armed with these equations we reduce the five dimensional Klein-Gordon equation to:

$$\tilde{g}^{\mu\nu} \left[ \frac{\partial}{\partial x^\mu} - \frac{iqA_\mu}{\hbar} \right] \left[ \frac{\partial}{\partial x^\nu} - \frac{iqA_\nu}{\hbar} \right] \phi_z + \frac{m^2}{\hbar^2} \phi_z = 0 \quad (8)$$

which is the Klein-Gordon equation for a particle of spin zero in an electromagnetic field, where the mass  $m$  and charge  $q$  are given by:

$$m = \hbar \sqrt{\frac{Z^2}{\xi^2} + a}, \quad (9)$$

and

$$q = \frac{Z}{\xi} \sqrt{2\chi} \hbar. \quad (10)$$

The first equation, when combined with numerical values, shows that the mass of the  $Z=2$  excitation is more than  $10^{20}$  MeV above that of the  $Z=1$ , so particles of that energy are of too great an energy to be observed. We can only observe the  $Z=1$  case, where the charge is the elementary unit  $e$ . The second equation gives the charge  $q$  of the parti-

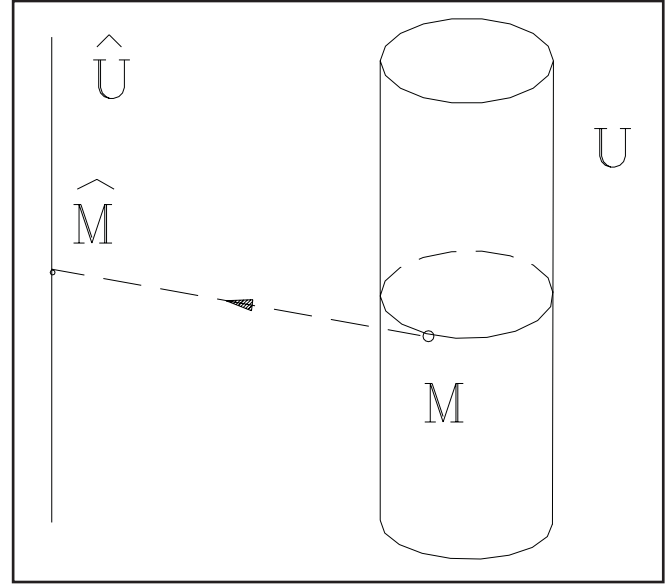


Figure 3. (After Souriau's Figure 1) Illustration of the map of points  $M$  to points of the usual spacetime.

cle in terms of the universal gravitation constant  $\chi = 8\pi G/c^2$  and the radius  $\xi$  of the fifth dimension. Solving for  $\xi$  gives

$$\xi = \frac{\hbar}{ec} \sqrt{16\pi G} = 1.341 \times 10^{-31} \text{ cm}. \quad (11)$$

We are using electrostatic units here (Purcell, 1985). The size of an atomic nucleus is of the order of  $10^{-13}$  cm, so this length is much smaller than the size of an elementary particle, giving credibility to the idea that the fifth dimension is "rolled up" to a negligible size.

Having derived these relations, we would now like to relate them back to the accelerated decay problem that started this exercise. As I pointed out in Chaffin (1994), only variations of dimensionless combinations of "constants" are physically meaningful. Theories which have variation while keeping all dimensionless ratios constant are physically trivial, amounting only to a continual redefinition of units over time. One such *dimensionless ratio* is the *fine structure constant*  $\alpha = e^2/\hbar c$ . In terms of  $\alpha$  the relation just derived can be written

$$\alpha = \frac{16\pi\hbar G}{\xi^2 c^3} \quad (12)$$

Both sides of this equation are dimensionless. A variation in the radius  $\xi$  thus could mean a variation of the fine structure constant while the gravitational constant, Planck's constant, and the speed of light  $c$  remain the same. Supposing the radius and circumference of the fifth dimension were larger at times early in creation week, one might expect nuclei to decay at an increased rate due to the smaller fine structure constant, amounting to a smaller Coulomb barrier for alpha decay (See Chaffin, 1994, for a model which could be adapted to this situation.). Of course, beta decay would also be affected. If the variation

were over by the time of the creation of man, then life would not be subject to increased radiation doses.

### Explaining the Isotopic Distributions of Uranium

Uranium isotopes U-238, U-235, and U-234 occur in the per cent abundances 99.27, 0.72, and 0.0055%, with other isotopes only occurring in trace amounts. The half lives of these isotopes are  $4.47 \times 10^9$  years for U-238,  $7.04 \times 10^8$  years for U-235, and  $2.47 \times 10^5$  years for U-234. A condition known as *radioactive equilibrium* occurs when the ratios of the abundance to the half lives of successive members of a decay chain are equal. The most probable decay mode of U-238 is alpha decay, which produces Th-234. Thorium-234 undergoes beta minus decay with a half life of 24.1 days, producing Protactinium-234. Pa-234 then also undergoes beta minus decay with a half life of 6.69 hours producing Uranium-234. Thus U-234 is in the decay chain of U-238, and radioactive equilibrium does exist because 0.0055 divided by the half life of U-234 is the same as 99.27 divided by the half life of U-238, roughly  $2.2 \times 10^{-8}$ . The two ratios are equal to within the uncertainties in the data. Kofahl and Seagraves (1975, p. 201) documented cases where radioactive disequilibrium exists in some samples, but the departures are relatively small. The variations may possibly be explained in terms of the difference in relative solubility of U-234 and U-238 starting from hexavalent and tetravalent uranium in compounds and their decomposition products (Chalov and Merkulova, 1968). For an earth of only some thousands of years old, it is difficult to explain the bulk of the approximately equal,  $2.2 \times 10^{-8}$ , ratios without an episode of accelerated decay. Starting from an arbitrary initial state, it takes only a few half lives of U-234 to establish equilibrium, implying an age of the samples of at least several hundred thousand years. To justify the young earth viewpoint, it is logically correct that the rocks may have been created already in this state of equilibrium, with no time needed to reach that state. However, a more natural explanation seems to be provided by accelerated radioactive decay. We do not know the original ratio of U-234 to U-238 in the created materials of the early earth, but if we assume that they were of the same order of magnitude, then a period of accelerated decay would adjust this ratio to the 0.0055 ratio presently found in the bulk of earth materials. This seems to be evidence that such accelerated decay did, in fact, occur (Heinze, 1992).

The U-235 abundance, compared to U-238, also seems to support this point of view. If the initial abundances of these two isotopes were of the same order of magnitude, then several half lives of U-235 are needed to establish the present 0.72% and 99.27% isotopic abun-

dances, implying sample ages of millions of years. To avoid this conclusion without accelerated decay, one seems forced to assume that the uranium isotopes were created in isotopic per cent abundances approximating those necessary for radioactive equilibrium.

### The Vacuum Is Not Empty

Part of the reason that Einstein and others worked on the Kaluza-Klein theory was motivated by the thought that the fifth dimension might provide the hidden variables that could eliminate the indeterminacy from quantum mechanics (Einstein, Rosen, and Podolsky, 1935). When the 1920's discovery of quantum mechanics was over, the classical laws were superseded by quantum laws based on the uncertainty principle. The quantum theory allows energy to appear out of nothing, in the form of pairs of virtual particles, such as electrons and positrons, as long as the virtual pairs annihilate within a small time interval given by the uncertainty principle. The vacuum, or "empty" space, is filled with pairs of virtual particles and antiparticles appearing, moving apart, and coming back together to annihilate each other. Theory allows energy density to be negative in some places, so that the total energy remains positive. There are measurable consequences of this concept, one of which is called the *Casimir effect* (Casimir, 1948; Casimir and Polder, 1948). Imagine two parallel metal plates a short distance apart. Hawking (1996, pp. 164-165) described the action between the plates as follows:

The plates will act like mirrors for the virtual photons or particles of light. In fact they will form a cavity between them, a bit like an organ pipe that will resonate only at certain notes. This means that virtual photons can occur in the space between the plates only if their wavelengths (the distance between the crest of one wave and the next) fit a whole number of times into the gap between the plates. If the width of a cavity is a whole number of wavelengths plus a fraction of a wavelength, then after some reflections backward and forward between the plates, the crests of one wave will coincide with the troughs of another and the waves will cancel out.

Because the virtual photons between the plates can have the resonant wavelengths, there will be slightly fewer of them than in the region outside the plates where the virtual photons can have any wavelength. Thus there will be slightly fewer virtual photons hitting the inside surfaces of the plates than the outside surfaces. One would therefore expect a force on the plates, pushing them toward each other. This force has actually been detected and has the predicted value. Thus we have experimental evidence that virtual particles exist and have real effects.

Hawking then goes on to say that these effects mean that there is a negative energy density between the plates. This so-called Casimir effect has recently been measured in the laboratory (Lamoreaux, 1997; Raiford, 1999). The assignment of these properties to the vacuum is part of the rationale for unified field theories, including multi-dimensional string theory. At some point in the early history of the universe, the extra dimensions “roll up” leaving only three space plus one time dimensions.

## Gauge Fields and Extra Dimensions

Witten (1981) discussed the possibilities of extending Kaluza-Klein theory to  $4+n$  dimensions. Our ordinary spacetime is sometimes referred to as Minkowski space,  $M^4$ . The present ground state of the universe is described in terms of the combination of Minkowski space  $M^4$  and a compact space  $B$  of dimension  $n$ , the so called *direct product space*  $M^4 \times B$ . Witten considered the *symmetry group*  $SU(3) \times SU(2) \times U(1)$  which describes the standard model of particle physics, the electroweak theory plus quantum chromodynamics. The compact group  $B$  needs to therefore correspond to a space which the group  $SU(3) \times SU(2) \times U(1)$  could act. This restricts the dimensions of  $B$  to at least seven, implying the universe had at least eleven dimensions. Although all possible theories have not been explored yet, Witten stated that “. . . the most serious obstacle to a realistic model of the type considered in this paper is that the fermion quantum numbers do not turn out right.” (Witten, 1981, p. 426).

Marciano (1984) constructed a model which related not only the fine structure constant, but also the coupling constants of electroweak and quark-gluon models to the size of the  $n$  extra dimensions. While his “model” is not the only possible one, his conclusion may extend to other cases also. Marciano posed the question: “Are extra dimensions a physical reality or merely a model-building mathematical tool?”

## Conclusions

Recently Webb et al. (1999) reported evidence for a variation in the fine structure constant between nearby matter and matter in gas clouds seen in absorption against background quasars. Quasars with high redshifts presumably are quasars which were young, at the time of emission, compared to nearby matter. For quasars with redshifts in the range from 1 to 1.6 (the highest range analyzed thus far), the data presented by Webb et al. seems to give evidence for a slightly smaller fine structure constant than the value in nearby matter. However, the difference is small

and it is possible that future work will uncover systematic errors in the observations.

Whether or not the future bears out Webb et al.’s findings, there is room for study of the possible variations of physical constants other than the fine structure constant. It may be that the fine structure constant was constant but some of the coupling constants involved in nuclear decay were not (Chaffin, 1994). Whether or not the extra dimensions really exist, the theory of fundamental decay processes is far from complete. Hence, the possibility of accelerated decay during earth history is real.

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## Appendix

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Once positivism destroyed Judeo-Christian consciousness, individuals were open “to respiritualization from non-Christian sources” that included such radical political ideologies as nationalism, humanitarianism, biologism, and psychologism.

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# The CCC Model and its Geologic Implications

Robert E. Gentet\*

## Abstract

When early non-evolutionary geologists named the geologic Periods, the ancient earth theory was already firmly a part of geologic thought. Twentieth century Flood geology has sought to correct this error. Nevertheless, the stratigraphic extent of the Genesis Flood Event (GFE) remains a major enigma and point of controversy among Flood geologists. A major reason for this enigma is the view of the current Flood model that pre-Flood geologic ac-

tivity was insignificant. The Creation/Curse/Catastrophe model (CCC) of earth history provides an alternative view that eliminates this problem. If the CCC model of earth history is found to be valid, the creationist's view of the causes of the stratigraphic record is enlarged and areas for additional, meaningful research become greatly enhanced. The result can only be a better understanding of the earth's turbulent past.

## Background History

The early 1800s had already witnessed the discarding in geology of the centuries-old belief in a literal, seven-day Creation Week and a short earth history. Geologists began the correlation of distant strata through the use of fossils in the early 1800s and soon established the nomenclature for the geologic "Periods." Non-evolutionary geologists who viewed the earth as very old then devised the geologic time scale. The stratigraphic record and its fossils were generally accepted by these early geologists as evidence of Divine creations spread over immense geologic time (Gillispie, 1951, pp. 98-148).

The Genesis Flood was still expounded in scientific literature during the early part of the 1800s, and then it too became passé later in the century. What had been thought to be possible Flood evidence was later seen to be deposits from the glacial period. Hutton's *The Theory of the Earth* (1785), Lyell's *Principles of Geology* (1830), and Darwin's *Origin of Species* (1859) dramatically changed the way the world's scientific establishment, many churches, and education institutions viewed the earth's history. This became possible because, even previous to the 1800s, fundamental truths had already been lost.

## Earlier Views of the Creation Event

Scripture begins with a basic truth: "In the beginning God created the heavens and the earth" (Genesis 1:1). God is

immediately introduced into the creation equation. God is seen as the Principle Cause. There is yet another equally important truth. God not only created but He sustains "all things by His powerful word" (Hebrews 1:3). Unfortunately, the notion of God as Sustainer began to be lost in the time of Newton (1642-1727):

He [Newton] believed in absolute time and absolute space, which he associated with God. Newton believed that the age of miracles was over.... Newton believed that God had withdrawn from the universe which He created, and that He operated solely through the laws which He had established at the time of creation.... Logically it led to deism and made agnosticism a reasonable approach. (Klotz, 1985, pp. 32-33.)

More and more God became the "God of the gaps." God became visible only when science seemed unable to supply the answers. As science seemed to supply more and more answers, God faded further and further away. However, Scripture consistently places what has become known as "natural law" squarely in the active hands of God. He is never pictured as distant from His creation, but rather as the One who began it and still actively sustains it (Acts 17:24-28).

James Hutton (1726-1797) introduced Newton's fundamental error into the early study of geology. It was not an out-and-out denial of God, but the exclusion of God from geologic events. As Gillispie (1951, pp. 48-49) observes:

Certain consequences of Hutton's views became immediately apparent. Most obvious was the vastness of geological time which his theory demanded.... Hutton offered no evidence for a creation, and no de-

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nial of it either; he simply had nothing to say about it.... And the whole concept hung upon the proposition that the cumulative effects of minute forces and infinitesimal changes can produce results equal to those of any sudden cataclysm and (though this was never stated) superseding the necessity for any divine intervention.

Newton had unknowingly set the stage for the much later works of Hutton, Lyell, Darwin, and others who had powerful philosophical theories concerning origins and earth history. Hutton never implicitly excluded God, yet his disregard for Divine intervention in the earth's history has become the hallmark of modern-day geology (Dunbar, 1960, p. 18):

Geology grew up under this [Christian Creation view] influence and, during its early years supernatural explanations were invoked for many natural phenomena.... The uprooting of such fantastic beliefs began with the Scottish geologist, James Hutton, whose *Theory of the Earth*, published in 1785, maintained that...given sufficient time processes now at work could account for all the geologic features of the Globe. This philosophy, which came to be known as the *doctrine of uniformitarianism*, demands an immensity of time.

Let it be understood that creationists do not deny in any way proper use of one's God-given senses while researching past geologic events. But on questions of origins, the framework must be what the Teacher has said on matters otherwise unattainable or forgotten. The only other option is a framework based upon human philosophy and that is a poor substitute for the words from the One who was there.

## A Return to Flood Geology

George McCready Price (1870–1963) can be credited with the renewal of Flood geology. Modern historians such as Numbers (1992, p. 73) label Price as probably “the greatest” of the “anti-evolutionists” early this century. Beginning in 1902 with *Outlines of Modern Christianity and Modern Science*, an almost catastrophic stream of Flood geology books/articles emanated from Price. But the real impact of Flood geology literature did not begin until such books as *The Flood* (Rehwinkel, 1951) and *The Genesis Flood* (Whitcomb and Morris, 1961) appeared along with many others who followed in Price's steps.

Among current young-earth creationists, particularly in America, variations of Price's Flood model dominate as explanations of the geologic record. In that model, the vast majority of fossiliferous strata is believed to have been formed as a result of the Deluge or its aftermath. In contrast, little geologic activity is pictured as occurring between Adam and the Flood. Furthermore, any pre-Flood

deposits generated are viewed as probably destroyed by the Flood (Morris, 1994, p. 106; Austin and Wise, 1994, p. 39; Walker, 1994, p. 584).

Whitcomb and Morris (1961, pp. 239–243) list Scriptural references (Genesis 1:6–8; 2:5–6; 7:11) which to them imply “that the age between the fall of man and the resultant Deluge was one of comparative quiescence geologically.” Wise (1992, p. 168), using the same Scriptures, urges caution, realizing that “to determine what the pre-Flood climate was truly like, it is necessary to supplement Scriptural data with physical data.” Creationists must be certain that both Scriptural understanding and physical data coincide. Significantly, creationists, using the Flood model, have been unable to reach consensus regarding the extent of the Genesis Flood Event (GFE henceforth) in the stratigraphic record.

## The Uncertain Lines

The stratigraphic extent of the GFE has persisted in Flood geology as a major enigma:

Creationists differ on where the pre-Flood/Flood and Flood/post-Flood geological boundaries should be defined.... Although many creationists would seem to include all Phanerozoic deposits less than Holocene among Flood deposits, others would tend to include all the Phanerozoic less the Neogene. Others would tend to include only the Paleozoic and Mesozoic, others would include only the Paleozoic or Lower Paleozoic, while others would remind us that the boundary may have to be determined differently in different places. Much research is needed.... (Wise, 1992, p. 170).

Since Wise's statement in 1992, much more discussion and research have appeared in creation literature. Nevertheless, a resolution has not been forthcoming. Without such resolution, the young-earth creationist cannot understand the stratigraphic record in an orderly way.

Another critical aspect of this question is revealed by Wise during an interview in *Bible-Science News* (1995, p. 18):

To my knowledge, virtually all creation geologists accept the entire Cenozoic as post-Flood. The real debate among us is whether the Mesozoic should also be seen as post-Flood. The European creation geologists tend to want to make the Mesozoic post-Flood, whereas Steve [Austin], Andrew Snelling, and I would put the Mesozoic as Flood.

The CCC model presents evidence showing that it is totally unrealistic to “accept the entire Cenozoic as post-Flood.” Not only is it Biblically unrealistic, it is also geologically unrealistic, assuming a young-earth model is used.

The stratigraphic record often depicts very limited ecological environments. Fossil plants and animals from radically diverse environments are rarely found mixed in random patterns. This factor was often overlooked or rejected by early creationists such as George McCready Price who strongly felt that the geologic record did not present an orderly pattern (1926, pp. 71–72).

Many creationists today realize the geologic record is much more orderly than Price ever imagined. Harold W. Clark, one of Price's own students, is an early example (1968, p. 42):

Then, too, I found that there was much more regularity to the stratified rocks than Price had recognized, and this, too, was developed by explaining this order and system as due to the burial of the ancient life zones rather than to a succession of life during long geological ages.

Clark credited the fossil order to the Flood's ability to bury flora and fauna in sequence of the biozones present. This concept was a great step forward as it acknowledged the general fossil sequence without giving it an evolutionary interpretation.

Nevertheless, well-known creationist geologist Snelling (1995, p. 162) speaks of:

...the creationist 'myth' that the geologic column is the product of an evolutionary/uniformitarian 'conspiracy' and so essentially doesn't exist/isn't real.... However, the physical reality of the strata of the geologic column cannot be ignored, as they do exist. The early geologists in Europe, for example, were able to physically trace the stacking of the continuous sequences of strata from country to country, and then later similar (and often identical) stacking of sequences was found on other continents. It is time for creationists to bury their 'myth', face up to the reality of the geologic record (not the time scale imposed on it, of course), and tackle the exciting task of building the Flood model of earth history based on that record.

Wise echoes these same conclusions about the consistency of the order of fossils in the stratigraphic column:

Some creationists for a long time have been arguing that 'there ain't no such thing as the geological column.' But all the creation geologists I know disagree with that... the creation geologists are pretty uniform in their belief that the stratigraphic column is a valid order. But we can't convince the lay creationists community of that.... It's an historical problem. It was George McCready Price's argument, and it's been repeated since then. But if you run up and down hills, looking at strata and beating on rocks, you'd be stunned by the consistency of the order (*Bible-Science News*, 1995, p. 18).

Watts (1984, p. 21) earlier had cautioned about drawing too much out of the Scriptural account of the Flood and thereby not allowing for the pre-Flood world as "a possible era of fossilization to be considered along with the Deluge year and the post-Flood era."

## CCC Model

The Creation/Curse/Catastrophe (CCC) model advanced in this paper acknowledges the reality of the order of the stratigraphic column. Among its postulates:

1. In agreement with the Flood Model: a young earth, a literal seven-day Creation Week, biozonation as a characteristic of nearly all newly created life forms, a world-wide Flood of great geologic importance, and limited genetic changes within each Genesis "kind." In contrast with the Flood Model: considerable pre-Flood geologic evidence is preserved in the stratigraphic record.
2. Genesis One and Two reveal life needing time to "fill" the earth,
3. The "Curse" on the pre-Flood earth was God's direct method of dealing with sinful humanity. It was progressive in intensity and left a fossil record of God's acts in history. The lessening of the Curse after the Flood is promised in the Noahic Covenant and results in God establishing human governments to administer civil crime punishments,
4. Geologic "Periods" are, in reality, ecosystems each having characteristic life forms. All "Periods" (ecosystems) were present *to some degree* on the earth immediately after Creation Week. Geologic events throughout the pre-Flood times locally stratified changing ecosystems (later interpreted as "Periods" by early geologists). Man's life-sustaining ecosystem ("Cenozoic") is seen in the CCC Model as starting geographically very small and expanding during pre-Flood times allowing the growing human population to eventually fill the earth. Not all ecosystems ("Periods") are seen as surviving until the Flood, and few except those of the "Cenozoic" appear to be post-Flood.
5. The "Periods" tend towards a similar worldwide stratigraphic sequence, because each local ecological succession tends to enlarge its food web, and this food web enlargement is "evolutionary" in appearance. "Evolutionary" geologic succession is actually a reflection of this ecological succession through the course of time since Creation Week (see Table I),
6. Fossil correlation between distant areas was made possible by the systematic changes of the earth's past ecosystems. Burial and fossilization of these ecosystems

Table I. The geological time scale in relationship to the CCC model.

| Eon                                                 | Eras                                      | Periods                              |                                                                                                                                                | Characteristic ecosystem                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------|-------------------------------------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                     | C<br>e<br>n<br>o<br>z<br>o<br>i<br>c      | Quaternary                           |                                                                                                                                                | This ecosystem is most characterized by the following types of life: Man, most mammals, and flowering plants/grasses (angiosperms) in great profusion. It is the ecosystem wherein humans can thrive and characterizes what is Biblically called “[Garden of] Eden.” It now dominates the earth whereas in the early earth it was only one of various ecosystems. Today, it contains remnants of the earlier ecosystems in many life-forms termed “living fossils” because in old earth, evolutionary theories, they have remained the same for long ages. The CCC model explains their continued existence as survivors from other created ecosystems which in the early earth covered large areas.                                                                                                                                                                                                   |
|                                                     |                                           | T<br>e<br>r<br>t<br>i<br>a<br>r<br>y | Neogene                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                     |                                           |                                      | Paleogene                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| P<br>h<br>a<br>n<br>e<br>r<br>o<br>z<br>o<br>i<br>c | M<br>e<br>s<br>o<br>z<br>o<br>i<br>c      | Cretaceous                           |                                                                                                                                                | This ecosystem is best known for the dinosaurs, the marine reptiles, and the flying reptiles. For most of the time, the dominant plant life consisted of cycads, conifers, ferns and other coarse herbage and succulent water vegetation that supplied food for reptiles.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                                     |                                           | Jurassic                             |                                                                                                                                                | In the Cretaceous strata, there is a noticeable change in vegetation from cycads, conifers, ferns, etc. to angiosperms. The CCC model interpretes this change of vegetation as an indication the surrounding “Cenozoic” ecosystem was expanding and beginning to invade the “Mesozoic” ecosystem. The result was a decline of the dinosaurs due to limited food supply and changing environmental conditions caused by geologic events of the pre-Flood Curse.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                     |                                           | Triassic                             |                                                                                                                                                | Except for possible Ark representatives, the reptile pre-Flood world may have been largely extinguished before the Genesis Flood Event.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                     | P<br>a<br>l<br>e<br>o<br>z<br>o<br>i<br>c | Permian                              |                                                                                                                                                | The “Paleozoic” ecosystem consists of many “Periods.” Much Paleozoic strata is marine in origin. A large amount of the sea life characterized by this ecosystem is now extinct or thought to be extinct. The trilobites that especially characterize the “Cambrian” comprise one obvious example. All these life-forms were created during Creation Week, but some forms dominated the early earth and later died out or greatly diminished in the ecosystem as the food chain matured. Biblically, this is the result of life heeding God’s command to “fill the earth.” In the pre-Flood earth as the various ecosystems changed due to geologic events, pressure from surrounding ecosystems, and changes within the Genesis “kinds,” etc., the ecologic successions were preserved in the geologic record and interpreted as immense time periods by early geologists using uniformitarian theory. |
|                                                     |                                           | Pennsylvanian                        |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                     |                                           | Mississippian                        |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                     |                                           | Devonian                             |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                     |                                           | Silurian                             |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                     |                                           | Ordovician                           |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                     |                                           | Cambrian                             |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Precambrian Eon                                     |                                           |                                      | Life-forms are relatively few and “simple” (algae, fungi, worms, etc.). Probably represents Creation Week/earliest post-Creation/Curse events. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

The CCC model proposes that the various geologic “Periods” are, in reality, different and geographically limited ecosystems with characteristic forms of life. Ecosystems with these characteristic life-forms were all present at the completion of Creation Week. The extent of each characteristic ecosystem (“Period”) must be determined by the geologic record. Through time, flora and fauna migrate, expand or diminish, change to new varieties within the restricted “kinds,” and, in general, tend to expand the capacity of each local food chain. This ecologic succession through time as geologic events preserved them in the time frames of Creation Week, pre-Flood Curse events, the Flood, and post-Flood happenings were wrongly interpreted by Darwin and others as evidence for the Theory of Evolution.

- resulted from the intensified Curse during the pre-Flood earth, the GFE, and post-Flood happenings,
7. The fossil record has many time indicators such as footprints which can only rarely, at best, be placed into the GFE itself and most often represent pre-Flood or post-Flood geologic events,
  8. According to the CCC model, three major *worldwide* unconformities in the fossil record could be expected: (a) the end of Creation Week, (b) the end of the pre-Flood world and the beginning of the GFE, and (c) the end of the GFE and the beginning of the post-Flood world. Between the (a) and (b) local unconformities may also be found in the abundant, pre-Flood fossiliferous record,
  9. The pre-Flood/GFE or GFE/post-Flood breaks cannot be expected at the same geologic “Period” worldwide and must be determined in each area through research.

Lack of proper understanding of the pre-Flood world is making location and/or recognition of the GFE within the stratigraphic record controversial with current Flood models. The CCC model is presented in hopes of finding a more accurate interpretation of the geologic record through incorporating a different Scriptural understanding of the nature of the pre-Flood world.

## Quantity and Placement of Life on Newly Created Earth

By the end of the Sixth Day, God had prepared the earth as a fit place for life. Klotz (1970, pp. 489–498; 1985, pp. 193–205) has nicely summarized how the solar system, the earth and its flora and fauna are all arranged in a way to make the earth extremely suitable for life.

To Adam and Eve God said: “Be fruitful and *increase* in number; *fill* the earth and subdue it” (Genesis 1:28a NIV). Although He could have, Scripture reveals that God did not immediately create a world full of people. He reveals creation of one male directly from the dust of the earth (Genesis 2:7) and then one female directly from one of Adam’s ribs (Genesis 2:21–23). Human habitation was centralized in the beginning and only spread as population increased and opportunity arose. Geologically, this means that human presence within the fossil record at any geographic location should not be expected unless there had been time and opportunity for human migration and the ecosystem would be one that could support human life. In addition, the longer life span for pre-Flood peoples would tend to delay the appearance of human fossils/artifacts in the fossil record.

Life forms other than Man were also created in limited numbers. They also needed time to increase in number

before other areas of the earth felt their presence. Notice specifically how the creation of sea creatures and birds is described: “Be fruitful and *increase* in number and *fill* the water in the seas, and let the birds *increase* on the earth” (Genesis 1:23 NIV).

God’s blessing on them, later repeated in His directive to humans, implies these creatures were restricted in number and location and required time to fill their ecological niches. In addition, life forms can expand into other areas only when the ecosystem of the other areas can support them with proper food and environment. This principle, incorporating hundreds of years of pre-Flood time and geologic events and resultant changing ecosystems, is fundamental to an understanding of the CCC geologic model.

While a restricted creation is not specifically mentioned in the Scriptures of land animals, we know by observation today—long after the redistribution of the animals after the Flood—that few animals actually have universal distribution. Klotz (1985, p. 135) speaks of six present-day areas of geographical distribution of plants and animals and mentions that “except for the earthworm and the ant, there are no plants or animals which are approximately universal in their distribution over the globe.” While a few other examples might be cited, such contemporary observations indicate biozonation should be a norm since Creation Week. Biozonation is commonly accepted as part of the current Flood model (Morris, 1974, p. 117.)

These built-in ranges of habitats result in limited mixtures of flora and fauna in each environment or ecological niche. These restricted habitats play important roles in determining what life forms are available for preservation as fossils in each area at any given time.

## Eden and Its Garden

Scripture provides some details regarding placement of Adam and Eve on the newly created earth. Genesis 2:8–9a informs us:

Now the LORD God had planted a garden in the east, in Eden; and there He put the man He had formed. And the LORD God made all kinds of trees grow out of the ground—trees that were pleasing to the eye and good for food (NIV).

Adam and Eve were placed in a garden with trees that furnished them food. The trees producing fruit “good for food” for humans are classified as angiosperms and are the characteristic flora of “Cenozoic” strata. Also, angiosperms “supply nearly all the plant food for the mammals that now dominate all other life upon the earth” (Dunbar, 1960, pp. 333, 336). Here is clear Scriptural evidence that at least this small portion of the newly created earth was “Ceno-

zoic" in its ecosystem/environment. *This would demand some "Cenozoic" strata dating from pre-Flood and/or GFE times.*

Where the Garden of Eden was located in reference to our modern-day political boundaries is unknown and open for research. The issue of Eden's extent and location of its Garden is critical and needs to be thoroughly researched. Its location provides a guideline of where to expect (or not expect, as the case may be) to find the earliest human remains in the fossil record. If the Garden had been preserved in the early fossil record, the CCC model predicts that Eden's location would be found on top of basement "Precambrian" strata and contain "Cenozoic" life forms, since clearly Eden is described as having plants and animals consistent with "Cenozoic" types.

We do not know from Scripture the exact geographic extent of "Eden," but the CCC model assumes this "Cenozoic" (angiosperm/mammal) land ecosystem was originally quite limited in extent at Adam's and Eve's creation. The geologic record may later prove useful in making this determination.

Only the area called "Eden" is assumed by the CCC model as having a "Cenozoic" environment at the end of Creation Week. And as the characteristic flora and fauna associated with this ecosystem created for Man expanded in area, surrounding ecosystems became greatly affected. For example, as angiosperms invaded the dinosaur ecosystem ("Mesozoic"), great changes occurred, as we shall later explore.

A basic postulate of the CCC model is that angiosperms and mammals (associated with humans from the ending of Creation Week) became more widely distributed as time passed in the pre-Flood world and human population increased and demanded a larger living area. Biozones expanded or contracted during pre-Flood time as environments changed due to geologic events, ecosystems matured, or other important factors such as migration. This point is crucial in evaluating the fossil record. And now we must examine some Scriptural reasons to expect fossil evidence from the pre-Flood world.

## The "Very Good" Earth Becomes Tainted

Genesis One concludes with the announcement: "God saw all that He had made [the previous six days], and it was very good" (v. 31). God was well-pleased with His handiwork, and rightly so, but something was about to radically change.

Adam and Eve were created in harmony with their Maker. Furthermore, God saw to it that their every need was supplied. In spite of this, they yielded to the temptations and lies of the serpent (Satan). Their sin resulted in a four-fold, broken relationship:

The result [of sin] was a fall in four different areas. The relationship between God and man was now broken.... The relationship between man and his fellow man was severed.... The bond between man and nature also was broken, with the ground producing thorns and thistles and the animal world no longer being benevolent (Genesis 3:17, 18). Man also became separated from himself.... (McDowell and Steward, 1993, p. 69.)

In the CCC model, we are principally interested in the effects of the Curse on the broken relationship between humankind and the earth itself and its ecosystems. The first result of the Curse is found in Genesis 3:17–19:

To Adam He [God] said, "Because you listened to your wife and ate from the tree about which I commanded you, 'You must not eat of it,' *cursed is the ground because of you; through painful toil you will eat of it all the days of your life. It will produce thorns and thistles for you...By the sweat of your brow you will eat your food until you return to the ground, since from it you were taken; for dust you are and to dust you will return*" (NIV).

Mankind's certain return to the dust is only one aspect of sin. One of the major emphasis of the Genesis Curse is on the ground, the earth itself. Sin breaks mankind's harmonious relationship with the earth and its creatures. Ecology and geology immediately become linked to the Curse. The pre-Flood world became an unpleasant dwelling place. The Curse made it a very different world from the "very good" one pronounced earlier at the conclusion of Creation Week.

## The Curse Intensifies

Later, when Cain killed his brother, Scripture reveals that the effect of the Curse would intensify:

Now you are under a curse and *driven from the ground*, which opened its mouth to receive your brother's blood from your hand. *When you work the ground, it will no longer yield its crops for you.* You will be a *restless wanderer* on the earth (Genesis 4: 10–12 NIV).

The Curse intensified: growing crops now became more difficult. Apparently, after Cain's sin, wandering and gathering became the norm for satisfying humankind's need for food. Something drastic seems to have happened to the pre-Flood earth's ecosystem. Paradise was truly lost. God spared Cain's life, but the earth itself provided the curse by driving Cain from the ground. Even in modern times, various events such as volcanism can disrupt food production and produce harsh environments (White and Humphreys, 1994). The CCC model postulates that the pre-Flood world was filled with many such disasters.

## Direct Divine Government

Cain grew very anxious thinking that a relative would kill him in revenge. God's response to Cain's concern holds an important Biblical principle about the pre-Flood world. When Adam and Eve sinned, God directly intervened and punished them. Later, when Cain killed Abel, God personally delivered the penalty. And when Cain worried that one of his relatives would take matters into his own hands, God's response is very revealing: "Not so, if anyone kills Cain, he will suffer vengeance [from Me] seven times over" (Genesis 4:15 NIV).

God not only personally meted out the punishment, but the punishment intensified as sin piled upon sin. And the punishment was directed at *the earth itself*. There is no mention of God using capital punishment prior to the Flood event. People seemed to automatically understand that God personally took revenge for sin by increasing the penalty (the Curse) on the earth. This seems understood by Lamech, because when he killed a man, he states: "If Cain is avenged seven times, then Lamech *seventy-seven times*" (Genesis 4:24 NIV).

Men prided themselves at fighting God and boasting about their evil deeds! In this regard, see Eusebius (1923, pp. 21–23.) In the long time span between creation and the GFE (at least 1656 years), Scripture tells us: "Now the earth was corrupt in God's sight and was full of violence. God saw how corrupt the earth had become, for all the people ["flesh"] on earth had corrupted their ways" (Genesis 6:11–12). It was a world of terror, violent people, and violent ecological disasters from the hand of God, ending in total human destruction at the GFE except for those in the Ark. Neither is there mention in the pre-Flood world of human government inflicting the penalty for civil crimes. That was yet to be authorized by God.

## A Change of Government

As the few survivors from the Ark were about to venture out into the post-Flood earth, for the first time the Lord institutes human government for purposes of punishing crime:

And for your lifeblood I [God] will surely demand an accounting. I will demand an accounting from every animal. And from each man, too, I will demand an accounting for the life of his fellow man. *Whoever sheds the blood of man, by man shall his blood be shed; for in the image of God has God made man* (Genesis 9:5–6 NIV).

This is the beginning of civil government empowered by God to keep the peace among peoples. St. Paul says in Romans 13:1–5:

Everyone must submit himself to the governing authorities, for there is no authority except that

which God has established [apparently referring back to Genesis 9:5–6, the beginning of nations].... For he is God's servant to do you good. But if you do wrong, be afraid, for he does not bear the sword for nothing. *He is God's servant, and agent of wrath to bring punishment on the wrongdoer* (NIV).

While civil governments (city states) may have existed without God's sanction prior to the Flood, they are only mentioned as a *God-given*, post-Flood development (Genesis 10). Hence, there is a Scriptural reason to suppose that God's pre-Flood punishments were much more severe in their ecological and geological extent than after He instituted human government in the immediate post-Flood world to melt out punishments for civil wrongs.

## Easing of the Curse

At Noah's birth, his father, Lamech, foretold the lessening of this Curse:

Lamech... said, "He [Noah] will comfort us in the labor and painful toil of our hands caused by the ground the LORD has cursed" (Genesis 5:28–29 NIV).

Lamech gives us a glimpse of the severity of the Curse in his day and the prophecy that the Curse would be eased in Noah's time. That it was eased is verified in the Noahic Covenant immediately after the Flood:

Then Noah built an altar to the LORD and...sacrificed burnt offerings on it. The LORD ...said in His heart: *'Never again will I curse the ground because of man, even though every inclination of his heart is evil from childhood. And never again will I destroy all living creatures, as I have done. As long as the earth endures, seed time and harvest, cold and heat, summer and winter, day and night will never cease* (Genesis 8:20–22 NIV).

After the GFE, God lessened the intensity of Curse upon the ground. In Revelation 22:3 we are told the Curse will only be totally rescinded at the establishment of the future new heavens and new earth. But for now, God has promised that never again will the total ecosystem of the earth (even the seasons) be disrupted as they had been. The diminished Curse today still involves local floods, volcanic activity, famines, tornadoes, earthquakes, etc. This present-day condition strongly implies much more intense geologic and ecologic activities on the ground-cursed, pre-Flood world. The present cannot therefore be considered the key to the past regarding geological *rates*.

God's Noahic covenant in Genesis Eight and Nine applies to all humanity until the end of time. It will only be revoked in a major way at the very end of time because "...the earth is defiled by its people [who have]...broken the everlasting [Noahic] covenant. Therefore *a curse* con-

sumes the earth....” (Isaiah 24:5-6, see also especially verses 1-6, 16-23 NIV). This next universal destruction will end with universal fire on the Earth (II Peter 3:10-13).

The GFE was the culmination of the intensifying Curse on the pre-Flood world. The universal Flood became a geologic benchmark in the ancient world. However, the GFE was not the first catastrophic event recorded in the fossiliferous record. Evidence for the Flood will vary locally, according to the CCC model, depending upon the ecosystem (“Period”) present at each locality at the time of the GFE.

### An Exceptional Time

The implication for the CCC model is clear. It postulates that the pre-Flood world was a time of *exceptional* Divine interventions upon the earth. Even in post-Flood times, when God takes a strong hand to show His displeasure over sin, floods, earthquakes, volcanic eruptions, plagues, etc. are cited in Scripture. The fiery destruction of Sodom and Gomorrah, the ecological events of the Exodus, the turning back of the sundial and Joshua’s long day are merely some examples of recorded post-Flood Divine actions.

It is also critical to notice that when God dealt with ancient Israel as a theocracy, He stressed that punishment on the Covenant people would be given with increasing intensity: “But if you will not listen to me and carry out all these commands...I will punish you for your sins *seven times over*....” (Leviticus 26:14, 18, 21, 24, 28 NIV). The final result of this increasing intensity would be a land wasted “...so that your enemies who live there will be appalled” (Leviticus 26:32 NIV). This increasing degree of punishment in order to bring them to repentance seems indicative of how the Lord has acted in history towards sin. The account of the pre-Flood world is brief in Scripture, but Divine activity appears to have been even more forceful in the pre-Flood world before God sanctioned human government to act on His behalf in dealing out punishments.

Strata from all geologic “Periods” have evidence of time indicators such as changing environments/ecosystems, footprints, nests, *in situ* growth, rain prints, trace fossils, fossil soils, etc. Young-earth creationists often acknowledge—in varying degrees—such time indicators in the post-Flood world. The CCC model allows ample reason to recognize them in the pre-Flood world as well.

### Other Geologic Implications

The question of geologic succession and strata correlation becomes easier to understand when the CCC model is applied. Not only is the earth viewed as very biozoned at the

time immediately after Creation, but the intensifying effects of the Curse over hundred of years of pre-Flood time provided ample reasons for systematic fossil and strata development. It is significant that evolutionary geologists recognize how *geologic fossil succession closely resembles ecologic succession today*:

At the present time, plant and animal succession occurs whenever newly vacated territory becomes available. Such opportunities arise after forest fires and the draining of swamps, and following the retreat of glaciers, and other similar natural events. In the dim geologic past, however, no outside reservoir of life existed, and not all the space and energy resources could be utilized immediately because nothing had yet evolved to utilize them. At one time, for example, the lands were barren of vegetation; many geologic ages ran their course before plants evolved that could live on dry land. *The gradual and lengthy process whereby the energy sources of our planet were utilized successively by plants and animals is called geological succession. It differs in no fundamental way from the ecological succession that occurs today when a new environment appears, except that it requires much more time* (Stokes, 1966, p. 370, emphasis mine).

The CCC model removes the immense time assumptions and views fossil, geologic succession as evidence of sequential environmental/ecosystem changes since Creation. Many of these changes seemed to be related to the cursed, pre-Flood earth. And, contrary to the evolutionary assumptions, life was readily available to move into adjacent disrupted ecosystems. Even in evolutionary thinking, migration has long been credited for the sudden and enigmatic fossil appearance of the angiosperms in the “Cretaceous” (Stearn et al., 1979, p. 339).

Migration has also long been suggested as an explanation to the sudden appearance of the larger mammals in the strata directly above the last of the dinosaurs fossils (Le Conte, 1905, pp. 541–542). Only a few small mammals are known to have existed in the dinosaur ecosystems (interpreted as “Periods” according to ancient earth geology). But this is exactly what the CCC and other creation models would expect since the larger mammals and the large reptiles lived in two distinct ecosystems and were unable to exist together. After the demise of the dinosaurs in each area, the existing larger mammals from surrounding “Cenozoic” ecosystems could, and did, safely migrate into the vacated ecological niche left by the dinosaurs.

Furthermore, it is important to understand that the dinosaurs are believed to have existed in limited coastal environments/ecosystems around the world:

The duckbills [dinosaurs] appeared in the late Cretaceous.... In whatever part of the globe they were, they lived on the coastal plains of one sea or an-

other. (As did all the dinosaurs.) We don't know whether they, or any other dinosaurs, also lived in inland areas, because there are no geological formations that preserve inland habitats from the dinosaurs' time (Horner, 1990, p. 72, see also p. 196).

Here is the strongest of indications that the dinosaurs inhabited only a narrow ecological niche worldwide. And equally important is the faulty conclusion that "no geological formations...preserve inland habitats from the dinosaurs' time." This is made on the basis that geologic "Periods" are distinct in time. In the CCC model, habitats other than coastal plain environments would also be forming geologic records simultaneously with the "Mesozoic" coastal plains. The evolutionist would miss their significance. These inland geological formations would be assumed by the evolutionist to be of another time.

The dramatic change to angiosperm vegetation in the dinosaur environment (from "Triassic and Jurassic" to "Cretaceous") may have greatly contributed to the doom of the famous reptiles while at the same time preparing the way for the migration of larger mammals (and man) into those areas. The diet of almost all of the dinosaurs is not thought to have included angiosperms (Stokes, 1966, p. 263).

The significance of this change in food supply in the "Cretaceous" becomes more evident when factoring out immense ages and having ecosystems change in the much shorter time-span in the turbulent, pre-Flood world. The CCC model's interpretation of the fossil record indicates that many types of dinosaurs may have become extinct even before the commencement of the GFE due to a change in the food supply.

## Correlation by Fossils

Most areas on the earth have only certain geologic "Periods" represented. The total geologic record is pieced together in an evolutionary scheme from around the world using the known principles of superpositional stratigraphy, biostratigraphy, and radiometric dates. Years ago, Henbest (1952, p. 305) summarized the situation:

To reconstruct the history of epochs and periods requires the assembling of records from every known province of the world and connecting them in the proper time sequence. This process not only calls into play every known device of age determination and correlation and cross-checks, but involves the handling of enormous quantities of complicated data whose quality runs the entire gamut of conjecture, speculation, and well-reasoned induction.

Traditional Flood geology has tended to reject the idea of correlation by fossils. Conversely, conventional, evolu-

tionary geology thrives on it. The CCC model proposes there is a "seed" of truth buried deep within the conventional thinking. But the plant that grows out of it looks neither like the conventional model nor the traditional Flood model. The evolutionary-ancient earth theory allows too much time. The Flood model by placing most of the fossiliferous strata into the one-year GFE does not allow enough time.

Evolutionary geologists today acknowledge that more and more catastrophic happenings have been recorded in the strata. Nevertheless, their demand of an ancient age for the earth continues unabated (Ager, 1981; Huggett, 1989; Donovan, 1989; Berggren and Van Couvering, 1984; Harris, 1990). The conventional solution is to account for most of geologic time in the "nothingness" of bedding planes and erosion surfaces. Conversely, the traditional Flood model has difficulty pinpointing the Flood's stratigraphic location. Some of this is due to the recognition that strata "time indicators" are difficult to fit into a one-year catastrophic Deluge. Also creationist geologist Snelling (1995, p. 162) graphically pointed out his belief that creationists have not adequately explained the reason for the general, orderly succession of fossils.

## Homotaxis and Synchronism

None other than the "bulldog" of Darwin, Thomas Henry Huxley, an early champion of the theory of Evolution, raised the fur on every respectable geologist when he questioned how correlation by fossils was being handled. As related by Woodford (1963, p. 75):

The presence of successive and dissimilar fossil faunas in the stratified rocks of northwestern Europe was demonstrated by William Smith and his contemporaries as early as 1815. Some forty-five years later, Darwin convinced the scientific community that evolution of stratigraphically lower faunas into higher ones is more probable than alternating creations and extinctions. Soon after the "Origin of Species" appeared, however, Thomas Henry Huxley (1862, 1870) challenged the assumptions, already well established in his time, that two widely separated sedimentary rock masses containing closely similar faunas or floras must have been deposited at the same time. He asked for a sharp distinction between *homotaxis* (identical or similar succession of faunas or floras) and the kind of correlation that implies *synchronism* (identical age for each correlated faunal or floral pair). Huxley (1862, p. xlv) asserted that 'a Devonian fauna and flora in the British Islands may have been contemporaneous with Silurian life in North America, and with a Carboniferous fauna and flora in Africa.'

This shocked the evolutionary world coming from the mouth of Huxley and is still considered the height of geologic heresy over 130 years later. Huxley's geologic "heresy" had hit too close to home. The reader is encouraged to read what Huxley (1898, pp. 272–304, 340–388) said in addresses before the august bodies of the Geological Society (1862) and the Meeting of the British Association for the Advancement of Science (1870).

This danger of confusing *homotaxis* and *synchronism* (Huxley's terms) is at the root of the correlation problem. Creationists need to keep their eyes open to a potential vast pre-Flood application, as well as post-Flood events. Geologic literature is full of concern regarding the effect of migration on correlation. True, this concern is often dismissed by evolutionists because of the old-earth belief. It is assumed that millions of years are available for flora and fauna to become widespread within each envisioned "Period," thus largely negating migration correlation concerns. Allan, for example, rejected Huxley's "bomb-shell" because "...geological chronology [has shown] the rate of dispersal of marine organisms may safely be neglected..." (1948, p. 2). Nevertheless, Allan acknowledged the "fundamental assumption" of "geological contemporaneity is the same as chronological synchrony...is current today, it is still a 'constant source of gratuitous speculations, and it is still logically unsound'" (1948, p. 2). Allan saw the need for paleoecological studies in geology. Paleoecologic studies have indeed become standard in geologic research since then.

The traditional Price Flood model overlooks the importance of paleoecological and geological changes over time or of migration because of its focus on the one-year Deluge. The CCC model uses ecological changes and migration as positive factors in evaluating both pre-Flood and post-Flood times. It is through such studies that stratigraphic boundaries for the GFE can eventually be better determined for each region on the earth.

Microevolutionary changes (those limited changes which occur within the created Genesis "kinds") are often the basis for strata correlation. In the CCC model the geologic activities of particularly the pre-Flood times (and to a lesser degree, the post-Flood times) allow opportunity for development of local stratigraphic sequences as "kinds" reproduce new varieties, die out, migrate, and ecosystems change. Floras and faunas within their respective ecosystems would be expected to diversify. Later they could migrate to surrounding ecosystems when the food web expanded and could now support them.

Furthermore, since ecological succession follows certain set patterns, we would expect worldwide similar patterns being detected. Ecological succession in each locality allowed the evolutionist's rationale for fossil correlation over great distances

## Tracks and Nests

Various strata worldwide clearly show evidences of time passing. For example, it is now known that strata from the dinosaur ecosystem ("Mesozoic") are replete with billions upon billions of dinosaur footprints found in *distinct* paleoenvironments, in *multiple* track layers on top of each other in many areas of the world (Lockley, 1991, p. 125). Layers of tracks may extend over thousands of square miles, yet follow definite paths around paleo-lakes or epeiric seashore environments (Lockley, 1991, pp. 83–138). Dinosaur nests are also increasingly found. Ingenious explanations notwithstanding, a satisfactory answer has not been found in traditional Price Flood geology on how such multiple layers of tracks and nests could have been preserved during the GFE or post-Flood events. Flood geologists have attempted to place such time indicators in the GFE (at all stages, you name it!) or in the post-Flood world (CRSQ, 1996, pages 231–239; See also the special issue of *Creation Ex Nihilo Technical Journal*, volume 10 [Part 1], 1996).

The CCC model would place the North American "Mesozoic" strata with its dinosaur fossils, tracks, nests, etc. as *pre-Flood*. It is rightfully noted that a "mighty erosive event" has left the strata containing the dinosaur nests and remains as only "erosional remnants" (Oard, 1996, p. 238). The CCC model would interpret the large, regional erosion as *the* continental evidence of the GFE. (Deposition is probably off the continent—see Figure 1 for what large floods in post-Flood times have done in this regard.) When dinosaur tracks and nests are seen as preserved from pre-Flood events, the whole question is more simply understood. The overall nature of the tracks and nests display a time element fundamentally foreign to the one-year Flood event. *Furthermore, placing vast amounts of strata with dinosaur tracks, nests, etc. as post-Flood creates unrealistic geological implications for a world in which the Curse is specifically said by the Scriptures as lessened.*

## The GFE and Stratigraphy

At Adam's creation we should also expect to find strata present that had been formed during Creation Week. It should never be overlooked that much happened geologically during Creation Week before Adam's creation. Such Creation Week created strata later provided raw material for geologic events associated with the Curse on the earth. Although the Flood violently affected the land, the CCC model predicts that much pre-Flood strata survived the GFE.

We should expect the GFE to record, as a minimum, great erosion (and probably often offshore deposition)

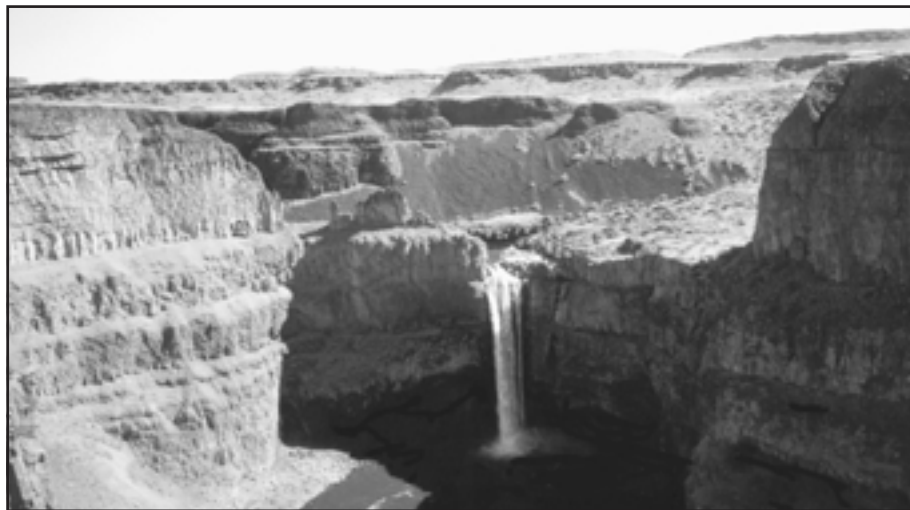


Figure 1. Palouse Falls in Southeastern Washington State is a minute reminder of post-Flood “Ice Age” floods that severely eroded out thousands of square miles of basalt and loess (thought to be wind deposits). It has been estimated that waters “raged 100 feet above land shown here” at Palouse Falls (Parfit, 1995, p. 58). The waters from Glacial Lake Missoula in western Montana contained the equivalent of the combined total of present-day Lakes Erie and Ontario. When the ancient ice dam was breached, the waters poured in a few days across parts of eastern Washington and down the course of the Columbia River westward into the Portland Basin “...and boomed out to sea” (Parfit, 1995, p. 58) leaving some deposits along the way. Although large in comparison to modern-day floods, the event was small in comparison to the Genesis Flood and shows we might expect the GFE to leave grand erosional evidence in many areas.

brought about by 40 days and nights of rain that created huge runoffs on the land areas. In contrast to the rapid water rising at the beginning of the Flood, Scripture noted how gradually the Floodwaters recessed. Other GFE geologic evidences would include volcanic activity, additional plate movements (the CCC model assumes periodic rapid plate movement at various times throughout the pre-Flood world as well as the GFE itself), etc. Forty days and nights of rain may have doomed most humans and land creatures to death by drowning and decay in the Floodwaters without continental burial, and hence the apparent lack of Flood-related fossils.

Research will have to show how widespread the “Eden” ecosystem (“Cenozoic”) had become by the GFE. Was it already worldwide? The Cenozoic landscape is now nearly universal on the earth with small exceptions.

Remnants of “earlier” ecosystems (i.e., Paleozoic and Mesozoic) still exist on the earth today. The most recent finding of such a remnant is the Wollemi pine—previously thought by scientists to be extinct for 150 million years—in an isolated 1.2 acre grove in a rain forest preserve 125 miles from Sydney (Anderson, 1994, p. 5). Here is a tiny “Mesozoic” plant ecosystem (it has been labeled the

“Jurassic Bark”) in modern-day Australia. It appears to have re-established itself in a limited way after the Flood.

Much of the world at the time shortly after man’s creation appears to have been something other than “Cenozoic” (mammals/ angiosperms) since large areas of the world have “Paleozoic” or “Mesozoic” strata directly on top of basement Precambrian. It is hoped that further research will refine this CCC model and in the process supply young-earth creationists with a better interpretation of the world’s geologic record.

## Acknowledgments

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point out that Erich von Fange (1990, 1994) has written some excellent general books on the effects of the Curse. Special thanks as well to Marji, my wife, for her immense patience over the years, her welcome encouragement, her listening ear, and her coining the name for the CCC model. And, thanks to Him who, in His own time and in His own way, provided a “window of opportunity” for the author to write and publish on a subject of interest since high school days. “Praise the LORD...He has caused His wonders to be remembered...He remembers His covenant forever” (Psalm 111:1, 4–5 NIV).

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## Submarine Volcanism

### Part I—Subaqueous Basalt Eruptions and Lava Flows

Carl R. Froede Jr.\*

#### Abstract

For many years significant differences were thought to exist in the form of basaltic lavas generated in subaerial and subaqueous environments. Only with the advent of modern oceanography and marine geology toward the middle the 20<sup>th</sup> century have uniformitarian geologists begun to understand the significance of subaqueous volcanic settings. Young-earth creationists have generally been unaware that high-volume lava flows and explosive-erupted ba-

saltic volcanic rocks extruded in a subaqueous setting are practically identical to those formed in a subaerial environment. This knowledge opens new possibilities within the young-earth Flood framework in the interpretation of basaltic volcanic strata found in the terrestrial stratigraphic record. While not all continental-based basaltic strata originated in an underwater setting, a more careful examination is now warranted.

#### Introduction

Basalt is identified as a dark-colored extrusive igneous rock, composed of calcium plagioclase and pyroxene. It contains little to no silica, and high levels of magnesium and iron. It is the most common volcanic rock on the earth occurring across the continents and flooring the world's oceanic basins. Differences were once thought to exist between subaerial and subaqueous basaltic lava in both eruptive style and resulting morphology. Until recently, little has been known of its subaqueous eruptive style or emplacement conditions due to its remote location from direct human observation (Cashman and Fiske, 1991; Griffiths and Fink, 1992a; Tazieff, 1972; Walker, 1992). Modern scientific knowledge of the processes by which basaltic lava erupts and behaves in an underwater setting has increased considerably within the past 45 years (Menard, 1964; Williams and McBirney, 1979). Only since the advent of deep-sea exploration, using the deep-sea submersible, has man finally been able to examine first-hand the processes and products of various subaqueous volcanic environments (Ballard, Bryan, Heirtzler, Keller, Moore, van Andel, 1975; Lonsdale and Batiza, 1980; Renard, Hekinian, Francheteau, Ballard and Backer, 1985; Smith and Batiza, 1989). Other important deep-sea volcanism research tools used are geophysics and side-scan sonar coupled with dredged rock samples for characterization and confirmation (Batiza, Fornari, Vanko, and Lonsdale, 1984; Lipman, Clague, Moore, and Holcomb, 1989). Re-

search continues into how basaltic lava erupts and behaves subaqueously.

Historically, continental silicic volcanism (e.g., non-basaltic) is typically viewed by uniformitarians as having occurred within a subaerial setting. The models used to study volcanic strata are compared to modern subaerial volcanic eruptions such as have occurred at Mount St. Helens, Mount Pinatubo, and El Chichon. Similarly, finding basaltic lava flows on the continents also typically invokes a subaerial setting (Ragland and Rogers, 1984). For example, the majority of the Columbia River Basalt Group flows are interpreted by most uniformitarians as having occurred over the course of millions of years within a subaerial setting (Hooper, 1982, 1997; Reidel and Hooper, 1989), and basalt lava flows in Big Bend National Park are also believed to have been erupted and emplaced in this same manner (Maxwell, 1968; Maxwell, Lonsdale, Hazzard, and Wilson, 1967).

Within both types of historic volcanic settings (i.e., subaerial and subaqueous) young-earth creationists do not have the same liberties with regard to time and energy as do the uniformitarians. We generally regard the majority of the Earth's stratigraphic record as having formed during the global Flood of Genesis (Froede, 1995, 1998a; Froede and Reed, 1999; Reed and Froede, 1997; Reed, Froede, and Bennett, 1996). One can immediately note the impossibility of young-earth creationists invoking the same millions of years of continental subaerial volcanism as do the uniformitarians within their model of Earth history. We must look for other means in which to explain and define Earth history within our Biblical framework. Submarine

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volcanism is both a relevant and important component of our model.

## Subaerial to Subaqueous Basaltic Lava Flows and Products

For many years geologists have known of changes in basalt lava morphology as it flowed from the subaerial environment into the subaqueous. This change is expressed by the formation of hyaloclastites, vitric breccia, and where flow is sufficient to continue underwater, basalt pillows (Furnes and Sturt, 1976; Jones and Nelson, 1970). In many instances this interaction with water is violent and results in four primary processes that generate volcanoclastic materials (Kokelaar, 1986):

...(1) magmatic explosivity, including accelerated extrusion resulting from rapid vesiculation; (2) explosive expansion and collapse of steam formed at magma-water contact surfaces... (3) steam explosivity resulting from enclosure of water in magma, or entrapment of water close to magma... (4) cooling-contraction granulation. These processes commonly occur together, and many enhance one another.

Where water is involved in terrestrial eruptions the resulting violent volcanic products differ slightly from those produced under subaqueous eruptions (Kokelaar, 1986; Ricketts, Ware, and Donaldson, 1982).

Basaltic eruptions which occur in relatively shallow water form hyalotuffs (Cousineau, 1994; Dimroth, Cousineau, Leduc, and Sanschagrin, 1978), and hyaloclastites (Honnorez and Kirst, 1975). The welding of erupted volcanic fragments is thought to more likely occur in a submarine rather than subaerial setting because dispersal is less rapid and fragments can be convectively reentrained while still hot, even though they have been quenched (Gill, et al., 1990; Orton, 1996).

Where violent subaqueous reactions with water do not occur hyaloclastite formation is minimized and basaltic lava typically flows along the submerged sloped surface (Moore, Phillips, Grigg, Peterson, and Swanson, 1973). Eventually these underwater flows terminate and the resulting exposed basalt surfaces are subject to both chemical and mechanical weathering.

## Subaqueous Basaltic Lava Flow Pillows

Probably the most common form of basalt erupted underwater occurs in the form of pillows (Figure 1). These features occur where the rate of effusion is considered to be of low volume. Underwater photography of an ongoing basalt lava flow reveals a lava tube which lengthens as it flows un-



**Figure 1. A block of basalt lava in pillow form taken from Copper Chief mine in Arizona. This basalt is associated with hydrothermal-produced mineral deposits and likely reflects events and processes associated with the Flood (See Froede, Howe, Reed, and Meyer, 1998). Jerome State Historic Park Museum.**

til it finally appears to run out of energy (see photographs in Moore, et al., 1973; Moore, 1975). The final form of these basaltic lava flows are pillows. Formal studies of these structures have been undertaken by Lewis (1914), Moore et al. (1973), Moore (1975) and Ballard and Moore (1977) where they found that lava pillows formed by the spreading cracks on the surface of propagating, branching, and curving lava tubes. The identification of basalt lava pillows is considered a definitive indicator that the lava originally formed within a subaqueous environment. According to Fisher (1984, p. 8) pillowed lava flows and hyaloclastites are:

...prime evidence of subaqueous environments. In areas where fossils or other evidence (e.g., turbidites, carbonates, and facies associations such as shelf, slope or submarine fan) are absent, pillow lavas are commonly the only evidence of a subaqueous environment.

Subaqueously erupted basaltic lava is not limited to the oceanic seafloor. Submarine eruptions and flows have also been documented on the continents having formed beneath glaciers and lakes. The resulting lavas which occur within these unique settings have been studied to determine if certain features in pillow lavas could be used as depth indicators (Jones, 1969). Some researchers have proposed that the multiple-rind structure in pillow lavas can serve as an indicator of shallow water eruption (Kawachi and Pringle, 1988). Basaltic magma chemistry is also believed to constrain the dimensions of basaltic lava pillows extruded in shallow water (Fridleifsson, Furnes, and Atkins, 1982). Interestingly, these subglacial and sublacustrine extruded basalts exhibit morphological features comparable to those which form in the oceans.

Studies on pillow morphology have been undertaken over the past decades to determine what forces, processes, and components affect and alter their form. Yamagishi (1985) found a direct relationship between pillow form and lava flow direction. Walker (1992) investigated pillow size variation and found that pillows have linear dimensions five times greater in one direction as a function of the angle of slope. The relationship between ophiolite complexes and three styles of pillow lava has been investigated and reported from southern Chile (deWit and Stern, 1978). They identified one type of pillow formed by non-explosive submarine effusion, another by magmatic intrusion into a preexisting aquagene tuff which resulted in explosive eruption, and the third pillow form occurred within dikes (p. 55).

Unfortunately, many scientists are unaware of the fact that subaqueously extruded basalt lava flows can occur in forms other than just pillows. However, this information has only recently become widely known.

### Other Forms of Subaqueously Extruded Basalt

Extruded submarine basalt flows are not limited to pillow form. Where basaltic lava has erupted underwater it derives its shape from many factors such as the rate of eruption, crystalline content of the melt, slope surface, and temperature. This results in basaltic lava morphology variation from pillow lava to sheet flows to channel flows to brecciated blocks derived from the destruction of the individual pillow lobes (Carlisle, 1963; Cousineau and Dimroth, 1982; Goldie, 1983; Hargreaves and Ayres, 1979; Jackson, 1980; Ricketts, Ware and Donaldson, 1982; Yamagishi, 1991a; 1991b).



Figure 2. Basalt lava flows along channels across the surface of older flows. The chilled lavas are all pahoehoe lava flows. From Kilauea, Hawaii.

Interesting features such as basalt pillars (some up to 45 feet high) form in the deep-sea where the top surface of a lava lake chills, only later to collapse due to the withdrawal of the subterranean molten lava (Ballard, Holcomb, and van Andel, 1979; Francheteau, Juteau, and Rangan, 1979; Gregg and Chadwick, 1996). These features reflect active magmatic activity. Extensive plumbing must be available in the subsurface to allow for the large volumes of lava to be extruded and later withdrawn to form lava pillars.

Basaltic lava domes are considered unique features within the submarine environment. They are believed to be the product of low effusion temperature and rapid convective heat loss which directly affect the magma rheology and influence the final dome-like structure (Smellie, Millar, Rex, and Butterworth, 1998). These features are formed as basaltic lava is pulse-injected into the overlying mass of volcanic rock and hyaloclastites (McPhie, Doyle, and Allen, 1993). Basaltic lava dome-shaped seamounts are also believed to be common on the seafloor (Bridges, 1995).

Subaqueously extruded basaltic lava morphology varies considerably. In a recent paper, Kennish and Lutz (1998, p. 63) identified five different forms of submarine lava flows along mid-oceanic ridges: 1) Pillows, 2) lobates, 3) lineated sheets, 4) folded sheets, and 5) jumbled sheets. Their article is the most thorough review of subaqueous basaltic lava processes and features to date, and should be carefully reviewed when investigating basaltic lava flows as candidates for subaqueous emplacement. Bonatti and Harrison (1988) noted that variations in basaltic lava morphology are linked to eruptive style (see Table I).

Table I. Summary of deep-sea eruptive styles (from Bonatti and Harrison, 1988, p. 2968).

|                    |   |                                                 |
|--------------------|---|-------------------------------------------------|
| Quiet Eruptions    | { | Lava Lakes (Pillars)                            |
|                    |   | Sheet Lavas { Smooth<br>Lobated<br>Corrugated   |
|                    |   | Pillow Lavas { Spherical<br>Elongated<br>Broken |
| Reactive Eruptions | { | Pavingstone Lavas                               |
|                    |   | Hyaloclastites                                  |

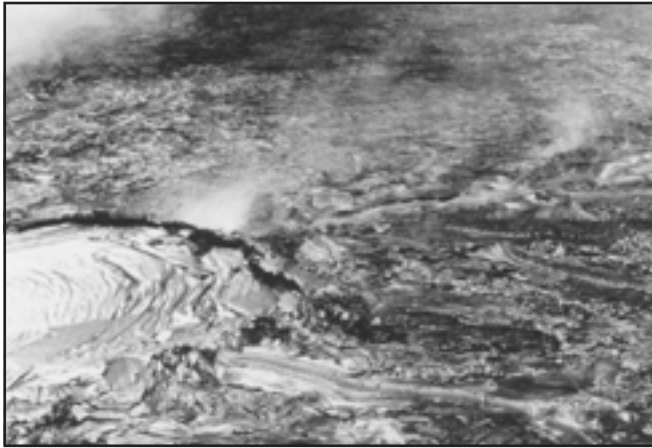


Figure 3. This set of complex basalt lava flows exhibit the smooth surface of pahoehoe style lavas. This style is believed to reflect a high volatile content, rapid rate of flow, and high lava temperature. From Kilauea, Hawaii.



Figure 4. A massive aa lava flow (Bonito lava flow) found at the base of Sunset Crater in Arizona. This style lava has a rough and sharp surface which is believed to reflect low volatile content, slow flow rate, and low lava temperature.

### Submarine Basalt Lava Flows and Their Similarity to Subaerial Lava Flows

Where large volumes of basaltic lava is erupted into a subaqueous setting, it flows away from the vent in a manner similar to what occurs in a subaerial environment (Figure 2). These submarine extruded lavas typically occur as either pahoehoe or aa style flows (Figures 3 and 4). According to the Basaltic Volcanism Study Project (BVSP) the subaqueously extruded basalt in many cases resembles its subaerial counterpart:

This is suggested by gross similarities between forms observed in widely separated locations, and by their similarity to many subaerial volcanic features. ... Overall, submarine lava surfaces bear a strong resemblance to subaerial pahoehoe lava (1981, p. 732). [italics mine]

This is no isolated comparison as numerous investigators have documented the similarities between the physical features of subaqueous flows and subaerially emplaced pahoehoe (Hon, Kauahikaua, Denlinger, and Mackay, 1994; Jones, 1968; Wells, Bryan, and Pearce, 1979). Lonsdale (1977) discovered abyssal pahoehoe lava coils 1.5 miles beneath the ocean surface at the Galapagos rift which remarkably resemble subaerial flows.

Submarine basaltic aa lava flows also closely resemble its subaerial counterpart (Kennish and Lutz, 1998; van Andel and Ballard, 1979). Differences between the subaqueous and subaerial forms are in the strength of the rock, the subaqueous variety appears to be less competent (Ballard, Holcomb, and van Andel, 1979).

### Scoriaceous and Vesiculated Basalts in Shallow and Deep-Water Settings

Shallow submarine eruptions can be quite violent (Macdonald, 1972; Thorarinsson, 1967). Explosive subaqueous eruptions generate scoriaceous breccia lavas resembling their counterparts in subaerial environments (Kano, Orton, and Kano, 1994) [Figures 5 and 6]. This is not surprising for shallow water eruptions, but is not expected in a deep water setting due to the confining pressure of the overlying water (Kokelaar, 1986). However, scoriaceous breccia is believed to have formed in water almost 6000 feet deep (Gill et al., 1990, p. 1214). This finding runs contrary to what has been predicted and described by Honnorez and Kirst (1975). They suggested a simple scheme in which to differentiate deep water basaltic eruptions from those which likely occur in shallow water by proposing to identify deep water erupted basalts as hyaloclastics (non-explosive granulated volcanic glass) and shallow water basalts as hyalotuffs (pyroclastic fine-grained matrix with accompanying scoriaceous breccia formed by explosive phreatomagmatic and phreatic eruptions).

Lackschewitz, Dehn, and Wallrabe-Adams (1994) invoked a complex eruptive style to explain scoriaceous and highly vesiculated basalts which they found on the submerged and active Kolbeinsey Ridge north of Iceland. Their model remains to be thoroughly tested as it requires a more explosive deep-water eruptive setting than documented in modern times. According to Sparks, Bursik, Carey, Gilbert, Glaze, Sigurdsson, and Woods (1997, p. 232) deep-sea eruptions of basaltic magma create:



**Figure 5.** Massive (3 to 5 foot diameter) scoriaceous blocks of basaltic lava associated with the Merriam Crater lava flows which created the Grand Falls on the Little Colorado River.

... a slurry of glass shards, seawater and possibly steam. However, because of the generally low volatile contents of most basaltic magmas and the great water depth (>1200 m) [>3960 ft], it is likely that the eruption fountains are denser than the surrounding seawater and will rise primarily as a result of their initial momentum. Collapse of these fountains cause shard-rich (hyaloclastite) gravity flows that move away from the source and deposit bedded hyaloclastite layers. (Brackets mine)

Explosive submarine eruptions are tied to three components (1) The depth (and corresponding hydrostatic water pressure) of the water column, (2) the composition of the magma (especially the amount of volatiles), and (3) the extent of interaction between magma and overlying water (Fisher, 1984). However, an important and commonly predefined component within the uniformitarian model of subaqueous volcanism is their understanding and application of the energy involved in a subaqueous eruption. Their model takes present eruptive rates and projects them back in time, with the foregone conclusion being low-volume and low-energy subaqueous eruptions occurring throughout most of earth's long history. Violent large-scale eruptions are only expected and predicted in shallow water settings. I believe this to be a serious failing of the uniformitarian model. This uniformitarian model deficiency is borne out in the relationship of volcanic fragmentation and explosivity as relate to water depth which is explained below.

The volcanic fragmentation depth (VFD; Fisher and Schmincke, 1984) or the pressure compensation level (PCL; Fisher, 1984) is the maximum depth at which explosive eruption fragmentation can occur. Originally, McBirney (1963) predicted that explosive eruption of basaltic magma would not likely occur below 1500 feet beneath the water surface. According to Fisher (1984, p. 8),



**Figure 6.** Smaller size (1 to 3 feet in diameter) scoriaceous blocks of lava from the SP lava flow in Arizona.

the PCL depth for most mafic basaltic magmas is less than 1650 ft. However, subsequent studies have shown the VFD/PCL to range from 660 to >3300 feet as a function of magmatic composition, volatile content, and temperature (Kokelaar, 1986; Lackschewitz et al., 1994). This wide range implies that fragmented shards and breccia of basaltic lava can occur at greater depth than is presently realized or generally acknowledged by many submarine volcanologists. It appears that violent basaltic eruptions occur within the deep sea sufficient to create pyroclastic rocks not predicted as typical to that depth range. Further study is warranted in this area of submarine volcanology.

## Flow and Joints Features in Submarine Lavas

For several decades geologists have been interested in basalt flow direction primarily in an effort to identify the source vent which in many cases was buried by the lava flow. Waters (1960) studied several subaqueous flows along margins of the Columbia River Basalt Group where he identified features which could be used to determine the original flow direction. The transition of basalt lava flowing from air into water is also believed to have a structural expression, one which can help decipher both the environment and the flow direction in which it was emplaced (Jones and Nelson, 1970). Additional research into lava flow direction indicators is still required as at present there is no single means by which flow direction can clearly be established.

The rapid cooling of subaqueous basaltic lava is believed to result in the formation of columnar jointing similar to subaerial flows, as well as "cube jointing" which closely resembles the entablature structure of the Columbia River Basalt Group flows (Bergh and Sigvaldason,



Figure 7. Columnar basalt showing the entablature structure. Located near the Coberg Hills, north of Eugene, Oregon. Photograph by Fred A. Brauer.

1991; Long and Wood, 1986)[Figure 7]. Also see Snelling and Woodmorappe, 1998, p. 539. Jointing along with other tensional features which form within basalt flows (both subaerial and subaqueous) can help the researcher attempt to determine whether water played a significant role in the cooling of the basaltic lava flow (DeGraff, Long and Aydin, 1989).

### Rate of Extrusion

Originally, scientists postulated that submarine basaltic lava only extruded into pillow forms. However, all of this changed when oceanographers and marine geologists began to examine both slow and fast-spreading oceanic ridges on the deep-sea floor:

The smooth-surfaced lava plains constitute the principle difference in volcanic morphology between these faster-spreading ridges and a slower-spreading ridge. These lava plains may be 0.5 km or more in width and may extend 2–3 km along the length of the valley. These plains have been provisionally called “sheet flows” by Ballard *et al.* (1979). Surfaces of some flows commonly consist of flattened pillows, giving a low, hummocky relief; other surfaces are flat, featureless, and divided into polygonal plates 2–10 m in diameter. This flat skin may be deformed and wrinkled to various degrees. This may produce intense crumpling and fracturing of the surface, or may result in whorls and ropy coils. *The resulting flow-forms strongly resemble the various forms observed on smooth-surfaced subaerial pahoehoe lava and lava lakes.* The various flow-forms do not necessarily delineate distinct flows, but may grade one into another on the surface of a single flow, and evidently result from different degrees of deformation of an ini-



Figure 8. An active vent expelling volatiles from basalt lavas flowing beneath this structure. With sufficient volumes of basalt lava this vent could erupt and produce lava. Note the small volume of lava around the base of this vent which flowed toward the left side of the photograph.

tially smooth skin during progress of the flow. *The formation of these sheet flows is attributed to relatively high rates of extrusion compared to that required to form pillowed flows.* (Basaltic Volcanism Study Project, 1981, p. 740) [italics mine]

A large-scale eruption of basalt from an active vent can produce tremendous volumes of lava (Figure 8). According to Cousineau and Dimroth (1982, p. 98), subaqueous basaltic lava can flow from the source vent in different ways:

Whereas sheet-flood flows advance simultaneously over their whole front, channelized flows advance by the budding and ramification of small flow lobes. Thus, principal channels divide into major distributories which by bifurcation and ramification deliver the lava to the flow front. Only part of the flow front is active at any time and only the lava in channels and distributories delivering lava to the active part of the flow front is in movement at the same time. A channelized flow then takes the form of an outward growing delta. As the delta advances and the gradient decreases, the existing channel system may not be able to contain the lava flow. In that case, break-out takes place, new channels form, and a new lava delta overlaps the old one.

This is the same style of flow behavior exhibited by subaerial flows, with the differences being in the shape of the lava and its moving frontal lobe (also see Swanson, 1972). Griffiths and Fink (1992a; 1992b) and Gregg and Fink (1995) experimented with polyethylene glycol wax in an effort to understand the relationship between the extrusion rates and flow patterns of subaqueous basalt. They found that the faster the hot wax was extruded the more



Figure 9. A lava tube in volcanic strata at the San Francisco Peaks in Arizona.



Figure 10. Basalt blocks with varying degrees of vesicles. The upper scale is in centimeters and the lower scale is in inches. These gas bubbles reflect the amount of volatiles present within the melt at the time the lava cooled.

likely that sheet-flow would occur. With the highest levels of flow wax pools formed which they believed would directly correspond to the formation of lava lakes. According to Orton (1996), the final morphology and facies of low-viscosity basaltic lavas are determined by the viscosity and volumetric flow rate.

### Lava Tubes and Channels

In subaqueous eruptions resulting in the generation of lava, as well as subaerial eruptions which flow into the sea, lava tubes (Figure 9) and channels are considered to be important in distributing lavas around the seafloor (Fornari, 1986; Greeley, 1987). These features are also believed to be characteristic of high-volume and large-scale submarine eruptions. According to Fornari (1986, p. 296),

lava tubes may enhance the length of a subaqueous lava flow:

... because the confining hydrostatic pressure limits a submarine tube's cross-sectional area and hence for a given eruption volume the flows may be longer because they were forced to move through a narrow tube.

Lava channels form where a high volume submarine eruption continuously breaks its rapidly chilled outer skin and continues to flow along a preexisting channel (Fornari, 1986, p. 297). This interesting flow style has been documented by underwater observation from lava flows originating subaerially from Kilauea volcano, Hawaii (Tribble, 1991).

### Factors Affecting Flow Length and Vesicle Size in Submarine Lava Flows

Large-scale basaltic lava flows extending up to 69 miles have been recorded on the deep seafloor in water depths greater than 4950 feet, in areas near Hawaii and the East Pacific Rise (Gregg and Fornari, 1998). It is believed that the confining pressure of the overlying water prevents the exsolution of the dissolved gases within the flow allowing it to travel great distances. The degassing of a subaqueous basaltic lava is believed to increase the viscosity and solidify the flow regardless of the lava temperature (Dixon, Clague, Wallace, and Poreda, 1997; Sparks and Pinkerton, 1978). It is important to note that this water-pressure containment of the dissolved gases within a basaltic lava is not limited to extreme depths of water. Moore, Fornari, and Clague (1985) reported on this same hydrostatic pressure containment of lava gases in basalt flows from a relatively shallow submarine eruption of Mauna Loa, Hawaii.

However, not everyone agrees that exsolved volatiles are the primary issue in the formation of long basaltic lava flows. Fornari (1986, p. 297) suggested that lava tubes played the most significant role in long lava flows. Crisp and Baloga (1994, p. 11,828) and Griffiths and Fink (1992b, 1993) believe that surface temperature cooling and crystallization of the melt slow and solidify basaltic lava flows. Other investigations into the dynamics of cooling melt crystallization have been performed by Stasiuk, Jaupart, and Sparks (1993) and Cashman (1993). They also suggested a causal relationship between temperature and crystallization of the lava. Bonatti and Harrison (1988, p. 2974) proposed that the crystal/liquid ratio at eruption, lava ascent rate, and temperature are the three key components in defining how subaqueous basaltic lavas might flow and solidify. With regard to volatile content, Bonatti and Harrison (1988, p. 2977) stated that:

... the volatile content of the melt is not important in determining whether lava lakes, sheet, or pillow morphologies will be produced...

While they proposed that volatile content did not appear to play a role in lava morphology, they did detect a trend toward decreasing eruption temperatures from lava lakes to sheet flows to pillow basalts (1988, p. 2976). According to Byers, Garcia, and Muenow (1986, p. 9) sheet flows and pillow basalts contain identical volatile contents:

Thus, volatile abundance is not a factor controlling flow morphology. Extrusion rate and/or surface topography are probably the most important factors influencing flow morphology on submarine basalts.

However, they did admit that dissolved water content within the lava did relate to the length of the resulting basaltic flow (p. 9). The loss of H<sub>2</sub>O has been proposed by Bridges (1995; 1997) as the means by which basaltic lava flows solidify. He believed that subaqueous flows would lose less water and would be less viscous than terrestrial counterparts.

Williams and McBirney (1979) reported on the relationship between the formation of vesicles and dissolved volatile content within the basalt lava flows (Figure 10). They determined that the greater the water depth and the higher the hydrostatic water pressure, the smaller the vesicle size. Basalt lava samples taken from depths of 2640 feet had vesicles averaging greater than 0.5 mm, while basalt lavas retrieved from depths of 2.5 miles had vesicles which averaged less than 0.1 mm (Moore, 1965, p. 43). Moore, Batchelder, and Cunningham (1977) identified CO<sub>2</sub> as the gas primarily responsible for the formation of vesicles in deep-sea basalt flows. Additional research conducted by Macpherson (1984) on vesicles in submarine basalts from various depths found a relationship between ratios of dissolved H<sub>2</sub>O, CO<sub>2</sub> and SO<sub>2</sub> in basaltic melts. He determined that vesicles in submarine lavas are mostly due to the release of CO<sub>2</sub> at ocean depths greater than 1.25 miles, CO<sub>2</sub> and H<sub>2</sub>O at depths between 1.25 miles and 660 feet, and CO<sub>2</sub>, H<sub>2</sub>O and SO<sub>2</sub> in water depths less than 660 feet (Macpherson, 1984, p. 74).

## Geological Record of Subaqueous Basalt Lava Flows

According to uniformitarians, probably the greatest period of subaqueous basaltic volcanic activity occurred early in the history of earth — during the Archean Eon (Wells, Bryan, and Pearce, 1979). Most of the evidence used in support of this interpretation comes from the Precambrian volcanic strata found in Canada (Baragar, Coleman, and Hall, 1977). Many of these outcrops of Archean basaltic rocks exhibit only two-dimensions of the former pillows because the outer surface of these submarine flows has been

sheared off exposing only a flat surface. These Archean basalt lava flows are believed to be completely analogous to modern day subaqueous basaltic lava flows (Dimroth and Lichtblau, 1979). According to Wells, Bryan, and Pearce (1979, pp. 438–439), the Archean subaqueous pillows were:

...compressed together while still very hot and plastic, implying rapid accumulation, compression, and outward spreading flow.

Our preferred model of Archean volcanism resembles that of the abyssal regions of the mid-oceanic ridges, but with *a minimum water depth of less than a kilometer*. The rate of lava production was likely greater than at present day ridges but relatively rapid subsidence for the rate of magma production maintained most volcanic edifices below sea level. (*italics mine*)

This scenario requires a high-energy high-volume large-scale eruption—one which presently has no modern analogue, and is also unique to the earliest periods of earth history. It should be noted that according to Plate Tectonic theory *all* of the earth's oceanic basins, composed of basalt rock which was extruded under subaqueous conditions, were created within the past 180 million years. Yet none of this subaqueous volcanic activity is viewed as being equal to or exceeding the size or volume that occurred during the Archean. This uniformitarian interpretation is based solely on the basaltic lava volume and morphology of flows found in Canada. Clearly in this instance the uniformitarian model drives the interpretation. It should be noted that more recently submarine volcanologists are starting to examine other submerged igneous provinces in an attempt to define the levels of energy necessary to form these large lava flow areas within the uniformitarian model (Mahoney and Coffin, 1997). Some of these areas required basaltic lava extrusion rates higher than has been measured in recorded history (Self, Thordarson, and Keszthelyi, 1997).

## Age-Dating Lava Flows

The relative dating of subaqueous eruptive flows is complex as the flow contacts in many cases do not allow for clear superpositional relationships to be established (Chadwick and Embley, 1994). Additionally, the outer surfaces of many of the flows weather at varying rates, preventing any accurate age determination (Kennish and Lutz, 1998). Age-dating basalt flows using rock weathering can yield incorrect dates by one or more orders of magnitude (Chadwick and Embley, 1994, p. 4773). Using sedimentary cover to age-date submarine lava flows can also provide an incorrect age (Ballard, Holcomb, and van Andel, 1979). Presently, the age dating of subaqueous ba-

saltic lava flows by using weathering rates has not been resolved.

## A Young-Earth Flood Model Perspective

When investigating volcanic strata exposed across the continents, the young-earth Flood modeler must first examine the local stratigraphic column in an effort to reconstruct how changing-energy levels (which operated during and following the global Flood) affected what is observed at the outcrop (or well core). Creationists neither have nor need vast periods of time of slowly changing paleoenvironments to explain how volcanic strata formed, in fact we often reconstruct the stratigraphic column within a catastrophic framework. Another important perspective within our short-term catastrophic framework is the likelihood that *the majority of the global stratigraphic column was formed underwater during the global Flood of Genesis*. Hence, our approach is radically different from that invoked by uniformitarians who use subaerial settings spanning millions of years to explain the majority of the strata found on the continents. While I am *not* identifying every volcanic layer (basalt or otherwise) as having formed subaqueously (that determination must be made on a site-by-site basis), much of the volcanic strata found on the continents and interpreted within the global stratigraphic column was likely formed within a submarine paleoenvironment. We must interpret extrusive basaltic strata in a manner which conforms to our Biblical framework. Creationists are now just beginning to examine and interpret volcanic strata in this manner (Froede, 1996a; 1996b; Oard 1996; Williams, 1998; Williams, Howe, and Meyer, 1999). Clearly, additional research should be conducted on basaltic strata found on the continents to determine whether they were extruded in a subaqueous or subaerial environment.

While basalt lava flows occur in similar forms whether extruded within a subaqueous or subaerial environment, other qualifiers are clearly necessary to determine the paleoenvironment in which basalt flows originated. For example, the type of strata which over and underlie the solidified basalt flow might provide some ideas about the previous depositional environment. Likewise, the presence of freshwater or marine fossils might also shed some light on the original setting. *The sole reliance upon the form (i.e., morphology) of a basalt lava flow to determine the original historic setting can no longer be considered the only source for paleoenvironmental reconstruction.*

Many creationists identify links between the high-energy volcanism associated with the Precambrian (specifically in strata identified as the Archean) and the onset of the global Flood of Genesis (Froede, Howe, Reed, and Meyer, 1998; Hunter, 1992; Reed, in press; Snelling, 1991; Woodmorappe, 1999). Understanding the various

factors which affect the morphology of basaltic lavas can lead to a better comprehension of the high-energy geological processes that were in operation with the onset and throughout the Flood. Massive subaqueously outpourings of basaltic lava likely occurred on the continents within very short periods of time during the global Flood. Most of this terrestrial volcanism would begin in a subaerial antediluvian environment only to be eventually inundated by rising Floodwater. Subaqueous volcanism along the continental margins and within the deep-sea floor during the Flood would have occurred in a manner greater than what is experienced today within those same types of settings. It should also be noted that subaerial outpourings of basaltic lava likely occurred following the withdrawal of Floodwater. Hence, only through a careful examination of the specific stratigraphic setting can the examiner gain a clear understanding of the possible original paleoenvironment(s). However, the creationist proposal that all the basaltic oceanic basins of the earth formed during the Flood (Baumgardner, 1986; 1990; 1994a; 1994b; Austin, Baumgardner, Humphreys, Snelling, Vardiman, and Wise, 1994) remains unacceptable to this author and several other young-earth creationists (Froede, 1998b; Froede, 1999; Reed, Bennett, Froede, Oard, and Woodmorappe, 1997).

Knowledge of the similarity in form and behavior between subaqueous and subaerial basaltic lava flows provides interesting alternative interpretation possibilities to the young-earth Flood modeler. We no longer have to restrict our interpretation of basalt lava flows found on the continents to a subaerial setting.

## Conclusion

Volcanic processes and products are important in reconstructing the depositional history of the local stratigraphic column. Explaining how volcanic materials became a part of the stratigraphic section follows the interpretative framework in which they are defined. Uniformitarians relate volcanic events occurring at time-discrete intervals over the course of millions of years. Continent-based eruptions are typically viewed as occurring within a subaerial environment. Basaltic lava within this same setting is viewed as flowing out and away from a rift or vent until it degasses and cools. In many instances this subaerial interpretation is based on the lack of any obvious subaqueous indicators (i.e., pillows).

Basalt is today extruded at various rates across portions of the seafloor. Oceanographers and marine geologists are just now starting to realize the processes in which this eruptive style occurs. Long gone are the days of subaqueously extruded basalt interpreted as only occurring as pillows. Today, submarine basaltic lava morphology is

known to resemble its terrestrial counterpart. The processes responsible for erupting and shaping the basaltic lava flows in a subaerial setting are the same that affect the shape, width, and length in an underwater setting.

Young-earth creationists must take a different approach to understanding Earth history, one based on the Biblical record of a global Flood, along with its corresponding link to high-energy geologic processes. Continent-based subaerial volcanism has a place in our model, but only after emergent conditions were established after the global Flood. Most of the high-energy volcanism we see exhibited within the global stratigraphic record probably occurred in a subaqueous setting during the Flood. Problems with interpreting basaltic lava flows as having occurred underwater has been in identifying features linked solely to subaqueous emplacement, such as basalt pillows. Many hold to the idea that without basalt pillows one cannot argue for subaqueous deposition. This is no longer the case.

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## Book Review

### *Refuting Evolution* by Jonathan Sarfati

Master Books, Green Forrest, AZ. 1999, 144 pages, \$10.99

Jonathan Sarfati says that recently the National Academy of Sciences (NAS)

made available to public schools and other institutions a book (*Teaching About Evolution and the Nature of Science*) that supposedly presents the latest information on evolution. . . It is designed to persuade and assist teachers to further indoctrinate their students in favor of evolution, with specific advice on countering anti— evolutionist students” (p. 10).

Sarfati thoroughly investigated the claims of the NAS book and found that some typically outdated and discarded ideas were still being presented as fact.

*Refuting Evolution* responds to many of the arguments in *Teaching About Evolution and the Nature of Science* so that a general critique of evolution can be made available to challenge educators, students and parents” (p. 14).

Sarfati, who received honors in physical and inorganic chemistry and in condensed matter physics and nuclear physics at Victoria University in Wellington, New Zealand, begins by stating some facts and biases for both evolutionists and creation scientists. He states, “It is a fallacy to believe that facts speak for themselves—they are always *interpreted* according to a framework” (p. 15).

In Chapter 2 the author calls attention to a common evolutionary concept in *Teaching About Evolution and the Nature of Science* in which *all* changes in organisms are called “evolution” and that this enables the book to “claim that evolution is happening today” (p. 31). An ex-

ample would be Sarfati’s quote from *Teaching About Evolution*, “Many strains of bacteria have become increasingly resistant to antibiotics as natural selection has amplified resistant strains. . .” (p. 39). To this Sarfati asks, “However, what has this to do with the evolution of *new kinds* with *new genetic information*? Precisely nothing” (p. 40).

Another quote from *Teaching About Evolution* used by Sarfati is:

A particularly interesting example of contemporary evolution involves the 13 species of finches studied by Darwin on the Galapagos Islands, now known as Darwin’s finches...

To this, Sarfati retorts,

However, again, an original population of finches had a wide variety of beak sizes... Again, no new information has arisen, so this does not support molecules-to-man evolution (p.42).

For each point given by the authors of *Teaching About Evolution*, Sarfati points out how the NAS has failed to prove that evolution should be the only origins theory to be taught in the secular schools system. Also, Sarfati in this book gives as much positive information as he can to defend the creationist position. Although a short book, *Refuting Evolution* provides a valuable summary for the layman of the whole evolution/creation controversy.

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## The Philosophy of Sequence Stratigraphy Part II—Application to Stratigraphy

Peter Klevberg\*

### Abstract

To properly evaluate the scientific validity of sequence stratigraphy and its applicability to geologic research within the context of a Biblical worldview requires a basic understanding of the philosophy of science. A review of the philosophy of science, emphasizing its application to geology, was presented in Part I<sup>1</sup>. The principles devel-

oped in Part I are now applied to stratigraphy in general. In particular, the “mixed question” problem and effects of disparate worldviews on stratigraphic method and practice are examined. In Part III, principles developed in Parts I and II will be extended to the growing field of sequence stratigraphy.

### Introduction

In Part I of this series, the philosophic background necessary to properly evaluate the validity of sequence stratigraphy was established. A review of the philosophy of science was presented, emphasizing the assumptions behind the scientific method and how these assumptions relate to philosophies of earth history. Particular mention was made of the “mixed question” problem, in which investigation of a phenomenon requires input from a plurality of sources and methods. Many of the phenomena investigated by geologists are mixed questions, and thus require input from sources and methods outside of natural science. These inputs are not neutral; they will reflect the philosophies or worldviews that govern them. Geologists who ignore these philosophic principles are virtually certain to err in their interpretation of sedimentary rocks.

In Part II of this series, the philosophic principles developed in Part I are applied to stratigraphy in general. Consistent application of these principles should enable geologists to avoid the many pitfalls that lead to errors in stratigraphic analysis. In Part III, the general stratigraphic principles developed here will be applied to the emerging field of sequence stratigraphy, an area of controversy among both mainstream and diluvial geologists. It should be possible for readers to effectively evaluate sequence stratigraphy based on the principles developed in the series. Readers unfamiliar with geological and philosophical terminology may wish to consult the glossaries at the end of Part I and this paper. Those who have not yet read Part I are urged to do so.

Although evolutionists uniformly accept the system of stratigraphic correlation known as the geologic column, for creationists, the geologic column remains a topic of considerable controversy. How the geologic column relates to philosophy is not as clear for many, yet resolution of the controversy is dependent on such an understanding. My evaluation of postmodernism and how it is likely to affect the practice of stratigraphy may be of more than passing interest; indeed, Bartlett (1997, p.10) refers to postmodernism in his important creationist treatment of sequence stratigraphy. Having summarized the philosophic influences expressed in the geologic column, I present a more detailed logical analysis of specific stratigraphic methods within the context of mixed questions. Readers may note that in many cases, a stratigraphic method may contain elements that are scientific and elements that are not, and methods that are scientific in theory may not be in practice. Recognition of these distinctions is vital for any researcher who wishes to make use of mainstream publications in his own research. A key goal of stratigraphic research is correlation, the matching of rock units over large areas. However, correlation presents many pitfalls which require skill, training and vigilance to avoid and, in some cases, the process of correlation encounters epistemological problems as well.

### Methodological Naturalism and the Geologic Column

Plantinga (1997a, 1997b) and P. Johnson (1995) expose the incompatibility of methodological naturalism<sup>2</sup> with natural science. It takes neither the detective acumen of Sherlock Holmes or Agatha Christie nor the wisdom of Solomon to perceive that for most stratigraphers, biologi-

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Table I. Perspectives on historical geology.

| Establishment Geologic Paradigm                                                                                                                                                                           | Diluvial Geologic Paradigm                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The present is the key to the past.                                                                                                                                                                       | The past is the key to the present.                                                                                                                                                                                                             |
| <b>Objective:</b> Explain all geologic phenomena in terms of present processes, and, whenever possible, in terms of present rates. Where this fails, invoke cyclical events or intermittent catastrophes. | <b>Objective:</b> Explain all geologic phenomena in terms of processes compatible with Biblical events and chronology.                                                                                                                          |
| <b>Primary variable:</b> Time.                                                                                                                                                                            | <b>Primary variable:</b> Energy.                                                                                                                                                                                                                |
| The EGP is characterized by low-energy processes acting over immense periods of time. Evolutionist catastrophists see energetic processes acting intermittently through great spans of time.              | The DGP is characterized by high-energy processes acting continuously over a limited period of time (principally the Deluge). Other geologic events have been much smaller than the Deluge, but have also tended to be brief, energetic events. |

cal evolution is *ipso facto* the basis of the geologic column, or that in practice the various stratigraphic methods are intertwined with this assumption. One need read little on the topic to recognize that, ultimately, biostratigraphy<sup>3</sup> is incorporated into all other stratigraphic methods in some way. Methodological naturalism is foundational to the current geologic column.

Reed (1996a, p.7) observes the effect of naturalism/materialism on geology:

The geologic column is an integral part of a naturalist worldview.... The connecting link between naturalism and uniformitarianism is evolution: *Evolution is the modern naturalistic explanation for the existence and character of phenomena, and is also the basis for interpreting the observed rock record into the geologic column.*

The circle is completed by the geologic column providing key ‘evidence’ for historical evolution, and for evolution providing the ‘scientific’ basis for naturalism.... *beneath the tautology lies a more basic relationship that is destructive of the scientific method itself.* This relationship is one that does not allow separation between the extrascientific parent system and derivative scientific models. Thus, these models are not truly open to revision and rejection by empirical investigation.

In geology, the application of this system is monolithic (emphasis mine).

The geologic column is the expression of the ruling geologic paradigm of the scientific establishment, referred to here as the establishment geologic paradigm or EGP. The EGP represents the postchristian majority opinion. The diluvial view (Table I), which typified “modern science” (Schaeffer’s term for preDarwinian science) and has experienced a revival, most notably since the publication of *The Genesis Flood* (Whitcomb and Morris, 1961), probably represents the majority opinion among modern crea-

tionist geologists<sup>4</sup>. Considerable variation exists within the EGP, especially between quietist and neo-catastrophist camps, but both are firmly committed to a naturalistic worldview. Bartlett (1997, p.11) shows the close philosophic ties of these two camps:

Indeed, a close review of current literature on the impact hypothesis (Shaw, 1994) reveals *a new epistemological strategy* for uniformitarians: if periodicity (cosmic resonances or chaos theory) is demonstrable in the larger equation of catastrophe, then catastrophe as known by the revelationist is not catastrophic (emphasis mine).

By contrast, the diluvial geologic paradigm (DGP) is overtly revelationist, emphasizing the unique role of divine judgment in earth history (Genesis 6:5–7, 11–13; 7:1–8:5; 8:20–22. I Peter 3:18–20. II Peter 2:1–3:13). The DGP

<sup>2</sup>The term “methodological naturalism” is sometimes used to assert the need to exclude the supernatural from scientific research, as opposed to *metaphysical naturalism*, which denies the supernatural altogether. In reality, science cannot be properly practiced by pretending the supernatural does not exist, but rather by recognizing the limitations of the scientific method and the nature of mixed questions. Plantinga (1997a, 1997b) elucidates this distinction effectively, as did Schaeffer (1976, p.167ff.). Part I of this series showed the incompatibility of metaphysical naturalism with natural science.

<sup>3</sup>By this I mean biostratigraphy as practiced, not biostratigraphy in an empirical sense. The spatial distribution of fossils can be studied without reference to evolution or time, though in practice it is not.

<sup>4</sup>A number of other ideas have been promoted, but many of their proponents no longer hold to the Biblical view of natural history espoused by the Creation Research Society. Most of these are variations of “neocuvierism.”

and EGP, as illustrated in Table I, are stereotypes or benchmarks to facilitate comparison.

The EGP is virtually synonymous with the geologic column. Many creationists from *The Genesis Flood* on have adopted the geologic column to some degree, albeit with a compressed chronology. Some have recommended that the geologic column be recognized as factual or substantially correct (Garner, 1996; Garton, 1996; Ritland, 1981, 1982; Robinson, 1995, 1996, 1997; Snelling et al., 1996). Woodmorappe (1981) provided a pioneering inductive evaluation of the geologic column. Reed (1996a, p.6) approached the issue deductively, demonstrating the extra-scientific nature of historical geology in general and the EGP in particular:

The most severe deficiency in the geologic column is its inextricable linkage to the naturalist-uniformitarian system, and its resulting inability to define and defend its axioms on a metaphysical level.

Creationists can as easily blur the distinctions when addressing “mixed questions.” However, the DGP has the *potential* to provide a coherent and correspondent description of natural history.

Naturalists have not, and probably logically cannot provide a non-theistic formulation that would justify those axioms foundational to modern science. Simultaneously, it has been demonstrated that the Biblical Christian framework passes these same formal tests. That comparison alone is sufficient to demonstrate that the naturalist system is false and that the Biblical Christian system provides a valid framework for earth history analysis (Reed, 1996a, p.12).

Most creationists do not appear to recognize the inextricable connection between the geologic column and methodological naturalism. Harmonization of Biblical history and the geologic column (or at least elements of it) has been the *modus operandi* of creationist geologists in recent decades. As Froede (1998, p.2) aptly put it, “Most, if not all, of these attempts to reconcile Scripture to the global evolutionary stratigraphic column have come at the expense of the biblical record.” They have also come at the expense of the scientific data.

Many creationists appear oblivious to the fact that an empirically defined sequence stratigraphy and the geologic column are mutually exclusive (Jeletzky, 1978). There is a good reason for this ignorance. *Sequence stratigraphy as currently practiced is not empirically defined*. This does not, however, preclude development of an empirically defined sequence stratigraphy any more than an empirically defined lithostratigraphy, magnetostratigraphy or biostratigraphy. Unfortunately, as long as the prevailing paradigm is derived from the naturalist worldview, the geologic column will remain an unrecognized “mixed ques-

tion.” As if the philosophic straitjacket surrounding stratigraphy were not bad enough already, we are about to be plunged into the morasse of postmodernism.

## Postmodernism

Postmodernism denies absolute truth, denies that one viewpoint can be valid and another invalid; in short, it is relativism. Postmodernism has subtle ties to the anachronistic empiricism or naturalism of the scientific establishment and that subconsciously pervasive philosophical reaction against it, existentialism. Postmodernism is the child of our time. To the extent that postmodern views affect stratigraphy, the result will be a further devolution of the discipline.

Naturalism/scientism did not arise in a vacuum. It, too, is clearly a child of its time (Taylor, 1991). During the “golden age” of quietism, Carl Becker (1932, p.5) pointed out, “Whether arguments command assent or not depends less upon the logic that conveys them than upon the climate of opinion in which they are sustained.” A stakeholder in the humanist establishment, Becker’s words imprison himself with the irony of Caiaphas (John 11:49–52). And modern stratigraphic concepts—evolutionist or creationist—have also arisen within specific historic and social contexts. The practice of science is not essentially objective (Lumsden, 1992; McGhee, 1987; Moreland, 1989; Pearcey, 1989).

Postmodernism is not a new philosophy—that would be a new “modernism”—but a denial that any particular system of thought can be superior to others, in any objective sense true, or correspondent in any understandable way. It can be thought of as the social outworking of existentialism (Breisach, 1962), described as an “antiphilosophy” by Schaeffer (1976, p.207), and as the natural consequence of the epistemological failure of the naturalistic/materialistic worldview. Phillip Johnson (1995, p.119) also notes the antiphilosophical nature of postmodernism. Gordon Clark (1978) decimates empiricism (naturalism/materialism) on epistemological grounds. Sire (1988) shows how this incoherence in naturalism leads logically to extreme skepticism and finally nihilism. Dembski (1993, p.2) describes how postmodernism (pluralism/contextualism/deconstructionism) is incoherent: “Here in a nutshell is the fallacy of contextualism, a fallacy that results from asserting with too much confidence that there is nothing about which we can legitimately have confidence” (Dembski, 1993, p.2). (For a succinct description of postmodernism in a nonscientific context, see the appendix.)

But does this mean that neither objective truth nor genuine communication is possible? The postmodernist says

Yes. His is a nihilistic epistemology incompatible with the metaphysical basis of natural science (Schaeffer, 1968, p.104; Schaeffer and Koop, 1979, pp. 368,369; Sire, 1988). Postmodernism/contextualism has profound implications for science. Although it arose outside the scientific establishment, it has shifted the prevailing worldview, with profound implications for the paradigms it spawns (cf. Figure I in Part I of this series). Indeed, postmodernism threatens to destroy the scientific enterprise outright.

Bartlett (1997, p.10) documents this using a critique of Gould:

The problem is existential dichotomy. The result is philosophic tension. Gould's methodological uniformitarianism (space-time invariance) is potentially fatal to his substantive uniformitarianism (rate, material conditions, and ultimately periodicity) since in an existential universe there is no regularity, no uniformity (beyond the moment) to describe. This situation is not producing rationality in geology—postmodern geology. Only confusion has arisen from Gould's dichotomy, a disorderliness of the post-modern mind inflicted upon secular, geologic science.

The hypocrisy of postmodernism is easily exposed. A former coworker of mine, while an English major at the University of Colorado, “deconstructed” several of her deconstructionist professor's writings (Sanchez, 1998). He was not amused! “The fallacy of contextualism involves a fallacy of self-referential incoherence” (Dembski, 1993, p.2). To insist on causality without an epistemological basis (i.e. pragmatically) is to assert rationality irrationally.

To date, the majority of geologists—at least in my experience—appear to be “traditionalists,” holding to a modern rather than postmodern worldview, but how long can this continue while postmodern influences grow? Neither postmodernism nor naturalism is logically coherent. Neither postmodernism nor naturalism can produce a scientifically sound approach to stratigraphy. Postmodern influences can only further muddy the waters of an already turbated discipline, further obscuring the mixed question nature of stratigraphy and rendering rational debate infeasible.

## Application of Logical Criteria to Stratigraphy

What is the first question a geologist is asked about a given stratum or formation? Almost invariably, it is “How did it form?” Man seems to have an inexorable yen for understanding the past (this includes those who claim no interest in history!). The *science* of stratigraphy (i.e. descriptive stratigraphy) cannot answer this question. The *science* of stratigraphy must, by the defining criteria of the scientific method, limit itself to empirical sources of knowledge<sup>5</sup>.

Both the EGP and DGP reflect philosophic biases based on their disparate views of history. They differ in that the DGP allows for historical knowledge to be provided from historical sources (viz. the Bible), while the EGP does not. A natural history developed for stratigraphic purposes may have value if its mixed question nature is recognized. *Historical stratigraphy*<sup>6</sup> might be an appropriate term for this approach.

The *science* of stratigraphy must meet scientific criteria:

- *Relevance*: Stratigraphic schemes must provide effective taxonomic structures for description of strata.
- *Testability*: Stratigraphic schemes must be empirically derived (attributes, scalars, vectors).
- *Compatibility with Previously Well-Established Hypotheses*: Stratigraphic schemes must be logically consistent with accepted axioms (e.g. cross-cutting features).
- *Predictive or Explanatory Power*: Stratigraphic schemes are superior which provide an adequate basis for development of statistical models.
- *Simplicity*: Stratigraphic schemes are superior which rely on fewer external hypotheses and require fewer cases of special pleading.

*Historical stratigraphy* must meet mixed question criteria:

- Recognition of the assumptions of the historical approach (e.g. EGP vs. DGP)
- Clear distinction between types of analysis required to adequately address the mixed question. In the case of historical geology, these will be principally history and science.
- Clear distinction between the types of data acquired, each type analyzed according to its method, with means for evaluation, testing, and verification/falsification according to the respective method. In the case of historical geology, these methods will be principally the historical method and the scientific method.
- A means for integrating the various analyses into a workable model. An historical stratigraphic model should exhibit predictive power in the same sense as a scientific model (e.g. lateral extent of beds and facies changes).

In theory, *scientific stratigraphy* may be practiced in a philosophically inconsistent way by those holding the naturalist/uniformitarian worldview or in a philosophically consistent way by those holding the Biblical/Christian worldview. Both may be careful and relatively impartial

<sup>5</sup>The *science* of stratigraphy concerns itself with mineralogy and petrology, grain size and sorting, color, thickness, bedding, and similar properties and gradients in these properties, and their spatial relationships.

<sup>6</sup>Some might argue that the term should be “historiographic stratigraphy,” being a mental picture of past events, but the distinction between *historiographic* and *historical* has not been made in geology—historically!

observers and prudently differentiate their observations from their interpretations. Lack of personal objectivity may prevent this in practice, but the results should be the same if definitions of empirical methods are observed.

In both theory and practice, *historical stratigraphy* cannot be consistent between the EGP and DGP because of its nonempirical nature. The approaches to the mixed question of earth history are very different, as pointed out by Reed (1996b, p.215) using terminology of R.C. Sproul:

The Biblical alternative to uniformitarian natural history will be distinct because the acceptance of a 'university' framework of knowledge results in the application of a multidisciplinary method, recognizing that no single branch of knowledge is competent for a complete analysis. This approach is consistent with the Biblical Christian framework, since truth is expected to be present in all disciplines, and to be consistent between them. Science by itself is inadequate to provide an interpretation of natural history, although there are facets of natural history that require scientific analysis.

Davison (1995, p.237) writes: "A re-occurring problem in this exercise was the dependence on others' evolutionary-based interpretations—certainly not the ideal for trying to do a Flood-based interpretation...." His experience is far from unique. It shows that a basic understanding of the philosophical underpinnings of science in general, and geology in particular, is vital to a successful effort in stratigraphic analysis.

## A Review of Stratigraphic Methods

Stratigraphy is not a single method, but a field of study that utilizes many methods. Many geologists who are familiar with these methods are not cognizant of the philosophic principles which underlie them (Part I of this series), of the mixed question nature of many of the phenomena they investigate, or even of the fundamental logical criteria presented above. Failure to recognize the mixed question nature of some popular stratigraphic methods has produced "mixed" results for many researchers, further reducing the potential for scientifically valid and productive stratigraphic research. Readers of geologic literature must be aware of these defects to prudently judge what they read. Recognition of the strengths and weaknesses of various stratigraphic methods is doubly important for the geologic researcher. Common stratigraphic methods are here summarized and evaluated.

Stratigraphy *as a science* (i.e. descriptive stratigraphy) has been promoted by advocates of the EGP. This is often stressed by the North American Commission on Stratigraphic Nomenclature (1983), including the following:

The objective of a system of classification is to promote unambiguous communication in a manner not so restrictive as to inhibit scientific progress. To minimize ambiguity, a code must promote recognition of the distinction between observable features (reproducible data) and inferences or interpretations.

Stratigraphic classification promotes understanding of the geometry and sequence of rock bodies. The development of stratigraphy as a science required formulation of the Law of Superposition to explain sequential stratal relations. Although superposition is not applicable to many igneous, metamorphic, and tectonic rock assemblages, other criteria (such as cross-cutting relations and isotopic dating) can be used to determine sequential arrangements among rock bodies (p.847).

Other than the acceptance of isotopic dating (probably a faulty interpretation of radioisotope data—cf. Austin, 1988, 1992, 1994, 1996; Austin and Snelling, 1998; Brown, 1994; Chaffin, 1987; Gill, 1996; Helmick and Baumann, 1989; Jeletzky, 1978; Johansson, 1993; R. Johnson, 1993; Molén, 1991; Snelling, 1995, 1998; Woodmorappe, 1979, 1999), and probably the tectonic rock assemblages (often interpreted based on biostratigraphy), these statements support a purely descriptive (i.e. scientific) approach to stratigraphy. The North American Stratigraphic Code contains many other imperatives to distinguish between data and interpretation and maintain the time independence of descriptive methods, including lithostratigraphy, magnetostratigraphy, and biostratigraphy. Sequence stratigraphic methods are especially seen by some to afford freedom from historic bias: "Sequence stratigraphy represents a breakout from the intellectual-philosophic Bastille of uniformitarian time" (Bartlett, 1997, p.12). However, some stratigraphic methods (e.g. geochronology) are clearly extrascientific.

Several stratigraphic methods are in common use. Often these are combined in actual practice. A review of current stratigraphic methods is presented in Table II. Also indicated is whether the methods as defined by various authorities contain descriptive (i.e. scientific) elements or genetic (i.e. historic) elements. Minor variations and purely theoretical (i.e. extrascientific) approaches have been omitted.

Of the 13 stratigraphic methods listed, six are defined as purely descriptive, i.e. time-independent, techniques. These include lithostratigraphy (and lithodemic stratigraphy), magnetostratigraphy, biostratigraphy, allostratigraphy, and seismic stratigraphy. Unfortunately, these definitions do not translate into common practice. Observe the philosophic inconsistency in other citations from the North American Stratigraphic Code:

Stratigraphic procedures and principles, although developed initially to bring order to strata *and the*

Table II. Summary of Current Stratigraphic Methods.

| Stratigraphic Method                                                                                           | Ref <sup>1</sup> | Desc <sup>2</sup> | Gen <sup>3</sup> | Remarks                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------|------------------|-------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lithostratigraphy                                                                                              | N                | ✓                 |                  | Empirical in theory but not usually in practice                                                                                                                  |
| Lithodemic stratigraphy                                                                                        | N                | ✓                 |                  | Extension of lithostratigraphy to nonstratiform earth materials                                                                                                  |
| Magnetostratigraphy                                                                                            | N                | ✓                 |                  | Empirical in theory but not usually in practice                                                                                                                  |
| Biostratigraphy                                                                                                | N                | ✓                 |                  | Empirical in theory but virtually never in practice                                                                                                              |
| Pedostratigraphy                                                                                               | N                | ✓                 | ✓                | Requires "recognition" of ancient soil horizons/weathering profiles                                                                                              |
| Chronostratigraphy                                                                                             | N                |                   | ✓                | Purely theoretical historical construct; rock units chosen as material referents for specific geochronologic intervals                                           |
| Polarity-chronostratigraphy                                                                                    | N                | ✓                 | ✓                | A chronostratigraphic framework in which to place magnetic data ("magnetic sequences")                                                                           |
| <i>Allostratigraphy</i>                                                                                        | N,B,W            | ✓                 |                  | Empirical in theory and more-or-less in practice; limited applicability                                                                                          |
| <i>Seismic Stratigraphy</i>                                                                                    | W                | ✓                 |                  | Potentially empirical, though purely geophysical unless nonempirical ideas are introduced; source of sequence stratigraphy.                                      |
| <i>Sequence Stratigraphy</i><br>(“Classical” or “Exxon” approach)                                              | B,W              | ✓                 | ✓                | Several ill-defined parameters, including some which are genetic; several <i>a priori</i> assumptions; limited to marine sedimentary basins with passive margins |
| <i>Genetic Stratigraphic Sequences</i><br>(“Depositional Episode,” “Flooding Surface,” or “Galloway” approach) | B,W              | ✓                 | ✓                | Several ill-defined parameters; overtly genetic; several <i>a priori</i> assumptions; limited to marine sedimentary basins with passive margins                  |
| <i>Transgressive-Regressive Cycles</i>                                                                         | B                | ✓                 | ✓                | Several ill-defined parameters; overtly genetic; several <i>a priori</i> assumptions; limited to marine sedimentary basins with passive margins                  |
| Event Stratigraphy                                                                                             | W,S              |                   | ✓                | Highly genetic in emphasis on “event;” concentrates on small scale (bed), in which are some descriptive components; often combined with sequence stratigraphy    |

<sup>1</sup>References: B–Bartlett (1997), N–North American Stratigraphic Code (1983), W–R. Walker (1990), S–Seilacher (1991)

<sup>2</sup>Descriptive (empirical, scientific) method

<sup>3</sup>Genetic (nonempirical, speculative, historical) method

*events recorded therein*, are applicable to all earth materials, not solely to strata. They promote systematic and rigorous study of the composition, geometry, sequence, *history*, and *genesis* of rocks and unconsolidated materials (p.847, emphasis mine).

Correlation is a procedure for demonstrating correspondence between geographically separated parts of a geologic unit. The term is a general one having diverse meanings in different disciplines. *Demonstration of temporal correspondence is one of the most important objectives of stratigraphy* (p.851, emphasis mine).

A pedostratigraphic unit is the part of buried soil characterized by one or more clearly defined soil horizons containing *pedogenically formed minerals* and organic compounds (p.849, emphasis mine).

Many upper Cenozoic, especially Quaternary, deposits are distinguished and delineated on the basis of content, for which lithostratigraphic classification is appropriate. However, others are delineated on the basis of criteria other than content. *To facilitate the reconstruction of geologic history, some compositionally similar deposits in vertical sequence merit distinction as separate stratigraphic units be-*

*cause they are the products of different processes; others merit distinction because they are of demonstrably different ages* (p.849, emphasis mine).

Major objectives of stratigraphic classification are to provide a basis for systematic ordering of the *time* and space relations of rock bodies and *to establish a time framework for the discussion of geologic history* (p.849, emphasis mine).

[Biologic remains are uniquely important because] *the irreversibility of organic evolution* makes it possible to partition enclosing strata temporally. Third, biologic remains provide important data for the *reconstruction of ancient environments of deposition* (p.849, emphasis mine).

The committee obviously had trouble keeping its worldview from showing! Notice how many times time, process, and blatant belief in organic evolution enter the definitions of methods intended to be scientific. Even methods defined in empirical terms have been affected by nonempirical (i.e. extrascientific or metaphysical) concepts. Can a “mixed” method produce a strictly scientific result? Can a researcher schooled in EGP methods produce objective results without a conscious effort? Are “data” really data?

There are good reasons for this loss of objectivity, including observer bias and the difficulties of the task (R. Walker, 1990, p.777): “In many local studies, facies descriptions may be so complex that they go beyond our interpretive abilities. The first way to simplify a complex scheme is to group facies perceived to be similar and/or genetically related....” This shows the importance of recognizing the mixed question nature of natural history research. What a researcher observes, records, and even subconsciously interprets is an outgrowth of his paradigm, the result of his preconceptions. When attempting to account for past events, such bias is inevitable. *Using stratigraphic “data” from methods defined as scientific may result in acceptance of historical interpretations incompatible with a Biblical worldview.* This problem arises because unscientific and unbiblical concepts are absorbed in the practice of stratigraphic methods.

## Correlation: The Achilles’ Heel of Stratigraphy

Correlation is the act of identifying various rock bodies over a laterally extensive area as pertaining to each other, for example, as part of the same rock unit, stratum or formation. This is a major goal of stratigraphy, enabling one to understand the relation of a given stratigraphic unit within the context of regional geologic processes. Correlation is what the geologic column is all about—on a global scale, through all of earth history. Global correlation is

what sequence stratigraphy is about. Stratigraphic methods are means of defining, describing and correlating stratigraphic units. As demonstrated above, a number of troubling deficiencies have been identified in these methods. Combinations of these methods inherit the doubtful elements of their weakest links. This is also true of correlation in general.

A still deeper and more disconcerting issue is raised at an epistemological level by the results of an experiment by Zeller (1964). In an effort to test the veracity of the stratigraphic methods used to correlate cyclic sediments, he created some *random* sedimentary columns, which several geologists readily correlated with the real section he supplied. Not surprisingly, their stratigraphies differed, but they defended their respective stratigraphic columns vigorously.

From the preceding story, it will be seen that our stratigraphic section, composed of randomly selected lithologies, does indeed show most of the characteristics that can be expected in a truly cyclic sequence. At this point the reader may wish to complain that the writer has gone too far in making up samples with which to taunt his colleagues. Let the reader be assured, however, that the writer’s humble efforts at creating confusion are of truly minute proportions when compared to those of nature (pp.635, 636).

Without a continuous excavation or uninterrupted string of boreholes, stratigraphy depends on correlation of data from scattered outcrops, isolated boreholes, or geophysical methods. Even when data are relatively abundant, stratigraphic correlations are often interpretive, classifying strata as “diachronous” and attempting to define them chronometrically (North American Commission on Stratigraphic Nomenclature, 1983).

What is so disconcerting about Zeller’s results is that they demonstrate that *no unique stratigraphic solution is possible. All correlation, even that free from EGP bias, even that which eminently “makes sense,” can never be more than tentative.* Some researchers have been perceptive enough to acknowledge this (Howe and Williams, 1994), but most are not. Miall (1992) repeated Zeller’s experiment using four randomly generated columns and the Vail Curve. They all correlated extremely well. An essential issue escapes the notice of many researchers unfamiliar with the philosophical principles presented above: *Only one fictitious correlation is required to discredit a deductive stratigraphic framework* (i.e. paradigm). This is the fallacy of “historical science”<sup>7</sup>: the “best reconstruction” of the past may be as far from the truth as the least tenable, and without the aid of history, we can never know.

<sup>7</sup>The term “historical science” is here used to refer to that common practice of misapplying the methods of natural science to historical study. See Table III in Part I.

## Conclusions

- Methodological naturalism and natural science are incompatible.
- Methodological naturalism is foundational to the geologic column.
- The Establishment Geologic Paradigm (EGP) is virtually synonymous with the geologic column. Much controversy exists in creationist circles regarding the degree of validity of the geologic column. Much of this controversy results from a lack of understanding of the “mixed question” nature of the problem.
- To the extent that postmodern views affect stratigraphy, the result will be a further devolution of the discipline.
- Scientific (i.e. descriptive) stratigraphy must satisfy scientific criteria; historical stratigraphy must satisfy historical criteria. Scientific stratigraphy may theoretically be practiced by diluvialists and evolutionists alike with free exchange of data, though in practice this is often precluded by a lack of personal objectivity. Historical stratigraphy (which embraces most in practice) is nonempirical by nature and cannot be exchanged with worldviews holding incompatible historical beliefs.
- Of 13 common stratigraphic methods, only six are defined as purely descriptive. Unfortunately, not even these are commonly free of extrascientific or metaphysical input in practice.
- An empirically defined sequence stratigraphy and the geologic column are mutually exclusive. Sequence stratigraphy as currently practiced is not empirically defined, though this does not preclude development of an empirically defined sequence stratigraphy.
- All correlation, however scientifically practiced and eminently pleasing, can never be more than tentative. Without historical attestation, genetic relationships cannot be known with certainty.

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## Appendix

Gene Edward Veith (1998) provided the following description of postmodernism within the context of American politics, but it is independent of application and so clear that it is worth quoting in its entirety.

There was a time when the biblical worldview was taken for granted, when historical facts, the laws of nature, logical ideas, divine revelation, and moral

principles were all issues of truth. Call this time of openness to outside reality “premodern.” The narrowing of the mind began in the 18th century when “modernists,” giddy with the promise of science and the dream of Enlightenment progress, claimed that the only truths were those testable by scientific rationalism.

The modernist confidence in naturalist reason is now passé; Christians can applaud that. But while many are taking advantage of the decline of modernism to rediscover biblical realism, the cultural mainstream has turned to postmodernism, a worldview that tries to do without truth altogether.

For postmodernists, truth is merely a “construction” by the culture or by the individual. We construct our beliefs, so that what is true for me may not be true for you. Truth, as they say, is relative. Morality depends on the individual’s choice. Religion occupies a private corner of the brain, as a source of personal serenity, but not a set of truth claims about ultimate reality, much less a relationship with an external, demanding, sovereign God.

The rejection of truth in postmodernism means that attempts to persuade are construed as acts of oppressive power. Since everyone’s beliefs have equal validity, “you don’t have the right to impose your beliefs on anybody else.” Logical contradictions are OK. The willingness to change one’s story is a function of the ability to “reinvent” oneself.

In the postmodernist dismissal of truth, image is everything. The meaning of words is not fixed but a function of “interpretation,” so that the speaker, listeners, and spin-doctors can construct their own meanings for them. What matters is not substance but projecting a positive image.

## Glossary

allostratigraphy: a stratigraphic scheme which categorizes rock units base on their geometric (spatial) relations within a sedimentary basin

chronostratigraphy: a scheme of time units devised for interpretation of geologic (stratigraphic) data

contextualism: the view that propositions can only be understood within the social or cultural contexts in which they were formulated

cross-cutting relations: in igneous and metamorphic terranes, relative age can often be inferred from observing which rock units cut through others, etc.; this is the basis of lithodemic stratigraphy

deconstructionism: an approach widely used in current literary criticism whereby the ideas of contextualism and the existential denial of substantive communication are

applied to literature to “deconstruct” it, denying the possibility of knowing the author’s intent, and evaluating it based on the critic’s perceptions

existential: pertaining to the philosophy of existentialism, which emphasizes the subjective (nonempirical), personal, moment-by-moment nature of individual existence; it is a reaction against empiricism/positivism and differs from postmodernism in asserting the need for personal action and responsibility within the context of relativism

genetic: pertaining to mode of origin

isotopic dating: idea that absolute (chronometric) ages can be inferred from ratios of radiogenic isotopes

Law of Superposition: doctrine that superjacent strata are younger and subjacent strata older than a given stratum

lithodemic stratigraphy: stratigraphy of nonstratiform rocks based on relative dating criteria (i.e. cross-cutting relations)

methodological naturalism: view that science must be practiced *as if* the supernatural did not exist, as opposed to metaphysical naturalism, which asserts this point outright.

nihilism: denial of being or ultimate reality

passive continental margin: the edge of a continent (shelf and slope) that is relatively stable relative to eustatic changes as opposed to, for example, a zone of active subduction

pedogenic: formed from soil

pedostratigraphy: correlation of rock units based on inferred paleosols (“fossil soil horizons”)

pluralism: view that a diversity of worldviews, belief systems or philosophies should be tolerated or promoted

revelationism: belief that true knowledge has been transmitted from God to man

seismic data: subsurface information obtained in the form of wave transmission rates and patterns of reflection and refraction; other geophysical methods are often used in conjunction with seismic

sedimentary basin: a relatively depressed topography which affords accommodation space for deposition of sediments

sedimentology: the study of sediments, sedimentary rocks and sedimentary processes

tectonic: pertaining to forces and movements in the earth’s crust

temporal: related to time, occurring during a particular period in time

Vail Curve: the curve of relative sea level or eustasy (promoted by Peter Vail et al. at Exxon and revised by Haq et al.)

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## Book Review

*Ota Benga; The Pygmy in the Zoo*, by Phillips Verner Bradford and Harvey Blume  
St. Martin's Press, New York. 1992, 282 pages, \$22.95

Ota Benga was a “pygmy” brought to America by anthropologist Samuel Verner, and eventually found his way (or more accurately was forced) into a zoo, specifically in the monkey house of the Bronx New York Zoological Park. It is in many ways also the story of the good and bad fortune of Verner himself, but more so the story of early 1900s America and race and evolution theory. Indeed, Ota often gets lost in the story which is supposed to be about him (Bergman, 1993).

The people who visited the zoo knew the purpose of the exhibit and indeed, some objected to it on the grounds that it was a deliberate attempt to try to prove evolution. The blatant racism, though, is nowhere as clear as the statements of the contemporary evolutionists, many of whom made it quite clear that they believed the “Negro race” is less evolved than Caucasians, and less worthy as human beings to inherit the earth. The existence of pygmies, many felt, made a lie of the teaching of Genesis that all men are brothers, all descendants of Adam and Eve. What further proof did they need than a living, breathing, evolutionary link who was clearly not the equal of the white man, but who certainly was more than just a monkey?

This well written in-depth story illustrates the results of Darwinist racism and its impact in American society, especially American science. The story reads like a novel, and includes much anthropological insight into central Africa. It also includes a great deal of information on how Africans were once treated by whites—in this case the Belgian government—an important part of which was their almost unshakable perception that the pygmies and the central Africans in general were racially inferior, and of less value and worth than whites.

Importantly too, one gains an appreciation of Ota and his incredible skill in surviving his world, and how without him and other pygmies many whites, even Verner himself, would likely have died in the African jungles. Once in America, Ota assimilated western society living skills to help him survive in a world hostile to him. Although whites were intrigued with pygmies, the pygmies were likewise intrigued with whites—and many could flawlessly im-

itate their behavior, such as their folding or unfolding of maps, cursing at mosquitoes, or writing notes in their journals (p. 145). Interestingly, Ota's view of evolution was like the pygmies of Africa, who were “very partial about how they apply the theory of evolution. When it comes to white men descending from the apes, they say they knew it all along” (p. 157).

The account also makes Ota a real, living person with thoughts, feelings, and fully human emotions. This background makes displaying him in a zoo and the words of his contemporaries all the more ironic. Unfortunately, the “primitive race” concept is still very much with us, and reviewing the life of Ota shows that, although he was culturally different, he was a very intelligent person in his own world (a world in which the whites were stupid and bumbling).

The story ended not long after Ota was released from the zoo when, in 1916, he tragically committed suicide with a gun. Thus ended the forced isolation from his family and people caused by the whites, most of whom were murdered by the “evolutionarily superior” race bent on exploiting their land and property. The work contains scores of reprints of contemporary newspaper accounts about the affair which tell much about the racism of Darwinism at the time.

The story of Ota Benga is only one of the many tragic fruits of early 1900s evolutionism, but one which contains a lesson that forces us to acknowledge the validity of the Christian teaching that all humans are brothers and sisters, all descendants of Adam and Eve.

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## Notes from the Panorama of Science

### Star Formation According to Faulkner and Mulfinger: Some Observations

By Emmett L. Williams\*

#### Introduction

Recently Dr. Danny Faulkner presented a paper at the Fourth International Conference on Creationism on the current state of creation astronomy (Faulkner, 1998) and I find much in the article with which to agree. In his conclusions, however, he criticized a paper of George Mulfinger on star formation published about 30 years ago (Mulfinger, 1970).

#### Star Formation as a Natural Process

Faulkner (1998, p. 211) stated that Mulfinger was one of the creationists who believed that star formation violates the second law of thermodynamics and Faulkner noted "...but this is not true." Mulfinger's analysis was considerably more discerning and penetrating than Faulkner indicated. Mulfinger employed a star formation model developed by Lyman Spitzer of Princeton (Jastrow and Cameron, 1963, pp. 39–53) and determined the entropy change for a protostar during a supposed contraction phase, accounting for the volume and temperature variation during that phase. Treating the protostar as an ideal gas, which Mulfinger (1970, p. 10) claimed was an excellent approximation since the distance between particles in the cloud was so great, the entropy change was calculated using

$$dS = Cp \frac{dT}{T} + R \frac{dV}{V} \quad (1)$$

which integrates to

$$\Delta S = Cp(\ln T_f - \ln T_i) + R(\ln V_f - \ln V_i) \quad (2)$$

where  $Cp$  is the molar heat capacity at constant pressure;  $R$  is the universal gas constant;  $T_f$  and  $V_f$  are the final temperature and volume of the protostar respectively;  $T_i$  and  $V_i$  are the initial temperature and volume of the protostar. Given that  $V_i = 5.64 \times 10^{47} \text{ m}^3$ ,  $T_i = 100 \text{ K}$ ,  $V_f = 1.40 \times 10^{33} \text{ m}^3$ ,  $T_f = 100,000 \text{ K}$ .

Before determining the entropy change, Mulfinger (1970, p. 10) stated:

Calculating with figures given by cosmologists, we can estimate the entropy change for such a hypothetical condensation (protostar contraction). If it turns out that the entropy increases in such a process, we must conclude that it is natural and in keeping

with the "downhill" trend of nature. If, however, we find that the entropy would have to decrease, we have every right to be suspicious; "uphill" processes require organizing intelligence and/or energy from the outside. We would then have to examine whether such could be supplied within the scope of natural occurrences. (Parenthesis mine)

Note that Mulfinger did *not* declare that the second law would be violated if an entropy decrease occurred, but questioned whether the force or process that caused the decrease would be within the scope of possible natural occurrences.

The calculation from equation 1 using the values in the Spitzer model yielded an entropy decrease of 33 entropy units per mole of gas in the cloud. Mulfinger (1970, p. 11) then commented that the condensation of the protostar is not a spontaneous process. He explained:

Applying the second law to the star formation process, then, we find that the reverse process (expansion) rather than the forward process (contraction) is favored (p. 11). (Parentheses mine)

The language of the second law is so structured that a calculated entropy increase indicates a spontaneous process, whereas a calculated entropy decrease indicates that a process must be forced so that it will proceed in an opposite direction. For instance, gases spontaneously expand (either in the laboratory or in an astronomical situation), but they must be constrained during contraction. If a gas contracts, there is not necessarily any violation of the second law, some external mechanism has forced the gas to decrease in volume. What would cause the protostar (a gaseous cloud at 100 K) to contract? Spitzer surrounds the protostar with another gas cloud at 10,000 K. As the hotter cloud expands, it is supposed to force the inner cloud (protostar) to contract.

#### Gravitational Considerations

Faulkner (1998, p. 211) suggested that a contracting protostar possesses considerable gravitational potential energy. Upon contraction one-half of the energy heats the protostar and the other half is radiated. Mulfinger (1970, pp. 11–12) performed gravitational force calculations at the surface of the protostar. He noted that in the initial stages of contraction, the outward force caused by the thermal motion of the molecules on the surface of protostar (even at 100 K) is greater than the gravitational inward force. The radius of the cloud would have to contract to slightly less than the radius

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of the earth's orbit before gravitation is strong enough to cause continual contraction. The release of any significant gravitational potential energy would be late in the star formation process, possibly too late to aid in contraction. Mulfinger concluded his gravitational section as follows:

In general, therefore, the smaller the object the more successfully it can contract provided equilibrium has not yet been reached. But the enormous clouds that are fashionable among theoreticians today (those that are supposed to produce stars in groups of hundreds of thousands) are extremely unfavorable for contraction. Gravitation avails little at such a radius (1970, p. 12). Thus there is not much chance of obtaining any release of gravitational potential energy.

### Radiation

Faulkner (1998, pp. 211–212) claimed that Mulfinger ignored the fact that energy is radiated from the protostar. How can heat initially be radiated from a 100 K protostar into a surrounding cloud at 10,000 K? Heat always moves from a hot object to a cold object spontaneously whether it be by conduction, convection or radiation. Mulfinger did not ignore radiation, it is not going to happen initially in the conditions specified in the Spitzer model.

### Entropy Production

Faulkner (1998, p. 212) stated that energy is radiated from the protostar ( $\Delta S$  is negative), but the absorption of that energy elsewhere produces an even larger positive increase in entropy resulting in a total positive entropy increase. No details were given on how this exchange would operate. Often when a calculated entropy change is negative, indicating a nonspontaneous, unnatural process or occurrence, a person often enlarges his system (mentally) to include entropy-producing mechanisms so that the entropy decrease is much smaller than the entropy increase. He then concludes that the entropy decreasing step can occur naturally because of the larger entropy increase elsewhere. Not so! All natural processes are spontaneous irreversible processes; each must reflect an entropy increase (Crawford, 1963, p. 260). Prigogine (1967, p. 17) noted the specific situation called for by Faulkner is not possible for natural processes. Prigogine claimed that when only irreversible (natural) processes are operating; “We can therefore say that ‘absorption’ of entropy in one part, compensated by a sufficient ‘production’ in another part of the system is prohibited” (p. 17).

Thus the ploy of an overcoming entropy increase to allow for an entropy decrease elsewhere is not feasible for natural processes. As an example, a house in a subdivision

is burning (entropy increase). There are no magical entropy decreases occurring in the house next door because of the rapid entropy increase adjacent to it nor would you expect any. All natural processes cause an increase in entropy. Thus Mulfinger's analysis remains valid. You may contrive or invent a nonspontaneous process or mechanism on paper to develop a desired condition (as in the Spitzer model—an outer, hotter cloud forcing a cooler, inner cloud to contract). This intelligent planning, however, has no guarantee of working in a natural situation (the real world). Naturalists often demand the use of only natural processes when discussing origins with creationists, but their origin schemes call for nonspontaneous, unnatural processes. This is what Mulfinger emphasized. The issue is not whether you are able to make star formation viable on paper, but did it really happen that way. George (1970, p. 9) quoted, G. R. Burbidge, a noted authority on the evolution of elements in stars as saying: “If stars did not exist, it would be easy to prove that this is what we expect” (Aller and McLaughlin, 1965, p. 577).

### Conclusion

Mulfinger discussed other topics in his paper; stellar aging, galaxy formation, galactic evolution, planet formation, various types of stars, age of the universe, etc. His article is still available for study as a chapter in *Speak to the Earth* handled by Creation Research Society Books. Read the essay and evaluate his claims. He never intended his thoughts to be the ultimate writing on the topic. He felt that in spite of the clever well-thought-out star formation scenarios that creation by an intelligent Being was the only means by which the universe and its components could have come into existence. A physicist criticized Mulfinger's paper in 1971. Essentially Faulkner used these arguments, but did not include Mulfinger's answers. See Hall, 1971, p. 87; Mulfinger, 1971, pp. 87, 88.

Mulfinger's work, however, is dated. It is time for other mathematically-detailed critical examinations of star formation concepts. I challenge creationists to tackle the topic. The new monograph to be edited by Faulkner is an excellent place for such an undertaking. Any discussion of this topic also is welcome in the *Quarterly*.

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## Evolution, Time, and *Brontosaurus*?

By Carl R. Froede Jr.\*

According to many evolutionary biologists, the Dinosauria are believed to have evolved from thecodontian ancestors (Benton, 1990; Colbert, 1965; Romer, 1959, 1966; Stahl, 1985). However, more recently this ancestry has fallen into question (based on cladistics), and the dinosauria now are proposed as being derived from the Archosauria (Archibald, 1996; Fastovsky and Weishampel, 1996; Padian, 1989; Parrish, 1997). It is suggested that the separation of a once unified Pangaeian landmass during the early Triassic isolated terrestrial plants and animals from the single genetic pool. Evolutionary forces in effect over the course of the millions of years of the Mesozoic Era then drove these groups of plants and animals to develop into new and different types/kinds on each of the then existing continents (e.g., Laurasia, Gondwana) [Fastovsky, 1989; Fastovsky and Weishampel, 1996, pp. 30, 359–384; Kurtén, 1969; Russell, 1993]. However, this interpretation is now coming into question due to the occurrence of similar types/kinds of fossilized flora and fauna found on each of the different continents. Fossil evidence suggests that there were similar distributions of plants and animals on each of the continents with little to no evolution occurring in the time intervals for which they are defined (Archibald, 1996; Charig, 1971, 1973; Colbert 1985; Weishampel, 1990). What does this say for evolution? Do we observe the parallel evolutionary development of the same kinds of dinosaurs on each of the separated landmasses or are we observing the same types/kinds of dinosaurs spread across the various continents?

### The Dinosaur Mix-Up

The Fernbank Museum of Natural History, in Atlanta, Georgia hosted one of the first exhibitions of Chinese dinosaurs and mammals in the United States, from April 1 to December 31, 1995. Several North American paleontologists came to Atlanta to examine these interesting and unique specimens of dinosauria. Some of these Chinese

dinosaurs were only known by a single skeleton. Hence, their extreme rareness contributed additional interest to western paleontologists. Much of the following information about the Chinese dinosaurs was conveyed to me by Fernbank Museum staff.

One large sauropod on display was the newly identified *Nuoerosaurus chaganensis* (Figure 1). One of the information signs for this exhibit stated that this Chinese dinosaur was so new that it had not been assigned to any particular sauropod genus or species. The Fernbank Museum staff was initially informed that this display specimen was 100 percent complete. Following its unpacking and assembly it was discovered that many of the bones were plaster casts made to fill in the gaps of missing bones. The Chinese paleontologists later informed the Fernbank paleontologists that this specimen was only 80% recovered from the Oagan Nur Salt Mine. It also was admitted that the skull of this particular specimen was not found. However, the Chi-



Figure 1. The now defunct Chinese sauropod *Nuoerosaurus chaganensis* which was believed to be a new type of *Camarasaurus*. Approximately 80 percent of this specimen was found and recovered from a salt mine. The skull of this dinosaur was never found, and one from another *Camarasaurus* was placed on this specimen. The remainder of the bones are composed of plaster casts in order to fill out the skeleton.

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nese paleontologists believed that the *Nuoerosaurus* sauropod was a new and unique *Camarasaur* and the skull of one such animal was placed on the skeleton on display (Figure 2). *Camarasaurians* are defined as four-footed plant-eaters which were 30 to 60 feet long and weighed up to 20 tons (Lambert, 1990, p. 49). The interpretation of this dinosaur being a new type of *Camarasaur* was based on the belief that many if not most of the Chinese dinosaurs are unique because of their evolutionary development far from the other dinosauria.

I was told by the Fernbank Museum staff that in November 1995, Dr. J. S. McIntosh (a recognized sauropod expert—see 1989, 1990, and Psihoyos and Knoebber, 1994) visited Fernbank to investigate and examine the newly discovered *Nuoerosaurus* skeleton. He quickly realized that the skull and skeleton were improperly matched, and that the sauropod body was not that of a new *Camarasaur*. Dr. McIntosh identified the body as that of a *Diplodocus* (Figure 3). This determination diminished the uniqueness of this Chinese sauropod as diplodocids are common. While this creature's genus or species may vary from similar diplodocids found on the other continents, it clearly does not represent a totally different type/kind of dinosaur as the Chinese paleontologists had originally believed. Diplodocids are described as very large four-legged plant-eaters which include some of the largest of all dinosaurs, growing to lengths of 54 to 90 feet. They have been found in North America, Europe, Africa, and Asia (Lambert 1990, p. 146).

The classification of this sauropod, as to genus and potentially even species, is now a matter of comparing subtle skeletal differences in this creature with other similar types/kinds of diplodocids. The assumption made by the Chinese paleontologists that their dinosauria represent a diverse and unique group is unfounded. The evolutionary assumptions that dinosaur diversity and uniqueness are based on distance and time does not appear to be supported by the fossil evidence.

This is not the first time that dinosaur bones have been incorrectly mixed with the head of one dinosaur attached to the body of another. The most famous case of this occurring in the past involved the sauropod *Brontosaurus*. The details of the *Brontosaurus* mix-up along with the creation and eventual elimination of this dinosaur genus will not be presented here. The reader is referred to works by both Gould (1991) and Berman and McIntosh (1978) for additional details of this interesting incident. What is important to note is that it took 24 years for this error to be rectified for scientific purposes, and 110 years for the issue to be resolved for public purposes (Gould, 1991). Today, the sauropod dinosaur known as *Brontosaurus* no longer exists, and is now properly identified as an *Apatosaurus*.



Figure 2. A close-up of the skull of a *Camarasaur* which was incorrectly placed on this skeleton of an *Apatosaurus*. This unfortunate mix-up is understandable based on evolutionary assumptions.



Figure 3. A side view of the incomplete *Diplodocus* skeleton. The tail of this creature is still missing bones and would extend an additional 8 to 10 feet if all the bones were present.

The misidentification of various dinosauria appears to be more common than perhaps we currently realize. Their identification is based on a direct comparison between the reconstructed original unknown creature and other similar types/kinds. This work is usually performed by someone who would know the creatures well enough to identify them. In the case of the *Nuoerosaurus chaganensis* on display at the Fernbank Museum of Natural History it was Dr. McIntosh. This error in the identification of this Chinese dinosaur could have potentially continued for many years, all because these sauropods are from a country which has only recently opened its doors to the world. The assumptions of a totally unique and different group of dinosauria made by the Chinese paleontologists is understandable if the evolutionary model for the development of these creatures is correct. The Asian

continent has been separated from other known dinosaur populations for breeding purposes (based on paleogeographical maps created to reflect the fossil sauropod collecting locales of today), for million years (Condie, 1989; Dietz and Holden, 1970; Psihoyos and Knoebber, 1994; Smith, Smith, and Funnell, 1994; Windley, 1995). They had assumed that over the course of time their dinosauria had evolved into new families, genera, and species due to the separation of breeding populations, vast periods of time, and evolutionary forces.

It is interesting to note that a current popular explanation as to why evolutionary radiation did not happen between the continents is due to the transgressions and regressions of sea-level during the Mesozoic. Evidently sufficient time and environmental pressures did not exist on any of the continents to create conditions conducive for much dinosaur evolution because the dinosauria were able to interbreed during sea-level regressions (via land bridges). Hence, we find rather successful creatures with no “transition types” and are told that they lived (basically unchanged from their “type”) for millions of years.

#### A Young-Earth Flood Framework Approach

Our Biblical framework would suggest that all of the terrestrial creatures were created on Day 6 (Genesis 1:24–25), and they existed along with mankind during the Antediluvian Timeframe (Froede, 1995). The Flood resulted in many changes on the earth including: 1) it served to kill all terrestrial animal life not preserved on the Ark, and 2) it provided the sediments to bury and preserve many of the dead plants and animals we presently identify in the stratigraphic record. We observe the fossilized remains of these large creatures at certain outcrops (usually concentrated in “dinosaur” graveyards) across the globe. It still is not understood how these complex creatures existed and functioned in the past (Alexander, 1989; McGowan, 1994; Psihoyos and Knoebber, 1994).

This simple mix-up of dinosaur bones presents an issue which speaks to the core of the evolutionary paradigm. If the dinosauria evolved from the Archosauria and if they were separated from interbreeding contact with one another for millions of years and if evolution has driven them separately on each of the continents, then why are there so many similar types/kinds found on each of the continents? We should expect totally different types/kinds of dinosauria on each of the continents if the various ancestors to dinosaurs were prevented from interbreeding and subject to hundreds of millions of years of evolution. However, the uniformitarians counter this argument with the suggestion that based on the similarity of the dinosauria on each of the continents there must have been some interbreeding among them (this of course all occurred with what

amounts to hundreds of miles of water separating the continents and thus preventing interbreeding during these suggested millions of years of time—see Colbert, 1985; Preiss and Silverberg, 1992, pp. 316–324; Psihoyos and Knoebber, 1994, pp. 6–7; Smith, Smith and Funnell, 1994). Transcontinental interbreeding is believed to have occurred during sea-level lowstands throughout the Mesozoic where various land bridges allowed the migration and breeding of the separated groups of dinosauria (Archibald, 1996; Fastovsky and Weishampel, 1996, p. 384).

An interpretation which better fits the fossil evidence would suggest that all the dinosauria were created and lived in environments defined by their kind/type. Little environmental input or time served to limit the diversity between the kinds. Dinosaurs outside the protection of the Ark were killed, scattered, and buried in the worldwide Flood. Subtle differences between dinosauria genera and species could be explained based on the variability of the population and the input of the environment. This would better explain the many similarities between the fossilized types/kinds of dinosauria genera and species on each of the continents today.

The assumptions of evolutionary biology and the supposed role that plate tectonics played in the millions of years of dinosaur development need to be challenged. If time and the environment played such a key role in the evolution of life then we should expect a greater diversity of flora and fauna on each of the separated continents. This is *not* what the fossil record reveals. Hence, evolutionary scientists are then forced to state that there was interbreeding between the creatures without explaining what role evolution played and how these creatures crossed what amounts to hundreds of miles of open ocean (using their continental plate positions at the suggested times) or of invoking sea-level regressions to form various land bridges. It is time we identify “belief statements” versus scientific evidence in explaining the origins and existence of the dinosauria.

The paleontological/stratigraphic record suggests that there is a similarity of “type/kinds” of dinosauria found on each of the continents. Those that we find fossilized in the various strata indicate rapid burial, and I suggest that this testifies to the global Flood of Noah recorded in the Scriptures.

#### Glossary

**Archosauria:** A subclass of diapsid reptiles, including the dinosauria, crocodilians, and pterosaurs and their ancestors.

**Gondwana:** The Late Paleozoic continent of the Southern Hemisphere. Various lines of evidence suggest that the present continents are fragments that have been sepa-

rated from each other by continental displacement. The supercontinent from which both Gondwana and Laurasia were derived was Pangea.

**Laurasia:** The protocontinent of the Northern Hemisphere, corresponding to Gondwana in the Southern Hemisphere, from which the present continents of the Northern Hemisphere are believed to have been derived by separation and continental displacement. The hypothetical supercontinent from which Laurasia and Gondwana were derived is Pangea. The protocontinent Laurasia included most of North America, Greenland, and most of Eurasia, excluding India.

**Pangea:** The supercontinent that is believed to have existed in Earth's past which included most of the continental crust of the earth, from which the present continents were derived by fragmentation and continental displacement.

**Sauropoda:** Jurassic and Cretaceous quadruped dinosaurs of herbivorous habit.

**Thecodontia:** An order of primitive archosaurian reptiles of varied body forms, some foreshadowing dinosaurs and some crocodilians.

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## Book Review

### *The Human Body: An Intelligent Design* by Allen L. Gillen, Frank J. Sherwin III, and Alan C. Knowles Creation Research Society Books, St. Joseph, MO. 1999, 149 pages, \$17

If there is no Creator, there is no real meaning to life. If there is no designer, there is no design but just a hodgepodge of unrelated, non-functioning, loosely assembled parts of machines or human bodies. When students first examine the human body, they are overwhelmed by the complex and intricate designs that give precise functional purpose to each structure. In 14 chapters the authors demonstrate repeated physiological patterns in the 11 body systems.

This book discusses the various body systems by comparing and contrasting the ideas of intelligent design by an inferred Divine Designer versus unthinking matter. The latter uses random processes over vast periods of time along with mutations to result in the alleged creative acts of natural selection. The book elaborates on the biochemical basis of blood clotting, the amazing immune response, the latest research on split brain studies, the physiology of flight, the body's adaptation to high altitudes and concludes that the human body is the "ultimate machine."

This book is built around the basic universal patterns and themes in human anatomy and physiology that include

- the direct relationship of structure to function,
- the laws of programmed homeostasis for precise functioning of metabolic mechanisms,
- the interdependence between body parts,
- short-term physiological adaptation to stressors,
- maintenance of membranes/boundaries and
- the triple concepts of order, organization and integration.

Most popular books on the human body, such as best selling National Geographic titles, *The Incredible Machine* and *Incredible Voyage: Exploring the Human Body*, as well as most human anatomy and physiology texts, assume an evolutionary development of matter, life and the human body. This book is unique in that it is built around the widely accepted view of the integration of structure and function, but advocates a distinct creationist approach to the study of the human body. It is ideal for students of basic biology, human anatomy and physiology, pre-medical, pre-dental and pre-therapy programs and all others interested in digging deeper into the logic that intricate design in the human body infers a Divine Designer. It challenges biology students to evaluate whether the creation or evolution model of origins makes more sense.

This book is highly recommended, either as a basic text or as a supplement to a basic text, for all human anatomy and physiology courses in Christian colleges and universities. It definitely should be a reference book for all Christian instructors of basic biology courses.

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## Letters to the Editor

### The Genesis Kind and *Psarolepis*, a Fossil Fish

I have long maintained that the Genesis kind is the plan or concept, which includes what can be seen in the phenotype and also what could be produced by the organism's genetic potential. Crosses between distinct species of camel produce females which are fertile and males that are infertile (Altman and Dittner, 1962). This same outcome can also be seen in crosses between lion and tiger (Siegler, 1972, pp. 89–94). A cross has been obtained between a camel and a llama (Ingham, 1998, p. 15). It is clear from these crosses and from the rest of the data in this paper that the Genesis kind does not conform to any particular hierarchical level of the taxonomic system because the above crosses involve species, genera, and even families. Can crosses occur between members of different orders on the classification table? It seems clear enough that cats and dogs which are both members of different families in the carnivore order can be ruled out from belonging to the same kind, but antelope with deer, hippo with pig, and moths with butterflies may be worthy of investigation to see how far crossing can go.

In birds, crosses between chicken and turkey or guinea fowl and chicken involve families belonging to the same order. Swans, geese, and ducks also produced offspring when crossed with each other (Siegler, 1972, pp. 95–116). In 1980 Strickling produced a paper in the *CRSQ* in which he suggested that the kind was a plan or concept, but he seemed to take the view that the whole group of birds was the same kind if I have understood him correctly. I doubt that all 27 orders of birds are in the same kind, I think that the limits of crossing among birds should be investigated (Strickling, 1980, p. 106). Within Strickling's view of the kind we can assume that the level of class would also apply to amphibians, reptiles, birds and only when we get to mammals would we have smaller groups like cats, dogs and cattle and within all these levels some groups could have given rise to others within the basic plan.

The organism's genetic potential is not to be underestimated. In man the variation that can be produced may be inconceivable! Many other life forms have just as great, if not greater, amount of potential genetic change within the kind that could be produced (Ayala, 1978, pp. 54–55). With this in mind, I have in two previous papers mentioned that it may have been possible that Marsupialia could have laid eggs in the past and that certain dinosaurs may have had feathers without ever going beyond their kind (see Brown, 1998; 1999 for further details).

In a recent experiment two Australian scientists crossed two species of sea urchin and were surprised to find that

the offspring looked like that of a starfish (Copley, 1999, p. 7). Like the birds mentioned earlier, the sea urchin and starfish are two classes which belong to the same phylum known as Echinodermata. It is still possible that the outcome of this cross means nothing, but it is, nevertheless, worth investigation by creationists to see just how much we can find out in terms of relationships within this group.

Finally, we come to a fossil discovery of interest. The fossil in question is a fish called *Psarolepis*. The fish stems from the very beginning of the Devonian rocks, although there appear to be remains of it found in the Silurian period. The fish is said to contain features that belong to several groups of fish. Bony fish are grouped into two camps: Actinopterygii or ray-fins and Sarcopterygii which contain the lungfish and coelacanth. Most of the skull is like that of the Sarcopterygii, however, the tooth-bearing bones of the snout and lower jaw and the cheek bones are like those of Actinopterygii. The shoulder girdle is like that seen in another group of fish called Placoderms, also found in Silurian rocks. *Psarolepis* also has spines in front of the median fins, a feature found in yet another group of fish from Silurian rocks called Acanthodians (Ahlberg, 1999 and Zhu, Yu and Janvier, 1999). The question is how did it come by so many different features from the viewpoint of creation?

The main options (though there are permutations within these options) are as follows. In the first option, the fish was created with most if not all of those features and, through its genetic potential, gave rise to most, if not all, of the other groups of fish. This would have most, if not all, of the class of fish the kind concept or plan and in this way Strickling's view of the class or most of it would be correct in this case, but by way of the organism's genetic potential and not a direct creation of most groups. In the second option, the fish gave rise to one or two lines of fish and no more, by way of the life forms' genetic potential. In the third option, the fish was created with all those features or a few of them and gave rise to no other group, but was a form of fish that remained separate from the others. All of the examples in this paper show that the created kind is not at any level within present-day schemes of classification system. But it is the plan or concept that is the kind and the genetic potential that each life form has that can help to produce the changes needed to adapt to a wide range of life styles and on the odd occasion produce features that we may not have expected. We must leave no stone unturned when looking for just what makes up a Genesis kind and what changes it can produce and try to be prepared for what may

at first seem like the unexpected, for we must never underestimate the kind's genetic potential.

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## Complexity, Variability Limits, and Holobaramin Boundaries

I recently came across an article by Waxman and Peck (1998) which I believe supplies a new and solid basis for hard limits on DNA modifiability. Commenting on that article, Wagner (1998) asks, “Are organisms ... infinitely malleable by the changing forces of evolution, or do they contain a Bauplan, or body design, which remains little changed . . . ?”. He answers that Waxman and Peck show “that there is a complexity limit beyond which genes can freeze into a fixed state ... once the genes affect more than two characters that are under simultaneous stabilizing selection”.

The article defines a ‘phenotypic character’, or simply ‘character’, as any characteristic of a particular individual, which “can be anything from the circumference of the stem of a plant to the distance between two subunits within a protein”. It further defines a ‘pleiotropic mutation’ as one that affects three or more of these characters when it occurs in an organism’s DNA. Waxman and Peck derive a statistical model concluding that a pleiotropic mutation that survives leads to evolutionary stasis in all characters it affects.

Allow me to define some more terms. A ‘Gaussian distribution’ or ‘bell curve’ is a curve of that shape on a graph. Imagine a graph in which the vertical axis measures a number of organisms within a population, and the horizontal axis measures the organisms’ value for a given character, like “the circumference of the stem of a plant”. The number of organisms tends to be greater toward the center value, and smaller away from the center, hence the bell shape. For our final definition, a ‘singularity’ is a point on the horizontal axis of our graph where the curve goes vertically to infinity. Given these definitions, Waxman and Peck show that a non-pleiotropic mutation produces a

Gaussian distribution for each character that is non-singular, i.e., there is no singularity. But they also show that a pleiotropic mutation produces a Gaussian distribution for each character that is singular. In other words, when a mutation affects three or more characters, the bell curve for each character is squeezed into a single vertical line of essentially zero width and infinite height. There are also ‘skirts’ in the curve to either side of the line, but their height is negligible.

What does all this mean? In the non-singular distribution, the number of individuals carrying exactly the optimal value for a given affected character is the area of a vertical line in the center of the bell curve, with near-zero width and the height of the curve’s maximum. This line is taller than any other such line under the curve, so the optimal value is the most likely one. However, the area of this line is minuscule compared to the total area under the curve, so relatively few individuals actually carry the optimal value in the non-singular case. The predominance of sub-optimal values allows microevolution to occur in the form of genetic drift. Conversely, in the singular distribution, virtually all individuals possess the optimal value for the given character. Thus, pleiotropic mutations prevent change in all characters they affect. In fact, as the number of affected characters increases beyond three, the skirts of the singularity flatten. That is, the portion of the population carrying the optimal value approaches ever closer to a perfect 100% for each affected character.

To make a loose analogy, cars become more difficult to repair as their subsystems become more interdependent, because any change to one subsystem becomes more likely to break another subsystem. It makes sense that survival in a population would also become more difficult as muta-

tions affect more characters, though the given analogy is imprecise at best. So there is at least a somewhat intuitive basis for the Waxman-Peck model. But the model goes beyond the intuitive to produce a singularity, implying not mere difficulty, but hard limits on variability.

On the other hand, the same findings have been used in that article to support macroevolutionary theory, by explaining away examples of evolutionary stasis. But the article ignores the fact that now all those chimerical mutations sought thus far in vain have a new restriction. We already know that each and every mutation that supposedly produced man from prokaryote, and indeed each one along every supposed descent line, must be beneficial. But now, it also must be either non-pleiotropic, or the last of these mutations to occur at its locus (gene location). The Waxman-Peck model says a surviving mutation would essentially never follow a pleiotropic one at the same locus. It follows that each time one of those billions or more of supposed mutations has occurred, if it is pleiotropic, then it has limited the number of loci available for further mutations. Even more important is the fact that it has prevented further changes in every character it affects.

This argument should be applied cautiously, because (as pointed out in Wagner, 1998) it is conceivable that the Waxman-Peck model is merely producing mathematical artifacts. But a quite similar argument was posed by Fox (1999), with an entirely different basis. He quotes a Gould (1999) article in which this leading evolutionist deplors “the one-gene-one-trait notion”, and says, “the very notion of a gene ‘for’ something ... lapses into absurdity”. Fox draws the conclusion that any mutation would then alter “a whole suite of traits in addition to the target trait”, and asks, “then how can anyone state categorically that evolution is even possible?”. Gould implies that all mutations may be pleiotropic. Note that if the Waxman-Peck model is correct, then Gould implies that every single mutation that survives may lead to stasis at its locus, and in all affected characters, adding considerable weight to Fox’s point that macroevolution is “impossible”. Creationist views on microevolution, however, are not affected by this model, since they are based only on the selection of pre-existing alleles, and the view that mutations which affect codons do not survive anyway.

But of even more use could be the broader implications of the Waxman-Peck model for holobaramin boundaries. You see, while the details are unclear, these boundaries are connected to complexity and thus (according to Wagner, 1999) to pleiotropy. Following Wagner, we postulate that at least in a broad sense, complexity implies increased pleiotropy. Following Waxman-Peck, we postulate that increased pleiotropy implies decreased DNA modifiability. It follows that we should generally find smaller species

counts for holobaramins containing more complex organisms and larger counts for simpler ones. Thus, ignoring evolutionary and other classification system biases, we hypothesize that holobaramins of complex organisms should tend to have boundaries corresponding to lower classification levels, and simple ones to higher levels. This hypothesis is testable and should be examined in future baraminology studies as well as with existing data. Furthermore, at the extreme of complexity we should not be surprised to find a holobaramin containing only one species, i.e., *Homo sapiens*. And the fact that the Scriptures agree here should lend some credence to the hypothesis.

However, we have a problem with our assumption that complexity implies increased pleiotropy. Are not mammals more complex than reptiles? Yet phylogenists attribute more stasis (implying greater pleiotropy, and thus greater complexity) to reptiles than to mammals, though again that view contains macroevolutionary bias. Worse, the same argument implies that blue-green algae are also more ‘complex’ than mammals. Perhaps the relation between complexity and pleiotropy is more subtle than we assumed. How does one measure complexity? Are there different types of complexity? On the other hand, could it be that pleiotropy is only one of several forces producing stasis? Since it appears obvious that mutations would affect more characters in organisms that have more characters, our assumption stands, but these discrepancies cry for resolution.

Comparing previous CRSQ baraminology studies against this hypothesis, we will see that the huge gaps in coverage prevent our elucidating much of any pattern. That pattern is also obscured by biases in the classification system as well as our inability to ‘measure’ complexity. But while Bergman (1999) refutes the notion of common descent between the two Monera subkingdoms, Archaeobacteria and Eubacteria, he does not preclude the possibility of a holobaramin as high as the Archaeobacteria subkingdom level. On the other end of the spectrum Robinson and Cavanaugh (1998a) find phenetic and cladistic support for the concept that the human species, as well as possibly the orangutan, constitute holobaramins at the species level. Interestingly, the latter authors also mention (p. 203) that the molecular data, when separated from all other differentiating criteria, only minimally differentiate humans from the pongids. This could be another effect of pleiotropy. That is, if variability is more limited within more complex holobaramins, then variability across their boundaries could also be more limited as compared to simpler holobaramin boundaries.

With the foregoing caveats in place, we are ready to compare published proposals associating holobaramin boundaries to classification levels as seen in this table:

|                    | <u>Testudinae</u> | <u>Felinidae</u> | <u>Primate</u> |
|--------------------|-------------------|------------------|----------------|
| Kingdom            |                   |                  |                |
| Phylum             |                   |                  |                |
| Class              |                   |                  |                |
| Order              |                   |                  |                |
| Superfamily        |                   | X                |                |
| Family             | X                 |                  | X              |
| Subfamily/Supergen |                   | X                | X              |
| Genus              | X                 |                  |                |
| Species            |                   |                  | X              |

The Testudinae (tortoise) column was drawn from Robinson (1997), while the Felinidae (cat) column was drawn from Robinson and Cavanaugh (1998b). The Primate information was taken from a combination of Garcia-Pozuelo-Ramos (1997) and Robinson and Cavanaugh (1998a).

The Testudinae/Felinidae relationship does not appear to fit my hypothesis. But does this contradict my hypothesis or does it contradict my *a priori* assumption that mammals would exhibit more pleiotropy than reptiles? Recall the problem with our assumption that complexity implies increased pleiotropy. Then again, Frair (1991) suggests a baramin for turtles (including tortoises) at the order level, which would remove the discrepancy in the diagram. But that does not remove the problem with 'complexity', and I leave the diagram as it is to illustrate that problem.

The Testudinae/Primate and Felinidae/Primate relationships do generally follow my expectation. But, the Monera, Protista, Fungi, and Plantae Kingdoms are not even represented at all. In fact, all Animalia phyla are also missing, except Chordata, and within Chordata, only the Vertebrata Subphylum, and only its Mammalia and Reptilia Classes are represented. Clearly, this analysis can become meaningful only with a more representative sampling of organisms. It will also require a greater understanding of the relation between phylogenetic placement and complexity, as well as the separate relation between complexity and pleiotropy. Also there are the biases in phylogenetic placement to deal with. Ideally, we would like to map all possible mutations to all their effects, and one might think that efforts like the Genome Project might make this possible. But a glimpse of the sheer magnitude of that problem is provided by Howe (1999) who says, "... nonhomologous structures can be produced even when two organisms have homologous (nearly the same) genes.", and "... some structures which are 'homologous' can be produced by nonhomologous (different) gene pathways.". Isn't God's creation humbling?

If my diagram shows nothing else, at least it shows that baraminology studies covering a vastly wider range of organisms are in dire need, irrespective of my hypothesis. It also shows what a gargantuan task has been carried forward thus far by such a small group of our colleagues. I do not mean to belittle all the other gargantuan tasks our colleagues are involved in, nor the role played by so many others whose work has supported the studies mentioned herein. Rather, allow me to paraphrase the closing statements of Frair (1991) to say that the naturalistic paradigm will never lose its grip on our culture, until we develop a relatively complete alternative, which includes among much else a relatively complete bariminology. Macroevolutionary theory can be picked apart with ease, but providing an alternative is another matter indeed, and as I understand, our true goal.

I would deeply appreciate comments by others on the *Science* article, my interpretations of its meaning, and its applicability to creationist studies.

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## The Production of Form, *Hox* Genes, and Symmetric Variation

In my letter (Brown, 1999) I explained how symmetric variation works and I offer a number of recent examples which support the idea that genes produce form. Symmetric variation is at the heart of why life forms remain within their respective kinds and it also governs the outcome of genetic change and the types of change that can occur. The way amino acids are coded by their bases ensures that some mutations will produce no change, hence the term “symmetric”. I prefer the term symmetric because the term “silent” implies that nothing has happened whereas something has happened, but the result remains the same. Other DNA changes produce changes within the same amino acid groups and yet other mutations can produce a broader form of the gene by mutating outside the amino acid group to which the original amino acid belonged.

Over the years, some 30 genes have been discovered that are active in producing the pattern of the embryo of the vinegar fly (*Drosophila melanogaster*). Three of these are involved with the production of the head to tail pattern of the organism (Nüsslein-Volhard, 1996). By injecting a protein called bicoid at what would have been the tail-end, a head and thorax are produced instead. With the bicoid protein a head can be produced at either end if desired (St. Johnston and Nüsslein-Volhard, 1992). An even more recent paper has shown that a new family of secreted proteins cause head induction in *Xenopus* (Glinka, Wu, Delius, Monaghan, Blumenstock and Niehrs, 1998, pp. 357–362).

A recent science program in the B. B. C. Horizon series presents a history of the Homeobox genes (Hopeful Monsters, 1998). In this program, a Hox gene that was involved in the guidance of eye production in a mouse was put into a fruit fly and the eye of a fruit fly was produced. A Hox gene known as Hedgehog was taken out of a fruit fly and put into a developing chick and as a result a mirror image of the chick wing was produced. This gene in the fly is used to guide the production of the limbs. In a remarkable case a woman in the U. S. A. had this same gene used to induce the production of new bone in her damaged leg. This shows that these genes are like switches that control other genes that guide the production of specific organs such as

wings. What type of organ goes where is determined by the Homeobox genes like turning on the production of an eye. But the nature of the eye which is built will be governed by many target genes which produce an eye that is typical of the particular kind of life form. Bony fish have a number of mammalian Hox genes, but do not produce anything beyond fish structures. Likewise horseshoe crabs have Hox genes belonging to higher forms of life but do not produce anything beyond crab organs (Carroll, 1995, p. 484). These phenomena fit well with the creation view. The list could be extended but space does not permit us to go further. There is enough here to show that there is a very strong genetic connection to form.

The genetic mutations hoped for by evolutionists to change life forms beyond their kinds will not come about. But any mutations that do occur will only produce changes within the genetic potential of the kind.

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I do not doubt that the world was created in the beginning with all the perfection which it now possesses; so that the Sun, the Earth, the Moon, and the Stars existed in it, and so that the Earth did not only contain the seeds of plants but was covered by actual plants; and that Adam and Eve were not born as children but created as adults. The Christian faith teaches us this, and natural reason convinces us that this is true; because, taking into account the omnipotence of God, we must believe that everything He created was perfect in every way.

René Descartes (1596–1650)  
Quoted from English edition of *Principles of Philosophy*,  
Ed. V. M. Miller and R. P. Miller, 1983.

## Assessing Creationist Stratigraphy (CRSQ 36:51–60) and the Formation of Clay

I read with interest this article as it is one of the few that are prepared to examine the whole subject of the real situation of geological strata in both a general sense and then to see in detail how it fits a particular location.

There is still considerable debate on where, in the evolutionist-based geological column, the upper limit of the Flood strata should be drawn. What neither side seem to be doing is actually answer the objections of the opposition. They are like “ships that pass in the night.” One of the most testing aspects of any model is the way in which it is able to answer any objections made by its critics. Creation is well able to defend itself against any evolutionary opposition, but it also needs to look at the way in which it handles contradictory viewpoints within itself. Its record on this score, and I could name several issues, is not all that good.

My main concern with these general stratigraphical papers is that every one of them misses a most important flaw in their basic assumptions when they refer to the many and varied strata as primarily the result of “erosion and deposition” of previously existing strata. This, in fact, is one of the main challenges that this paper presented to creation geologists. It often refers to “erosion” and “high energy levels”, demonstrates that existing creationists theories are inadequate to explain the present strata, and finally contends that “a new approach to creationist stratigraphy is required” and hopes “that other creationists will focus their efforts developing concepts and models that eschew the GUC.”

The problem is that the “high energy” required to produce the mass of clay that there is around the world by grinding rocks to powder is far higher than we could possibly imagine and neither could it have taken place in the short period of time within or outside the Flood. I would ask any geologist with an ability in mechanics to calculate just how much energy it would take to grind one cubic meter of rock into clay. Then multiply this up to give the vast volume of clay deposits known. I am sure that he will find that even the most violent water and wave action could not carry this out even within the lifetime of this earth. But then, even this calculation is irrelevant, because grinding does NOT produce clay—only the much larger particles of silt.

What, then, was the source of these huge deposits, and how could they have been settled out from great depths of water in the very short time of the one year of the Flood?

There is one simple proposal which answers both these questions. I am convinced that the vast majority of both pre and post—Flood deposits of clay and granular materials was the result of hydrothermal water (HTW—or supercritical water) bringing up vast quantities of the various dissolved minerals which then spread out over the ocean floor, engulfing the various sea creatures and eventually

land animals that it overcame. The extremely fine clay particles are the result of *chemical* reactions between the sea water and the HTW, and cannot be of erosion.

One feature of this model that might make interpretation of local strata far easier is that this outpouring could take place over dry land just as easily as under water. Some “sedimentary” deposits would not, therefore, have to be below the existing sea level of that time. Even clay could have been produced by chemical reactions within the rising HTW.

This source of strata material is not a new proposal but was made by a secular geologist—R. L. Stanton (1982). The ramifications of this subject are far too extensive for a letter such as this but I have discussed it in my *Science vs. Evolution* (Bowden, 1991, pp. 147–150) and more extensively in my *True Science Agrees With the Bible* (Bowden, 1998, pp. 355–375). In the latter I deal with many aspects of the geological column that the hydrothermal water (HTW) model solves. HTW is the only source that can provide anywhere near an adequate explanation of the many problems that face geologists, particularly creationists, who must deposit vast quantities of very fine material in a very short period of time. In no way could our present geological strata have been the result of erosion, and the puzzlement of the authors of this interesting, realistic and challenging article on this problem is plain for all to read.

I am convinced that not until creationist geologists examine the model of the source of the strata being dissolved material in upsurging hydrothermal water—the “fountains of the deep”—will they even begin to produce an adequate explanation of the present day geological deposits. Revolutionary as it may seem, it will have to be taken eventually.

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## The Uniformitarian Column and Flood Geology: A Reply to Froede and Reed (1999, *CRSQ* 36:51–60)

Froede and Reed's (1999) assessment of creationist approaches to stratigraphy creates a major problem for dialogue between diluvialists. Their essay is dominated by value judgments which make it clear that they think acceptance of any aspect of the geologic column leads to confusion, incoherence and the danger of compromise. We consider that the appropriate way forward for such exchanges is to present rational arguments and draw conclusions. Claims to occupy the "moral high ground" are premature and unwarranted.

We are able to find some common ground with Froede and Reed. One sentence in their article expresses a sentiment that we share in principle. "It is our opinion that a viable creationist stratigraphy requires adherence to Scripture and eschews modification of a biblical worldview to accommodate uniformitarianism" (p. 53). The only problem for us with this is the use of the term "uniformitarianism" in a pejorative way. The word is fuzzy, like "evolution". We need to define our terms carefully and make it clear which forms of uniformitarianism we object to. However, we are sorry to find that, despite all their warnings about compromise, Froede and Reed have not given any valid grounds for thinking that diluvialists who accept the concept of the geologic column have veered in this direction. Similarly, they are wrong to imply that these same diluvialists have any lesser convictions about what faithfulness to Scripture entails.

In a statement about the geologic record (Snelling et al., 1996), which Froede and Reed cite, a group of diluvialists distinguished concepts which that are conflated within the geologic column: particularly the lithostratigraphic column, the biostratigraphic column and the chronostratigraphic column. The general validity of the first two elements was affirmed and considered to be a sound basis for future research in creationist geology. This clearly points people in a different direction to that advocated by Froede and Reed, but it did so in a way that avoided inflammatory language and the making of value judgments. This statement also affirmed "that the starting point for our geological thinking is the historical record in the book of Genesis, which we accept at its face value."

All Froede and Reed's expressions of "fear" and concerns about "compromise" relate to their perceptions about the "global uniformitarian stratigraphic column". It is obvious that Froede and Reed consider the geologic column to be inherently evolutionary and uniformitarian in its formulation and that without these conceptual foundations, the column could not have been erected. This point has been addressed on numerous occasions in the diluvialist literature (Clark, 1946; Ritland, 1981; 1982;

Watts, 1985; Garton, 1990; Robinson, 1997) and we consider that there is little to be gained by going over the same ground again and again. Suffice to say here that the lithostratigraphic and biostratigraphic columns can be constructed (and, as a matter of history, were constructed) without utilizing "evolutionary" and "uniformitarian" presuppositions. In our judgment, these columns have the status of aggregated field data. The concept of evolution from a common ancestor has been used to interpret the data, and various uniformitarian ideas have been used to explain the processes of erosion and deposition, but the data is independent of these theoretical constructs.

Froede and Reed believe that the northern Gulf of Mexico Basin provides an excellent setting for testing various approaches that seek to integrate the geologic column with biblical history. We have no problem with this approach in principle, but we do find the methodology for testing adopted by Froede and Reed to be wholly defective. For the end-Palaeozoic and end-Mesozoic boundary proposals, Froede and Reed offer four objections. These are: (a) the volume of sediments deposited after the Flood is considered excessively large, (b) the fall in mean sea-level over this time is considered excessively dramatic, (c) there is a necessity for high-energy erosion/transport/deposition in a post-Flood context, (d) there are difficulties in identifying source sediments outside Flood conditions.

In order to test the models, it is necessary to examine critically how the various proposals handle these questions. However, Froede and Reed do not do this with any of the diluvialist models! For the end-Palaeozoic and end-Mesozoic boundary proposals, they simply assert "We do not believe that any reasonable explanation can be offered for these conditions in the NGOMB (Northern Gulf of Mexico Basin)." Later, this statement of belief hardens: "As expected, each of the creationist models tied to the GUC fail to explain the observed stratigraphic sequence in a logical and defensible manner." The quality of argument here is unacceptable! Froede and Reed have evaluated nothing; merely offered assertions. This is not the way science is undertaken and this kind of pre-emptive strike against alternative views is devoid of content.

For ourselves, we have no doubts that the questions raised by Froede and Reed can be answered in a rational and coherent way and that the NGOMB can be understood in a post-Flood context. This would require the preparation of a paper to discuss the relevant issues. Similarly, Froede and Reed have much work to do to justify their assertion that everything in the NGOMB prior to Ice Age sedimentation can be classified as high-energy Flood deposits. In failing to justify this assertion they render them-

selves open to the charge that their Flood model exists independently of field data. When they do prepare something to support their thesis with a proper analysis of data, we would request that they address wider issues arising out of the regional geology. We would like to know what a “local geologic column” looks like in this area of the world. Geologists have excellent drill core data and horizons are correlated over long distances. Froede and Reed need to explain how they handle this issue of correlation where there are abundant data from drill cores and seismic surveys. Since the Paluxy and Glen Rose Formations are traced from surface exposure to depth, and since these strata have been previously discussed from different perspectives in the *Quarterly* (Garner et al., 1996), the validity of these correlations is of considerable interest. In addition, we consider that some discussion of the volumes of Palaeozoic and Precambrian rock should be included, as this has to be part of the total picture.

We are very concerned about the claim that the geologic column concept is inherently uniformitarian. We find that opponents of the geologic column have written pages and pages of polemical material which do not address the real issues; they are laboring under false perceptions about what their fellow diluvialists are doing. This response to Froede and Reed is essentially a plea for a higher standard of debate and a challenge for diluvialists generally to engage with the real world of geologic data.

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## Bible-Based Flood Geology: Two Different Approaches to Resolving Earth History — A Reply to Tyler and Garner

### Introduction

A simple question: Would young-earth creationists have ever developed anything like the evolution-based global stratigraphic column to define Earth history had it not already been invented by the evolutionists? If the answer is “no” then we ask “Why use it?”

Mr. Tyler and Mr. Garner present a case for creationists to use the global uniformitarian stratigraphic column in defining a Biblical version of Earth history. They are not alone in proposing this approach (Snelling, Scheven, Garner, Ernst, Austin, Garton, Scheven, Wise, and Tyler, 1996). Although we have the high confidence in Mr. Tyler and Mr. Garner, we are concerned with their approach because many “Christian” geoscientists have over the years

attempted this same sort of modification of the global uniformitarian stratigraphic column only to abandon the young-earth approach completely for theistic evolution (e.g., Morton, 1986; Northrup, 1986; Ross, 1994<sup>1</sup>; Van Till, Young, and Menninga, 1988). This alone causes us concern that anyone would continue to espouse the belief that they can use the evolution- and time-based stratigraphic column within a young-earth Flood context, sans evolution and sans time. We continue to wait for examples

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<sup>1</sup>See Van Bebbler and Taylor (1994) for a great critique of Ross's book, one consistent with Scriptures within a young-earth framework.

from this group where they can successfully demonstrate this approach. However, despite our differences on this issue we desire the advancement of earth history within the young-earth Biblical framework.

Mr. Tyler and Mr. Garner state that our paper “*creates a major problem for dialog between diluvialists.*” We respectfully disagree. They are correct in pointing out the need for dialog, implying disagreement over a significant issue. A dialog requires the statement of opposing positions and the presentation of evidence in support of each. We fail to understand how our paper (especially read in light of our previous work) does not do so for our position, or how it precludes Mr. Tyler and Mr. Garner from doing it with theirs. We believe that our paper is a part of a needed dialog between diluvialists. Many of the readers may now be asking what this dialog is all about.

The issue at hand is simply this: *does the geologic column represent a compilation of objective empirical data, a tabula rasa of stratigraphy, or not? It is Mr. Tyler and Mr. Garner’s position (as well as that of other prominent creationist geologists previously mentioned) that it does—it is ours that it does not.* Readers should be aware of this fundamental issue so that they can understand articles and letters written from either perspective. We would be more than pleased to continue this dialog in print, but until we are convinced otherwise, all of our articles, notes, letters, and monographs should have been and should be clearly understood to include a *rejection* of the geologic column as a starting point for defining or defending diluvial geology. We believe that this critical point has been communicated repeatedly in our past work.

Mr. Tyler and Mr. Garner appear to believe that this is a closed issue; “...there is little to be gained by going over the same ground again and again.” We disagree, again respectfully, and suggest that this question is one of the most fundamental to diluvial geology, and therefore worth revisiting on a regular basis, especially since there is still honest disagreement over it.

### Getting at the Issues

The letter raises five questions to be answered. We have taken the liberty of organizing them for the benefit of the readers. If we have not captured their thought completely, we welcome a further exchange. These questions include:

1. Why do we reject the geologic column,
2. How do we intend to proceed apart from the geologic column,
3. What evidence for our position was presented in the paper,
4. Where do we go from here, and
5. What is at stake?

### First, Why Do We Reject the Geologic Column?

Tyler and Garner assert that the geologic column, as they define and use it, has no connection to either evolution or uniformitarianism. They state that *the lithostratigraphic and biostratigraphic columns can be constructed... without using “evolutionary” and “uniformitarian” presuppositions.* We disagree, and that is precisely why we reject the geologic column. The geologic column is the summary of natural history as it played out in Earth’s past. The most fundamental assumptions behind modern natural history are those of uniformitarianism and evolutionary progression. In past works, we have presented arguments for these links. We would refer anyone interested to Froede (1995, 1997, 1998); Reed (1998), Reed et al. (1996); and Reed and Froede (1997). We are not alone in this evaluation. Both creationist (e.g., Bliss, Parker, and Gish, 1980; Gish, 1985; 1993; Wilder-Smith, 1981) and naturalist writers (e.g., Berry, 1968; Harbaugh, 1974; Jablonski, Erwin, and Lipps, 1996) have long asserted the necessary relationship between the geologic column and its evolutionary presuppositions.

The North American Stratigraphic Code [NASC] (1983, p. 849) states: *Biologic remains contained in, or forming, strata are uniquely important in stratigraphic practice.* Why? Tyler and Garner’s independent biostratigraphic units appear in the first sentence: *First, they provide the means of defining and recognizing material units based on fossil content (biostratigraphic units).* However, that is not the whole story. The NASC does not leave its biostratigraphic units hanging in midair without stating how to integrate and interpret them. It continues: *Second, the irreversibility of organic evolution makes it possible to partition enclosing strata temporally. Third, biologic remains provide important data for the reconstruction of ancient environments of deposition.* (We assert that the reconstruction of ancient environments of deposition is carried out using the presupposition of uniformitarianism. Since we understand uniformitarianism to be the historical presupposition of Naturalism, it is only proper to use it in the sense of being opposed to a biblical understanding. If that is read as “pejorative,” so be it.)

The NASC (1983, p. 849) continues: *Major objectives of stratigraphic classification are to provide a basis for systematic ordering of the time and space relations of rock bodies and to establish a time framework for the discussion of geologic history. For such purposes, units of geologic time traditionally have been named to represent the span of time during which a well-described sequence of rock, or a chronostratigraphic unit, was deposited... This procedure continues, to the exclusion of other possible approaches, to be standard practice in studies of Phanerozoic rocks.*

The International Stratigraphic Guide (Salvador, 1994) states the same ideas with regard to defining stratigraphic

units via evolutionary biology, and measuring geologic time by way of the evolution of life (as exhibited by the change in fossils). Stratigraphers and evolutionary biologists use this as a basis for defining the entire global stratigraphic column. So any attempt by anyone who wishes to dissect and import portions of the global column will necessarily require some explanation about how the evolutionary assumptions are divorced from the new young-earth creationist interpretation. This presents a problem as we see it.

Stephen Jay Gould (1997, pp. 157–158) captures the essence of the problem addressed by the writers of the stratigraphic code:

A chronometer of history has one, and only one, rigid requirement—something must be found that changes in a recognizable and irreversible way through time, so that each historical moment bears a distinctive signature. Geologists have long appreciated this principle in the abstract, but had not found a workable criterion... Moreover, rocks are simple physical objects formed by chemical laws and, as such, do not bear distinctive temporal signatures. Quartz is quartz—conjoined tetrahedra with a silicon ion in the center, surrounded by four oxygen ions, each shared with a neighboring tetrahedron. So it was in the beginning and is now, and ever shall be so long as nature's laws prevail. Cambrian quartz is not different from Pleistocene quartz. But life is complex enough to change through a series of unrepeated states. Today we attribute this irreversible sequence to the workings of evolution...

So history is not interpreted on the basis of some lithostratigraphic or biostratigraphic assemblage of sequences independent of presuppositions. As Gould points out, only the workings of evolution provide a strand to follow the events of history through the rock record. Gould, in the same book also explains that 19<sup>th</sup> century geology (when the column was assembled) was dominated by the views of Hutton and Lyell, and that biologic views of progress were common when Lyell published his multi-volume work *Principles of Geology* between 1830 and 1833. Furthermore, as was described in Reed (1998), the assumption of uniformitarianism provides a time dimension to positivism, and is thus a prerequisite for any historical interpretation within the Naturalist worldview.

Another difference between Christian and Naturalist views of history was stated in Reed and Froede (1997). The geologic column is predicated on the uniformitarian assumption that the rock record must be described in terms of processes rather than events, and that this bias is necessary to Naturalism which has no principle of historical continuity outside of nature. Continuity is provided geologically by the continuous operation of processes that can be scientifically described today. Continuity is

provided biologically by the inexorable march of irreversible evolution. In contrast, the Biblical model of history is one of physical discontinuity resulting from supernatural intervention, which is anathema to Naturalism. Historical interpretation is not precluded however, since continuity is found in God, and open to man through revelation.

A key feature of the geologic column is that it correlates by the parameter of time. Whether the duration of time involved is measured in microseconds or millions of years, the fact remains that in the geologic column, correlation is by necessity, choral correlation. Therefore, to assert that lithostratigraphic and biostratigraphic columns exist independent of a chronostratigraphic column ignores the fundamental fact that both the uniformitarian (old earth), and Tyler/Garner and Snelling et al., (1996) (young earth) versions of the geologic column create a single vertical model that must globally correlate point X in the Paris Basin to point X in the Gulf of Mexico (or anywhere else) on the basis of time equivalence. Tyler and Garner appear to think that the argument is simply one of duration—we take a quite different approach and argue the wisdom of holding to time *per se* as the basis by which to correlate strata. We believe that since most of the rock record was produced by the Genesis Flood (one year) and that other parameters (such as energy in Reed et al., 1996 or environment in Woodmorappe, 1999) are appropriate to correlate the rock record in diluvial models.

Long time intervals are congenial to this time-correlation approach of the geologic column. Short time intervals, advocated by Mr. Tyler and Mr. Garner, do not result in merely a quantitative change to the column—they wreck the entire structure. The severely limited duration required by a global Flood destroys the possibility of a single vertical succession representing laterally isochronous strata on even a regional scale, much less the entire earth. For example, Austin (1994) presents a model of a northward transgressing Flood front over southwestern North America. If this is true, then the sequence expected from that prediction might include (a) erosion surface, (b) basal clastic lag, and (c) sediment deposition. This sequence is generally encountered in what are classified as the lower Paleozoic sediments in much of central North America. However, if Austin's model is correct, then Cambrian sandstones would be deposited synchronously with Ordovician dolomites, and perhaps even Mississippian limestones as the Flood front migrated across the continent. Similar sequences of sediments deposited in similar conditions would not be choral equivalents, as has been discussed in Berthault (1994). During the massive transgressive-regressive cycle imposed by the Genesis Flood, there would be a point of maximum potential global isochronity at the height of the Flood (the point in time at which geologic processes would tend to be occurring simi-

larly at the widest scale). The potential for global isochronous processes would decrease both forward and backward in time from that point. That is why correlation is better performed by another parameter such as environment or energy in a Flood model. Thus, it is not the duration of the chronostratigraphic column that we question—it is the possibility of a single, global, valid chronostratigraphic column at all. Even in a compressed timescale, the vertical model does not provide a guide to laterally correlating synchronous sediments.

Finally, we assert a link between the geologic column and the Naturalist worldview because we reject the possibility of neutrality in historical interpretation. All history is interpretation, and all interpretation is guided by presuppositions independent of data (see Reed, *in press*). The fact that Mr. Tyler and Mr. Garner would assert that the column is *aggregated field data* supports our position. The reader should stop and wonder under what assumptions were the data aggregated the way they were, and why did the aggregators even believe that they could aggregate the data at all? Why were the data aggregated in one way and not another? The fact that diluvialists and uniformitarians may share a set of presuppositions that allows some common ground does not change the fact that the presuppositions exist. Since presuppositions operate in any interpretation of history, the issue is to make sure that they are consistent with methods and conclusions.

### Second, How Do We Intend to Proceed Apart from the Geologic Column?

We have described our methodology in Reed and Froede (1997). For the sake of brevity, we refer readers to that article. If our fundamental assertion of the invalidity of the geologic column is correct, then the development of a creationist stratigraphy is open to significant innovation. Such has been the impetus for the recent proposals made by two young-earth creationists in the development of a Biblical time-scale (Froede, 1995; 1998; Walker, 1994). This new approach takes us away from the existing baggage of evolution and time, and places the stratigraphic record squarely within the Biblical framework, one based on changing energy.

### Third, What About the Evidence Presented in Our Paper?

Mr. Tyler and Mr. Garner appear disturbed about the volume of evidence and the level of detail presented in our paper. We concede that the evidence presented in our paper was concise and of a summary nature. However, that was done not absent of any appreciation of the geology of the area, but because the case appeared so clear as to not require a full discussion about the particular nature of strata in the area. Restated, it was as follows:

1. If the global uniformitarian geologic column is a valid correlation tool, then historical events related to the Flood can be pinpointed on the existing column and correlated all over the world to other points sharing the same position in time.
2. Diluvial geologists have in the past predicted different locations of a Flood/post-Flood boundary within the framework of the geologic column (see references in Froede and Reed, 1999).
3. The nature of the geology of the northern Gulf of Mexico demonstrates (without documenting exhaustive detail) that conditions required in a post-Flood world to explain the volume of sediment, the unique geochemical conditions during formation of the Jurassic salts (for the end-of-Flood-equals-end-of-Paleozoic scenario), and the dramatic changes in sea level would be highly improbable, and better explained by conditions expected during the Flood. For example, in Table I (Froede and Reed, 1999) we noted that a rough estimate of post-Paleozoic sediments in the northern Gulf included 240 times the volume of the present Mississippi delta plain. We based our conclusion on the assumption that geological processes in the post-Flood world would have been much more similar to present day processes than those operating during the Flood.
4. If the boundary proposals do not work in the Gulf of Mexico, but do work at other locations (as asserted by various authors cited in our paper), then proposition #1 is falsified, and progress in diluvial geology is pointed away from applying the global uniformitarian geologic column.

Evidently, Mr. Tyler and Mr. Garner misunderstood the thrust of our evidence. We are not necessarily denying any potential for correlation between rock units—such as the updip and downdip sections of the Glen Rose Formation (although the work by Guy Berthault suggests that such correlations deserve a second look). What we are questioning in their context is the *necessary* choral correlation of the Glen Rose Formation with the Potomac Formation in Delaware, the Clarendon Springs Dike in western Vermont, the Torok Formation on Alaska's north slope, or any other Albian (Cretaceous) time-rock unit within the context on any Biblical Flood model.

### Fourth, Where Do We Go from Here?

We applaud Mr. Tyler and Mr. Garner's acceptance of our approach to historical geology which emphasizes the primacy of Scripture, and believe that our article and this exchange will help clarify the nature and terms of the issue at hand for creationists interested in the earth sciences. We seriously doubt that this letter will change the approach of Mr. Tyler, Mr. Garner, and others of the same persuasion.

We encourage them to continue their work in diluvial geology as God leads, as we will continue our work in diluvial geology as God leads. After all, our differences with fellow diluvialists are molehills compared to the mountains of differences that we share with uniformitarian geologists. We will be happy to discuss differences between these models in print with anyone, as we appreciate the opportunity to do so in this exchange. We choose to believe that work done in any biblical model has the potential to transcend our individual shortcomings, and benefit diluvial geology in general. We work to that end, and appreciate others who share that goal.

### Fifth, What Is At Stake?

If Mr. Tyler and Mr. Garner are correct in their assessment of the global uniformitarian geologic column, then we will have rejected a significant shortcut, and will perform a quantity of unnecessary research until we reach the same position of Mr. Tyler and Mr. Garner. If we are correct in our assessment of the geologic column, then they will be pursuing a path that leads to a dead end of incompatibility between diluvial and uniformitarian geology. Neither of these consequences need be seen as negative. We believe in the possibility of fruitful failures in the pursuit of truth, and we believe that whichever approach leads to a "failure" can prove fruitful for future diluvialists. Either way there is potential benefit, and although we are not necessarily walking in the same conceptual direction, we respect and appreciate Mr. Tyler, Mr. Garner, and all other geologists committed to ordering the discipline within biblical boundaries. We ask the same respect of them.

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## *Archaeoraptor liaoningensis* Is Introduced to a Sticky End

*Archaeoraptor liaoningensis* is one of a number of fossils discovered in China in recent years. The features of this fossil I would describe as being both bird-like and reptile-like. One of the main reptile-like features is the long tail. Having warned about this fossil my words bore fruit (Brown, in press) when the discovery of its long tail had been glued on to the rest of the fossil (Hecht, 2000, p.12). The Chinese farmers have been blamed for it, because it was they that discovered the fossil and knowing that more money is paid out for fossils with long tails they glued it on. The loss of the tail makes it less reptile-like, but more work is needed on this fossil yet before any firm conclusions can be drawn, and it would be worth while looking closely at anything else the farmers may have had their hands on.

The fossil, given recent pride of place, has been introduced to a sticky end. We await with our eyes glued on China to see what else may come out of those strata.

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## The Origin of Flowering Plants

Last October 29<sup>th</sup> Carol Yoon (1999) of the *New York Times* newspaper produced an article in which she asserted that some Harvard scientists had recently answered the tough question of how flowering plants arose by macroevolution. In making this outlandish claim, *Times* writer Yoon was referring to an article which appeared that same day (October 29, 1999) in *Science* magazine. In it, Sarah Matthews and Michael Donahue of Harvard Herbaria claimed to have discovered which flowering plant groups are the most primitive and hence the probable evolutionary ancestors for the other groups. I have read this article and am now studying it carefully along with several similar papers.

Contrary to the *New York Times* report, these botanists produced no scientific support whatsoever for macroevolution among the flowering plants. Instead they have analyzed the DNA sequences of two genes known as PHY A and PHY C, genes coding for very important phytochrome pigments governing the production of flowers in plants.

They propose that a bush called *Arborella* (found only in New Caledonia) is close to the ancestral prototype for all other flowering plants and that the water lilies as well as the spice star are quite ancestral. But this research demonstrates nothing more or less than the degrees of similarity among certain plant groups for these pigment genes. The researchers ignored the fact that *similarity* can be the result of *design* rather than *kinship*.

Along with studies of other genes and research on morphology, the data of Donahue and Matthews may help improve our systems of plant classification. An outline of plant taxonomy, however, does not show which plants evolved from others. It is merely a helpful scheme of classification. These DNA resemblances in phytochrome genes may have resulted from the systematic and non-evolutionary work of a Divine Creator, as the fossil record strongly suggests.

Apparently neither the *Times* writer nor the Harvard researchers have read the very important book, *Evolution*:

*Theory in Crisis* by biochemist Michael Denton of Australia. Denton shows that all such biochemical homology points to separations between living groups, a view that Denton calls “typology”. Comparative studies of DNA or protein, like this one, simply emphasize and entrench boundaries between groups and do not demonstrate a tree of macroevolutionary descent. The data support evolution only for those workers who start with evolutionary preconceptions.

Perhaps an illustration here involving our own species—*Homo sapiens*—will help. If we wondered which animals should be classified closest to humans, we would find that DNA has a greater than 99% similarity with the DNA of pygmy chimpanzees. This demonstrates that people and chimpanzees should be put close together in the outline of primate taxonomy. But since chimps are so obviously different from humans, it also shows that DNA similarity and closeness in the outline does not indicate kinship or relatedness. Human fossils do not show connections to chimpanzees.

I close the matter by wishing Matthews and Donahue the very best in their skillful analyses of similarity patterns in plant genes. But I also wish that they and their *New York*

*Times* spokespeople would stop equating similarity with evolutionary relatedness. We still know nothing about which plant group actually produced the first flowering plants and nothing about which flowering plants then produced other groups of flowering plants. The fossil record shows no such transitions. The Bible says in Genesis 1:11–13 that on the third day of creation God made flowering plants according to their various kinds. Nothing from empirical science conflicts with this precise statement about events on day three of creation.

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## Comments on Bergman's article on the Piltdown Hoax (CRSQ 36:145–154)

I have read with great interest this article by Dr. Bergman in which he rightly demonstrates the very considerable attention given to these few bones before they were exposed as fraudulent. I have a very high regard for all of Dr. Bergman's articles, particularly the very wide range of subjects he examines and the depth of his investigations. May I make a slight addition to the general view he gives on two connected aspects of the whole hoax? This is with regard to:

1. the perpetrator(s) of the hoax and
2. the events that led to its exposure.

On the first point, Dr. Bergman does not point to any particular person as the hoaxer and presumably he concurs with those who consider it “an unsolved hoax”. There are two of those he mentions who were certainly both deeply involved; Teilhard de Chardin—at the pit—and M.A.C. Hinton—at the British Natural History Museum. They were named as the prime hoaxers by Dr. L.B. Halstead in a letter to the *Times* on November 25, 1978. Hinton provided the jaw and Teilhard the elephant tooth and the filed canine, the latter dropping all the fake fossils into the pit over a period of time. The various claims that others, including Sir Arthur Conan Doyle, were the perpetrators is only a smoke screen to protect the names of the real culprits, principally Teilhard.

On the second point it is generally believed that the *first* time it was realized the fossils were fakes was when Prof. Oakley decided to carry out fluorine tests on them. The real sequence of events is quite different and the evidence shows that the fraudulent nature of most of the fossils (i.e. those found *after* Dawson's discovery of the genuine skull pieces) had long been known by many experts before Oakley's tests.

I have investigated the Piltdown hoax in some depth (Bowden, 1981) and updated the evidence in a later book (Bowden 1991). Teilhard's complicity is beyond doubt as is Hinton's (Bowden, 1991, and website), but I will very briefly outline the evidence that great care was taken *before* the fluorine tests to ensure that the “story” that would be publicized could not be challenged by anyone still alive who was present when the genuine skull pieces were found. It was essential to say that these also were fakes as Dawson found them before Teilhard became involved in the digging. Dawson could then be claimed as the faker of everything and Teilhard would be exonerated.

There was a conference in London on 27th July 1953, during which the Piltdown fossils were on display. It is then claimed that during that evening in a hotel meeting of Oakley, Washburn, and Weiner, it occurred to the latter that the fossils might be fraudulent. Oakley was later

phoned about this possibility and he then did his fluorine tests and found the fossils fraudulent. What is not mentioned is that Weiner, prior to that meeting, was touring round the Piltdown area in the *spring* of that year with Harrison checking whether any of the “diggers” at the site who found the original skull pieces were still alive. Had they been, they could have confirmed that they were found in virgin gravel and then handed to Dawson. That this early visit by Weiner took place was stated by Miss Mabel Kenward (whom I interviewed) who, as a young girl, was present with her father when the first pieces of the skull were found in 1908 (Bowden 1991, pp. 184–185). When the hoax was publicized, Weiner with others later interviewed Miss Kenward and flatly denied that he had visited her in the spring of that year. This infuriated her and she wrote letters to the newspapers to state her case.

Thus, there is evidence that the whole “exposure” of the fraud by the authorities was very carefully planned to ensure that no one in an important position would be implicated. This particularly applies to Teilhard de Chardin,

and how and why he was “let off the hook” and many other revealing aspects I cover more fully elsewhere (Bowden, 1991, pp. 177–194).

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## The Key Largo Limestone: Correlating Physical Information to Models

Recently, Michael Oard (1999) raised some excellent questions regarding my article on the growth and development of the Key Largo Limestone coral reef tract which composes the northern portion of the modern day Florida Keys (Froede, 1999). Mike offered his own interpretation for the rapid formation of this large coral reef and stated that my proposed growth period of 500 to over 1000 years following the Flood was excessive. I appreciate the opportunity to further elaborate on my ideas about the origin and development of the Florida Keys and to respond to several questions that were raised. I believe that some of Mike’s ideas are model-driven assertions which do not fit well with the physical information. Ultimately however, it is a matter of personal interpretation and conjecture based on the known size of the massive Pleistocene coral reef.

### Dividing the Flood Timeframe

At present there are differences between Mike’s and my perspective in defining what constitutes Flood or post-Flood “Floodwater,” and in how we divide time during the Flood. For example, he (Oard, 1999, p. 101) stated:

Since real reefs are not expected to form during a violent global Flood, the surficial, linear Key Largo Limestone is very likely a post-Flood feature.

It would appear that Mike’s definition of Flood versus post-Flood water is based in how he defines Flood energy. This interpretation is reinforced with his position of day 150 marking the end of a period of Flood-derived high en-

ergy processes, and day 371 marking the end of the Flood and the beginning of the post-Flood period (Oard, 1999, p. 101). I define and place the formation of the Key Largo Limestone within my interpretation of a Biblical perspective (Froede, 1995; 1998) based on changing Flood energy levels under marine conditions. My perspective allows for greater time for coral reef development than Oard allows since I believe that Floodwater covered this portion of southern Florida for a thousand or more years (Froede, 1998).

In following his previously noted day 150/371 approach, Oard (1999, p. 101) asked:

What is the definition of “Floodwaters” after the violence of the Flood has ended with sea level higher than today? Would this higher sea level still be considered Floodwaters?

I define Floodwater in relationship to the position of water on the continents. Floodwater maximum would have occurred when waters covered the face of the earth by at least 20 feet (Genesis 7:20). Floodwater minimum would have occurred at glacial maximum during the Ice Age Timeframe following the Flood (a period of time which I define as being longer than the 500 year period proposed by Oard, 1990). Previously, I have defined the Flood/post-Flood strata boundary (specific to the northern Gulf of Mexico) where marine deposition ended and terrestrial/fluvial sediment deposition began (Froede, 1997; Froede and Reed, 1999). I believe that Floodwater slowly receded from the continents at rates which have yet to be

determined (Froede, 1995b; 1998; Froede and Williams, 1997). In the case of the Key Largo Limestone, I would draw the Flood/post-Flood boundary close to the uniformitarian Pleistocene/Holocene boundary as I believe that the majority of the former coral reef tract developed as Floodwater level dropped due to tectonism and the Ice Age.

### Was the Earth Dry?

Another question that Mike (1999, p. 101) posed was:

...even if sea level was higher, does not Scripture indicate the Flood was finished and the ocean basins stable at the end?

Oard then cited Genesis 8:2—the fountains of the great deep and the windows of heaven were stopped by day 150. I contend that on day 150 we do not know at what depth or where Floodwater still covered the earth, and we do not know at what rate Floodwater receded. Following day 150 of the Flood, Oard (1999, p. 101) stated that:

Then the waters steadily subsided and were expected to continue to subside until the water reached a more or less stable sea level. Genesis 8:13 states that “... the water was dried up from the earth,” and Genesis 8:14 follows by stating that “... the earth was dried.” Since the context of the Flood was for the entire earth, I believe “earth” in these verses refers to the entire earth and not just the portion Noah could see from the top of the Ark.

I must disagree with Mike’s understanding of this portion of Scripture. If what Mike suggests is true then *all* of the water in the world’s oceanic basins would not have existed, as I take the meaning of the phrase “...the earth was dried” to mean globally (as Mike inferred above). I believe that this refers to the place where Noah could see from the top of the mountains, and do not believe that it is necessary to require that all of the Floodwater had receded to a near-present day sea level position. I propose that while Scripture is very clear that the Flood was global, it is not correct to extrapolate portions of Scripture as meaning the entire globe especially when doing so implies that the oceans ceased to exist. We simply do not know much about sea level decline following the Flood. I propose that one way of determining a rate of sea level decline might be possible if we could establish the period of time from when Noah and his family stepped off the Ark to when the people associated with Shinar built the Tower of Babel (Genesis 11:2). If Shinar could be correctly identified on the Tigris/Euphrates river system, then we might be able to calculate a Floodwater withdrawal rate over a specific period of time (this is dependent on an accurate list of generations and ages recorded for each person in the post-Flood genealogy). However, we must rely on Bible historians and scholars for this type of information.

I believe that there is ample physical evidence in support of slow Floodwater retreat at least for the North American continent (Froede, 1995b; 1997; Froede and Reed, 1999; Froede and Williams, 1997). I have previously proposed that the Key Largo Limestone coral reef tract formed during the late stages of the Flood and continued in its development as Floodwater slowly retreated from this area (Froede, 1999). I believe that the physical presence of this massive coral reef tract (8–10 miles wide and 220 miles long) as well as its maximum vertical thickness (over 170 feet on its western end) reflects a considerable period of time, greater than the 371 total days of the Flood (or the 221 days following day 150). As creation scientists we must use the Bible as our framework for investigating the earth but remember that it only records mainly historical events. The global sea level situation and Floodwater withdrawal rate following what Mike defines as the high-energy portion of the Flood (day 150) is simply not addressed in the Bible. I cannot envision a sudden stable earth in the 221 days following Flood maximum without considerable physical evidence to support such a position.

### Tectonics During and Following the Flood

Previously, I proposed that the tectonics associated with the global Flood slowly decreased (from high activity during the Flood) throughout the post-Flood Ice Age Timeframe and into the Present Age Timeframe (Froede, 1998; based on Reed, Froede, and Bennett, 1996). I believe that this period of time covered much more than the 371 days following the initiation of the global Flood. This period of tectonic readjustment could have extended well over 1000 years following the Flood. South Florida was one of those areas where slowly receding Floodwater created a favorable environment where a large submerged coral reef tract could form and develop over an extended period of time.

### Defining a Sea Level Highstand Position in Relation to the Flood

In defining sea level position at the end of the Flood, Oard (1999, p. 101) stated:

In summary, it is likely that sea level was 100 to 160 feet higher at the end of the Flood than it is now.

While Mike defines what he believes to be the final Flood sea level position before the onset of the ice age, he does not define any means of understanding what observable physical features support this position. He does cite paleo-shorelines on the Huon Peninsula of Papua New Guinea as evidence of local *post-Flood* tectonism. I would like to know what information Mike uses to support and defend his proposed sea-level position of Floodwater levels

being 100 to 160 feet higher than the present at the end of the Flood in south Florida.

### Coral Growth Rates as Sea Level Indicators

Mike raises excellent questions regarding my assumption of coral growth rates. He (1999, p. 101) asks the following:

The problem boils down to this: How fast can coral grow? Is 300 years enough time, or do we need 500 to over 1000 years as Carl presumes? The problem is that we really do not know how fast a reef can grow, especially when we attempt to factor in the differences between the paleoenvironmental conditions after the Flood and those presently operating in south Florida.

Mike is correct—we do not know how fast the various coral species can grow under optimum conditions. My estimation for 500 to 1000 years was based on an accelerated growth rate for the primary species of coral composing the Key Largo Limestone—*Monastrea annularis* [see Table I]. My original calculation was based on the estimated present-day growth rate as calculated by Hoffmeister (1974), then extrapolated to 170 feet (estimated thickness of portions of the Key Largo Limestone), and calculated assuming a Biblical framework.

A seven-foot tall coral head of *Monastrea annularis* similar to the one shown in my Figure 8 (Froede, 1999) was estimated to have taken 250 to 500 years to have formed (Hoffmeister, 1974, p. 90). This translates to possible growth rates of 8.5 and 4.3 mm/yr, respectively (based on modern growth rates). More recently, several scientists re-examined this same coral head and determined that it required between 300 to 400 years to grow (at an estimated age of 360 years) [Shinn, Lidz, Kindinger, Hudson, and Halley, 1989, p. 23]. This information was based on counting what uniformitarian geologists believe to be annual growth bands in this coral. Annual changes are believed to form the growth bands. This technique is one of the standard uniformitarian means of calculating the age of coral heads. These dates suggest a growth rate from 7.1 to 5.3 mm/yr. If it is 360 years old then its growth rate would have averaged 5.9 mm/yr. No one has yet determined if other factors can affect the formation of growth bands in corals (as is currently recognized in tree ring development).

Using this growth rate of 5.9 mm/yr the 170 vertical feet of coral (assuming that all the different corals comprising the Key Largo Limestone grew at the approximate same rate as this particular head of *Monastrea annularis*) we arrive at a time span of approximately 8,782 years. This value is based on present-day growth rates which are much slower than under optimum conditions (even recognized by uniformitarian geologists—Shinn et al., 1989, p. 21). Unfortunately, no one knows how fast this coral could grow under ideal conditions. Obviously, I have assumed a

much higher growth rate for the coral reef tract to propose that it formed in 500 to 1000 years time following the Flood. A possible means of testing my proposal would be to secure a Pleistocene coral head at depth and examine its annual growth bands to see if they are thicker with fewer growth bands compared to those found in modern coral species. I would expect the annual growth bands to thin and multiply with time as the warmer than present post-Flood oceans cooled throughout the Ice Age and Present Age Timeframes (Froede, 1995, 1998). Thicker growth bands might reflect a higher coral reef growth rate in less time.

### Water Temperature and Coral Reef Growth Rate

In discussing the potential for increased coral reef growth, Mike (Oard, 1999, p. 101) suggested that warmer water might be a key factor:

It is probable that the warm water after the Flood, likely several degrees warmer than the ocean water around south Florida now, would increase the growth rate.

Coral cannot tolerate extremely high or low temperatures without suffering die-offs (Glynn, 1988; Jaap, 1979; Shinn, 1966; Shinn et al., 1989; Veron, 1995). If coral becomes too warm or cold it will die. For the Key Largo Limestone reef tract, a reasonable increase in water temperatures would have enhanced the growth of the coral (Shinn et al., 1989, pp. 21–24). Likely the temperatures would not have been much higher than what the region experiences at present. I propose that the slowly withdrawing warm marine Floodwater did not immediately cool down for many years after the year-long Flood. This would have allowed for the development of thick annual growth bands which did not begin to reflect seasonal changes until late in the Ice Age Timeframe when the over-lying seawater became shallower and the air temperature would have had more impact on the shallow water depth. This is an area that deserves further research especially as it relates to the young-earth Flood framework.

### Storm Impact on Coral Growth

Mike was interested in knowing whether strong storms might serve to enhance coral growth and development (Oard, 1999, p. 102). He asked what this relationship might hold with regard to regrowth:

Is it possible that reef growth both vertically and laterally was aided by strong storms spreading coral debris laterally, initiating a more rapid regrowth?

Coral reefs typically grow where there is agitated water and moderately swift currents. They grow upward to the low spring-tide level. Storms pass over the reef and break apart the corals with debris infilling low areas between

Table I.—Corals of the Key Largo Limestone Reef Tract: Modern Growth Rates

| Coral Species                                                                | Source       | Growth Rate*                                 |
|------------------------------------------------------------------------------|--------------|----------------------------------------------|
| <b>Major Framework Corals</b>                                                |              |                                              |
| <i>Montastrea annularis</i><br>(Star coral)                                  | Hoffmeister  | 10.7 mm/yr (approx 12 inches/28.5 years)     |
|                                                                              | Shinn et al. | 8.2 mm/yr nearshore patch reefs              |
|                                                                              | Shinn et al. | 6.3 mm/yr offshore waters (20 ft deep)       |
|                                                                              | Shinn et al. | 11.2 mm/yr shallow areas ( ft deep)          |
|                                                                              | Shinn et al. | 1 m equals 100 years in age                  |
| <i>Diploria strigosa</i> and<br><i>D. labyrinthiformis</i><br>(Brain corals) | Shinn et al. | 3.5 mm/yr                                    |
| <i>Porites astreoides</i><br>(Mustard hill coral)                            |              | Not recorded                                 |
| <b>Minor Framework Corals</b>                                                |              |                                              |
| <i>Acropora cervicornis</i><br>(Staghorn coral)                              | Hoffmeister  | 100 mm/yr (four inches/yr)                   |
|                                                                              | Shinn et al. | 10 cm/yr (four inches/yr)                    |
| <i>Acropora palmata</i><br>(Elkhorn coral)                                   | Hoffmeister  | One occurrence (58 feet below Looe Key Reef) |
|                                                                              | and Multer   | 10–12 cm/yr (Shinn et al.)                   |

\* Growth rates are based on modern species found within the Florida Keys. According to Shinn et al., (1989, p. 24) the rate at which modern corals grow can vary by several orders of magnitude:

A consideration of the rapidity with which corals grow, compared to the rate of sea-level rise, indicates that coral reefs are complex and that upward accumulation of coral reefs is not continuous, but that it is frequently interrupted for long periods [this statement is to explain why the historical reefs are not thicker following the uniformitarian model since they have been around many tens of thousands of years longer than they are represented in the physical record]. As noted earlier, accumulation rates for Florida reefs fluctuate between 1.31 and 4.85 m/ka... [ka is one thousand years]. The fastest rates, based on C14 dating of corals from reef cores, are at St. Croix, where Ady (1975) measured rates as high as 15 m/ka. [Brackets mine]

Realize that these growth rates are for modern corals and we still do not know the rate at which the ancient corals grew — we can only guess. Much study into the formation and development of annual growth rings especially for the ancient species of corals remains to be conducted. It would be interesting to compare and contrast the thickness of annual growth bands from coral at depth with what is found at or near the surface. The present is *not* key to the past and we must develop our own model accordingly as we describe and define the Key Largo Limestone within a Biblical approach.

From Hoffmeister, 1974; Shinn et al., 1989; and Hoffmeister and Multer, 1968.

coral heads. Commenting on the impact that a major hurricane might have on coral reef growth, Shinn et al., (1989, p. 22) stated:

Surprisingly, major hurricanes do not appear to affect growth rates or to leave a recognizable signature in the coral skeleton.

However, where space is newly available and prime conditions exist (i.e., water temperature, clarity, and nutrient load are at their optimum levels) the faster growing corals can regrow back to their pre-break levels in a matter of a few years (Shinn et al., 1989, p. 23).

### Flood Versus Post-Flood Setting

In concluding his letter Mike (1999, p. 102) makes it very clear that he views the Key Largo Limestone coral reef tract as having formed in a post-Flood setting:

In summary, a post-Flood higher sea level potentially can account for the reefs in the Florida Keys. This higher level could easily be caused by the lack of Greenland and Antarctic ice sheets without any need to postulate remaining “Floodwaters” for 500 to over 1000 years after the Flood ended.

My proposal for the formation of the Key Largo Limestone coral reef tract over a period of time ranging from 500 to 1000 years is based on what I view as reasonable coral growth rates under conditions associated with slowly retreating Floodwater. I took the physical information (a 220 mile-long coral reef which thickens to at least 170 feet on its buried western end) and suggested what I view as a valid and defensible time frame for its growth within a young-earth Flood framework. Oard (1999) has proposed that sea level dropped from a Flood high position of +130 feet to a glacial maximum low position of -150 feet (a total of 280 feet) in a period of 500 years. In following Mike's 500 year glacial maximum and the accompanying drop in sea level it would require only 200<sup>2</sup> years to form and develop this entire coral reef tract. To explain the 170 foot thick coral reef covering a large portion of south Florida in only 200 years (to comply with his model), appears to be more model driven than what is physically possible. I support the origin and development of the Key Largo Limestone coral reef tract covering a period of time ranging from 500 to over 1000 years following the Flood. I believe that Floodwater slowly receded from this particular area of south Florida and this vast coral reef tract provides that testimony.

## Appendix

### Differences in Coral Species Within Similar Settings

An interesting problem still confronting uniformitarian geologists occurs in explaining the differences (where none should exist) in coral species between the Key Largo Limestone and the modern (i.e., Holocene) coral reef tract. Originally, the Key Largo Limestone was proposed as having formed in a deep water setting similar to the modern West Indian coral reefs (Stanley, 1966). This interpretation fell out of favor when it was proposed that the laterally adjacent Miami Oolitic Limestone formed contemporaneously with the Key Largo Limestone (Hoffmeister and Multer, 1968). Modern oolitic production and deposition presently occurs in shallow shoals which implies that the ancient coral reef existed in this type of envi-

<sup>2</sup>Mike proposes a 280 foot drop in sea level over the 500 years following the global Flood. As the Key Largo Limestone once existed 18 feet above today's sea level position this only allows 112 feet of water over the former coral reef at the time Mike defines as the end of the Flood. According to Oard's (1999) numbers, the drop in sea level to the top of the Key Largo Limestone would have occurred 200 years after the Flood. Although Mike suggests in several places in his letter that there was as much as 300 years available to form this coral reef tract, his values only allow approximately 200 years for the formation and development of the Key Largo Limestone.

ronment as well. Within this shallow water model, the Key Largo Limestone was interpreted as having formed in a series of patch reefs growing parallel and behind an older former coral reef which existed further offshore.

Two major problems occur in following the shallow water model proposed by Hoffmeister and Multer (1968). One problem is in identifying a former coral reef tract further offshore from the Key Largo Limestone, where one does not exist today. Another problem is explaining why *Acropora palmata* has only been found in fragments in one well at a depth of 58 feet below sea level in a core taken near Looe Key Reef (Hoffmeister and Multer, 1968). This particular coral species comprises a major portion of the modern coral reef tract. Why is it missing from the Pleistocene Key Largo Limestone in what is believed by uniformitarians to have been a similar setting? These issues for uniformitarians remain unresolved.

For the creationist, a careful examination of a modern tropical deep water coral reef setting provides a possible analog for the formation and development of the Key Largo Limestone under Floodwater conditions. This topic will be developed in a future article discussing the Florida Keys.

## Acknowledgments

I thank Dr. E. L. Williams and Dr. J. K. Reed for providing me with helpful review and comment on this letter. Any mistakes which remain are my own. I thank my wife Susan, who continues to support me in my research efforts. Glory to God in the highest (Proverbs 3:5-6).

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## Book Review

*Scopes: Creation on Trial* by R. M. Cornelius and John D. Morris  
Master Books, Green Forest, AR. 1999, 48 page, \$9.00

How did “The World’s Most Famous Court Trial” happen to take place in an obscure small town in Tennessee? Readers of this small book will learn, perhaps to their astonishment, that the real reason for the trial was not evolution, religion, or academic freedom; it was economics.

The book’s first chapter, written by Dr. Cornelius, tells the story based on an unpublished M.A. thesis by Warren Allen (1959). Cornelius writes, “When George W. Rappleyea, a young metallurgical engineer with the ailing Cumberland Coal and Iron Company, picked up his May 4, 1925, copy of the *Chattanooga Times* and read an announcement of an ACLU offer to pay the expenses of a teacher willing to make a test case of the recently passed Tennessee anti-evolution law, he knew that a powerful remedy for the limping local economy had been discovered” (pp. 6,7).

With the help of a local druggist, the superintendent of schools, and teacher John Scopes, Rappleyea laid his plans. Lawyers and town officials were drawn into the plot, and “the casting of the principals was complete” when William Jennings Bryan accepted the invitation to help with Scopes’ prosecution, and Clarence Darrow and Dudley Field Malone volunteered to manage the defense. The rest of the scenario developed through the eager interest of the press—and the play called the “Monkey Trial”

became a smashing success, probably beyond the wildest dreams of its promoters. But, continues Dr. Cornelius, “In spite of all the ballyhoo, the trial involved serious, complex questions, and much of the court record portrayed skillful legal thrusting and parrying... “(p. 13).

What those questions were develops later in the book. This includes a cogent critique of evolution written by William Jennings Bryan. John Morris also points out that every argument presented for evolution at the Scopes trial has been disproved.

In a final short chapter, Morris discusses the relation of the creation/evolution controversy to basic Gospel truths. The entire book is very well written and presents a quantity of information out of all proportion to its small size. Highly recommended.

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## Keyword Index for Volume 36

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“I think it’s fair to say that every scientist in the world agrees that evolution is a feature of life on earth,” Malcolm said. “And that we are descended from animal ancestors. Yes.”

“Okay,” Kelly said. “So, what’s the big deal now?”

Malcolm smiled. “The big deal,” he said, “is that everybody agrees evolution occurs, but nobody understands how it works. There are big problems with the theory. And more and more scientists are admitting it.”

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## 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* has been gradually enlarged and improved and now is recognized as the outstanding publication 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 solely a research and publication society. It does not hold meetings or engage in other promotional activities, and has no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund is 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.

# **The Cambrian Explosion: A Strong Argument Favoring Creation**

**Curt Sewell**

The chart on the next page shows a simplified version of the way animal life is thought to have evolved. Beginning with raw chemicals (at the bottom of the chart) simple life-forms such as algae supposedly formed several billion years ago. By some evolutionary process, it's thought that creatures gradually got more and more complex. Finally (at the top of the chart), the types we see around us today appeared.

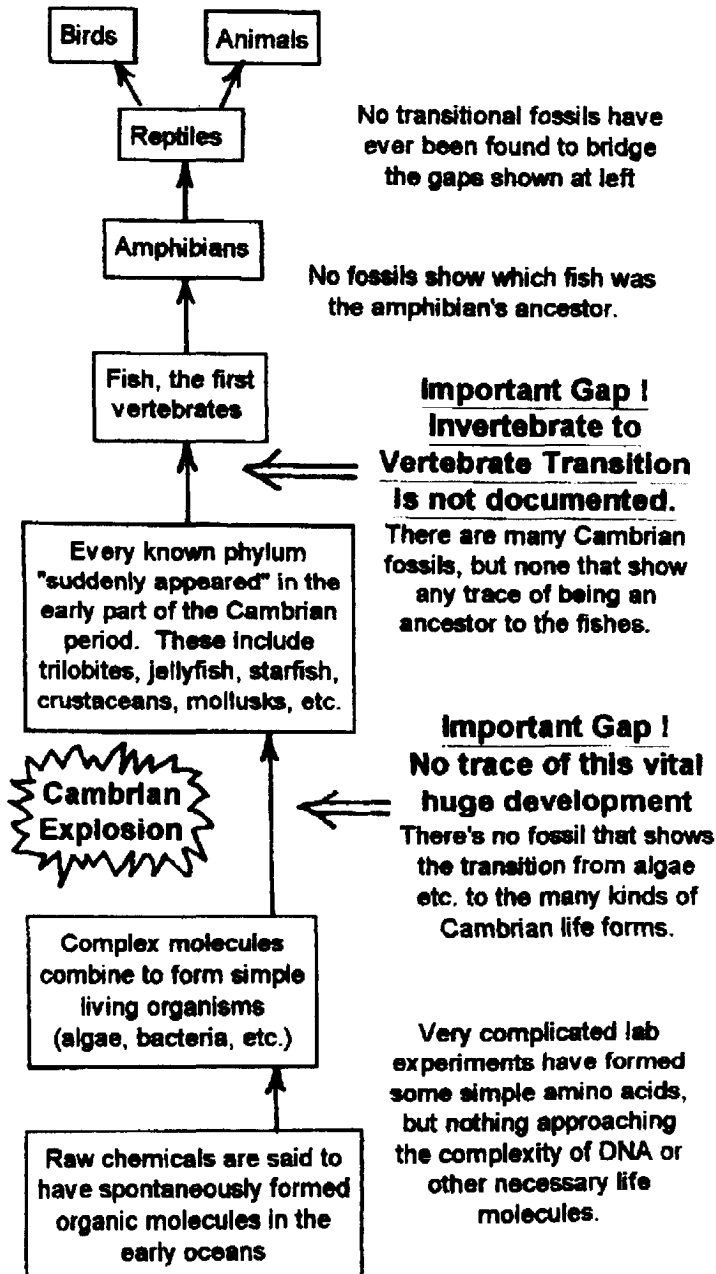
But there is a vast mystery, that's been nicknamed the "Cambrian Explosion." This took place about 600 million years ago (according to the usual geologic column). Prior to this time, the only forms of life that show as fossils are simple single-celled types such as algae and bacteria. Then suddenly a gorgeous array of shelly invertebrates appeared (as paleontologist Niles Eldredge said). As he put it, "Indeed, the sudden appearance of a varied, well-preserved array of fossils, ... does pose a fascinating intellectual challenge." These include more than 5000 species, including sponges, jellyfish, corals, worms, mollusks, trilobites, and crustaceans.

There is no apparent explanation for this. We find traces of the algae and other simple forms that preceded these invertebrates, and millions of Cambrian fossils have been found. But surely, if evolution is true, there should be a great many in-between transitional fossils, Richard Dawkins said, "It is as though they were just planted there, without any evolutionary history."

Creationists say that this is a strong sign that God created all the kinds of animals within a one-week period, as the Bible says. We must remember that the "geologic column," that yields million-year ages, is based on highly questionable assumptions, and held together by circular logic.

There's another cavernous gap in the fossil record, between Cambrian invertebrates and fish. The fish are considered to be the earliest vertebrates (that sub-phylum also includes amphibians, reptiles, birds and mammals) and, if evolution is true, must have evolved from one or more of the

**The Presumed Sequence  
of Animal Evolution**  
(Start at bottom of chart)



**Earliest Pre-Life Beginning**

invertebrate phyla just discussed. But again, there are absolutely no intermediate forms found in the rocks; it's as if fish were just suddenly there, having no ancestors.

In his 1966 presidential address to the Linnaean Society, ichthyologist (fish expert) Errol White said: "But whatever idea authorities may have on the subject, the lungfishes, like every other major group of fishes I know, have their origins firmly based in nothing." This is still true in the mid-1990s.

Creationist Dr. Duane Gish discussed this absence of vital transitional fossils in his book *Creation Scientists Answer Their Critics*. He wrote, "These anti-creationists have enshrouded this profound discontinuity in the history of life in an enormous fog of silence. They not only make no attempt to offer 'just-so' stories how this may have occurred, they completely ignore it. It is too embarrassing to evolutionary theory even to discuss in their anti-creation polemics."

If all of these expert evolutionists, to whom Gish was replying, and who had written specifically to try and discredit creationism, knew of any way to refute Gish's claims about the huge gap in the ancestry of fishes, and the Cambrian explosion, they would certainly have done so. That they have all remained silent on this tremendously important point shows their tacit agreement that the gap is real. These two cavernous gaps alone should be enough to absolutely disprove evolutionism.

Many elementary textbooks make claims about transitional fossils proving evolution. These claims are nonsense. The only transitional fossils that have ever been found are those that show tiny changes, that lead to a new species. These certainly exist, and this principle is utilized by many plant and animal breeders in their everyday activities. But these only show change in colors, sizes, bill shapes, etc. Never have there been transitions above the Family level.

Archeopteryx is often called the missing link between dinosaurs and birds. This is a figment of evolutionist's hopeful imagination. Harvard's Stephen J. Gould said that "Archy" is simply a "curious mosaic" — an extinct bird that has some reptilian features (like several present-day birds also have). "Archy" doesn't qualify as a transition because there is no ev-

idence of which reptile he may have descended from, or which modern bird he evolved into. He had no known ancestors or descendants, so he can't be fitted into any sort of missing gap.

Biblical creationists argue that this Cambrian explosion, and the tremendous void in the fossil record preceding fishes, this sudden appearance of so many different kinds of life, with no trace of ancestors, is good evidence for the sort of divine creation described in Genesis; this conclusion is just what the fossil record clearly shows. But the evolutionists say that that's simply religious nonsense; and yet their answer is no clearer, and it has almost no evidence to back it up.

While these two huge gaps in the fossil record don't disprove evolution, they clearly demonstrate that evolution is not a proven fact. It's dishonest for public schools to teach that it is, yet this is often done. Why? Simply because the majority of the scientific and educational establishments believe in evolution, because it's the only materialistic approach that avoids the necessity of acknowledging divine creation by God. The fact remains that:

- Both creation and evolution are actually religious philosophies, because both require faith to believe. One invokes faith in a divine Creator, the other relies on faith in random materialistic processes. Thus one faith is theistic; the other faith is atheistic.
- Neither creation nor evolution is truly scientific, because neither can be proved or disproved.
- Adherents of both belief-systems can find evidences that show their faith to be superior to the other. It's a matter of choice. As a Christian, I choose to believe in God and in the Bible—the record He gave to humankind.

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