Creation Research Society Quarterly

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

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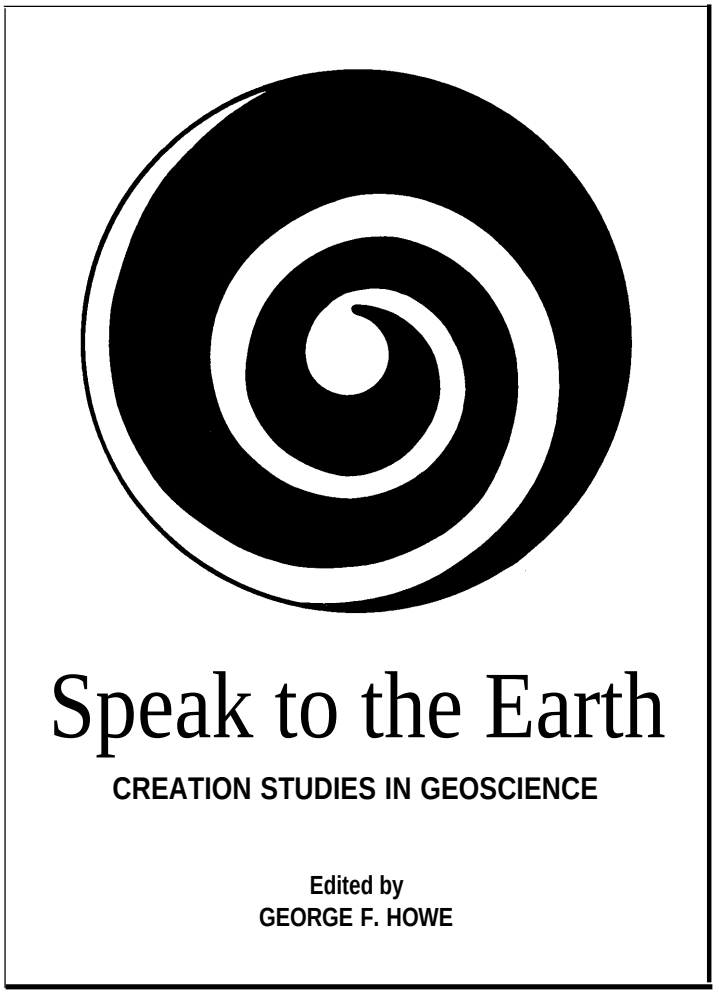

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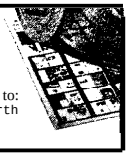

QUOTE

Reason versus faith, then is a conflict not between two varieties of belief, but rather between an intelligible universe that opens up only as an individual submits to it with praise and thanksgiving, and one whose access risks no more than the acceptance of its axioms.

Niemeyer, Gerhart. 1984. Reason and faith in Carey, G. W. and J. V. Schall, editors. ***Essays on Christianity and Political Philosophy.*** **University Press of America. Lanham, MD p. 17.**

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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. The Society operates two Experiment Stations, the Grand Canyon Experiment Station in Paulden, Arizona and the Grasslands Experiment Station in Weatherford, Oklahoma.

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Statement of Belief Members of the Creation Research Society, which include research scientists representing various fields of successful scientific accomplishment, 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. In 1970 the Society published a textbook, ***Biology: A Search for Order in Complexity,*** through Zondervan Publishing House, Grand Rapids, Michigan 49506. 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 Saviour. The account 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.

SOME SIMULATIONS OF THE POSSIBLE ROLE OF CAVITATION IN CATASTROPHIC FLOODS*

EDMOND W. HOLROYD, III**

Received 20 October 1989; Revised 5 December 1989

Abstract

The process of cavitation in water has been involved in the damage of many types of man-made structures. Flow speeds greater than 30 m/s appear necessary for cavitation damage. Major damage can occur with flow depths of only a few meters but it decreases with flow depth, channel roughness and air bubble content of the water.

A computer model predicting damage potential, calibrated qualitatively with actual damages to dam spillways, is used to indicate the locations and relative intensity of damage for several spillway profiles. While damage is more likely associated with steeply sloping channels, because of the high flow velocities achieved in them, damage can occur in nearly horizontal surfaces if there is some other mechanism for achieving the necessary flow speeds. In a hypothetical spillage of water over the rim of the Grand Canyon, there are numerous locations at which cavitation destruction of the rock would be as great or greater than the worst damage ever seen in actual dam spillway. A flow of water of only four meters (m) initial depth, approaching a rapid elevation drop of less than 100 m at an initial speed of only 10 m/s can be expected to produce major cavitation damage for a variety of natural land profiles. The process of damage by cavitation appears to be a likely mechanism for rapid removal of rock in channels experiencing catastrophic flows of high speed shallow water with little air bubble content.

Introduction

Cavitation is the creation of gaseous phase bubbles in a liquid as a result of a decrease in pressure. While the creation of the bubbles themselves is relatively harmless, it is the *collapse* of bubbles that can cause structural damage to surfaces that are in contact with the liquid. It will cause powerful shockwaves and possibly minute jets of water that impact on the solid surfaces. Though the collapse of the bubbles is actually the opposite of the creation of vapor cavities, the term cavitation tends to be used to refer to the entire process. The U.S. Bureau of Reclamation conducted extensive studies to be able to understand the conditions under which cavitation damage might occur, to predict the location and severity of damage, and to design corrections to prevent future damage to the water conveyance structures. Falvey (1990) suggests that water heads in

***See* a technical presentation on the same subject by Holroyd, *CRSQ* 27:23-32.**

Edmond W. Holroyd, III, Ph.D., 8509 W. 63rd Ave., Arvada, CO

excess of about 45 meters and flows in excess of 30 m/s are suspect for the potential for producing damage to structures by cavitation. They found that it was possible to control the curvature of spillways in the design process so as to minimize the possibility of cavitation damage. It was also found that the injection of air bubbles into the water flow stopped the damage under normal operating conditions. Holroyd (1990) summarized the findings of the monograph along with descriptions of other phenomena related to cavitation. Along with the text, giving all relevant equations and some calibrations using actual structures, the monograph (Falvey, 1990) includes a set of 5.25 inch floppy disks for use on an IBM compatible microcomputer. The original pro ram code is provialed in FORTRAN. One piece of software receives as input a nominated initial flow condition and structural profile. The output is a table of flow conditions throughout the structure, including parameters relating to cavitation. Some of the outputs can be graphs of a few parameters. Additional programs provide guidance for profiles having a constant cavitation index, for design of aerator slots for injecting air bubbles into the flow, and for estimating the damage index from a record of historical flow conditions.

One of the computer programs supplied with the monograph was run, first on the Glen Canyon Dam tunnel profile, where damages were measured, and then on several other profiles, man-made, artificial, and natural. These computer model runs give guidance on the possibilities of cavitation damage to water channel surfaces during flow conditions greatly exceeding those experienced during the 1983 floods.

Cavitation Parameters

There are three numbers among the equations given by Falvey (1990) that are used to describe several aspects of the cavitation process: the cavitation index, the cavitation potential, and the damage index. It is challenging for those who do not use the terms regularly to distinguish between them. The definition equations are repeated in Holroyd (1990).

The cavitation index has as its numerator the difference between the ambient water pressure and the vapor pressure of water at its particular temperature. The denominator is the ambient kinetic energy of the water and therefore is proportional to the square of the water velocity. A small cavitation index indicates that it is relatively easy for some flow disturbance to vaporize water.

The damage potential addresses the question, given that cavitation is likely to occur at a location, of how strong the damaging forces will be. Falvey (1990) points out that the damage potential is inversely proportional to the cavitation index and appears to be proportional to the sixth power of the water speed. The definition equation compares the cavitation index and flow velocity to reference values for the threshold of cavitation. The damage potential was crudely calibrated in the Falvey monograph by comparing actual damage at several dams with the theoretical damage potential numbers. He gives values of damage potential for "incipient;" "major," and "catastrophic' damage as 500, 1,000 and 2,000, respectively. The damage at Glen Canyon Dam in 1983, in which the water forces consumed reinforced concrete one meter thick and excavated sandstone bedrock to a depth of nine more meters, was considered to be "catastrophic." It is the behavior of the damage potential that will be examined later in this report.

The damage index is an estimate of the cumulative damage produced by cavitation. It is defined as the damage potential times the logarithm of elapsed time. It is likewise crudely calibrated at 5,000, 10,000, and 20,000 for incipient, major, and catastrophic cavitation damage, respectively. The damage index recognizes that cavitation is self-limiting. As the solid surface is destroyed by the forces of cavitation, that surface tends to recede from the location of the collapsing bubbles and becomes less susceptible to further damage.

Computer Simulations

The Falvey software presents theoretical cavitational characteristics for a variety of flat and curved profiles of water channels, surface rugosities, flow depths and speeds, and several sizes and shapes of flow disrupters. That part of the software for eliminating cavitation damage by better design of curves and design of aerator slots is useful for construction purposes only; it is of limited usefulness for investigating the response of existing natural structures to flows capable of producing cavitation damage. The other programs describe and graph the flow and cavitation conditions for any nominated profile and initial flow conditions. The software has been run for over 20 Reclamation-designed dams. Experience with structures in other parts of the world has also been considered, including some in which no cavitation damage has ever been observed. The software is currently able to predict locations of cavitation damage with high reliability. Though more research and calibration is probably in order, the present computer model can be considered to be approximately calibrated for real flow conditions. Its outputs are in good agreement with observations.

There are limitations to the software, however. It is only a one-dimensional model with presently up to 40 profile data points allowed as input. The array dimensions could be increased and the FORTRAN program recompiled. But to change it to a two- or three-dimensional model would require major surgery and the result may require a computer much bigger than a microcomputer. The one-dimensionality presently means that the program only deals with conditions in the direction of the flow. It does not address lateral flows or longitudinal vortices. Furthermore, the computational results of most computer models must be considered suspect when the models are pushed to conditions outside the ranges for which they were calibrated. This model gives complaints in the output when it is subjected to conditions likely to produce erroneous results. Therefore the outputs of this model should only be considered to be qualitative at the upper and lower extremities of the ranges considered.

The input table requires a consecutive listing of surface elevations versus downstream distances (stations). A variety of channel cross sections are allowed, and they must be described at each station. The vertical radius of curvature at each station is also

required. For man made spillway structures, such radii can be gleaned from design speciifications. But for those seeking to input natural channel profiles as determined from topographic maps, the local radius of curvature must be calculated separately. A special computer program was written by Holroyd and included with the software package for that purpose. Its main equations are given in the Appendix.

The sample data set that comes with the software describes the profiles of eight structures. The computer operator can easily change initial flow rate (volume/see), initial depth at the top of the structure, and surface roughness. The entire profile can be changed to anything else. The program will tell where it needs intermediate data points, up to a total of 40 in the profile.

However an interested person may find it easier to relate to flow speed rather than to flow rate. Therefore most of the following simulations express downstream cavitation damage potential as a function of location and initial depth for certain initial flow speeds rather than flow rates. For a given channel cross sectional area, any two of depth, speed, and flow rate determine the third quantity. For constant flow rate, the depth and speed are generally inversely proportional, with some adjustments resulting from channel cross sectional shape. The initial flow rates of these simulations were those determined by the nominated initial depths and speeds.

The "catastrophic" flows through the Glen Canyon Dam drainage tubes were small compared to flows that those interested in catastrophic geological processes would like to consider. Therefore the software was used to explore greater magnitudes of flows. The Glen Canyon left tube model was subjected to flows from so low that the software complained of analysis difficulties up to the limit of the design capacity of the tubes. Then the left tube profile was retained but the cross section was changed from circular to rectangular of slightly greater width and unlimited top. Again the flows were varied from near the lowest to near the highest that the software would accept. Then, to minimize the effects of the side walls, they were moved out to a separation of 1000 ft (305 m). Such variations on the Glen Canyon profile showed that the model could be extrapolated into conditions unlikely to be experienced today. The integrity of the results during such modifications gave confidence that the next modifications to artificial and natural profiles would give reasonable results. In this way there is an orderly progression from known cavitation conditions to those far beyond present day experiences.

Glen Canyon Left Spillway Simulations

The initial flow and flow depth at the top of the left spillway of the Glen Canyon Dam were varied over a wide range, subject to the ability of the computer program to describe the resulting flows farther down the spillway. Very shallow flows ran into boundary layer problems and then could not climb up the flip bucket at the end of the tunnels. (The flip bucket is a curved surface at the end of a spillway that launches the water into the air on a trajectory that makes it fall into a pool of water and dissipate its energy there.) Very large flows sometimes choked the tunnel. The program output provides numerous parameters related to cavitation. Only the speed profiles and the damage potential are presented here.

The program was stepped through an orderly series of initial depths with the initial flow rates for each computer run carefully adjusted to produce initial speeds of 5, 10, and 20 m/s at the top of the spillway. Subsequent speeds are presented in Figure 1 with respect to distance downstream of a standard reference point. The water rapidly accelerates as it falls down the spillway. After passing the 700 m mark (see Figure 5, Holroyd, 1990, for the tunnel and damage profiles) the tube bends to the horizontal (starting about 800 m). The sudden transition between the centrifugal pressures of the curved profile and the nearly static pressures of the horizontal flow produces a forward acceleration and suddenly higher velocities there. It is also the location of the deepest damage. Figure 1 also shows that the shallowest flows have their speeds reduced by the friction of the boundary layer. Flows greater than 4 m initial depth became choked at the slow 5 m/s initial speed. Throughout the profiles the subsequent depth of the flows tended to be inversely proportional to the flow speed at each location. The combination of fastest speeds and shallowest depths near the 800 m location is what set up the damaging conditions there.

The damage potential for the same initial flow speeds and depths are given in Figure 2. For this figure and all of those to follow, the damage potential is for a surface perturbation consisting of a 10 mm

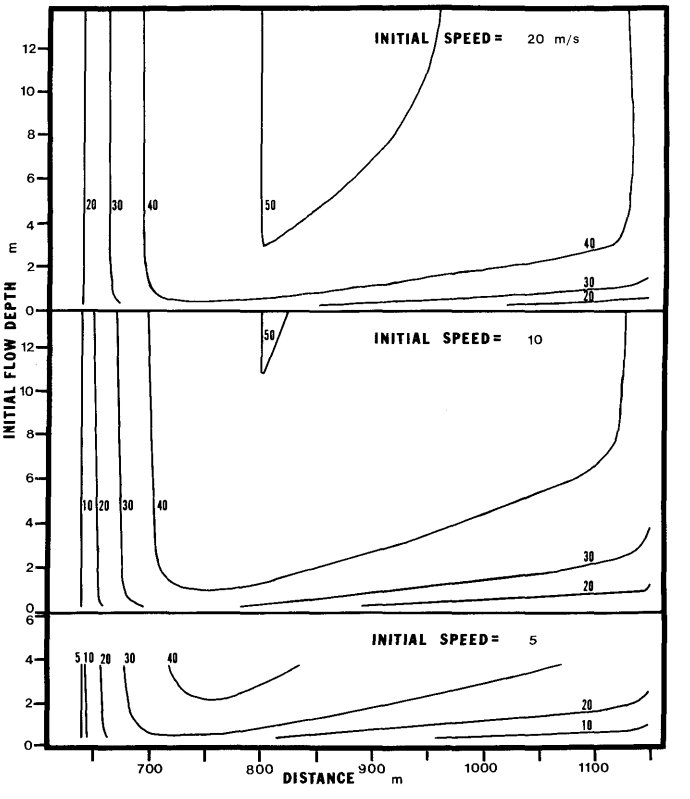

Figure 1. The flow speeds, all in m/s, along the left spillway tunnel for a variety of initial water depths and three initial speeds at the top of the spillway.

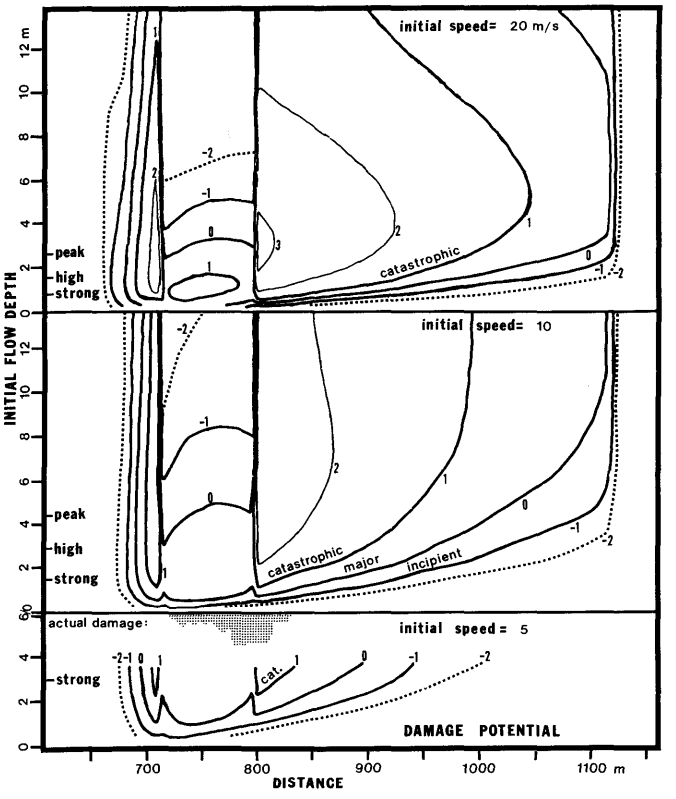

Figure 2. The damage potential for the Glen Canyon Dam left spillway tunnel as a function of initial depth. The low velocities are those given in Figure 1. The damage potential is labeled in terms of powers of two times "major" cavitation damage potential.

(1/2 inch) circular arc. At about this size the damage potential is approximately proportional to the size of the bump. (It is amazing that a bump as small as 10 mm can initiate a chain of craters leading up to hole 10 m deep.) The program output also gives the values at other bump sizes and shapes. The rugosity value was that for very smooth concrete. For this and subsequent figures the damage potential contours are given number labels, n, on a logarithmic scale, where the damage potential is 1000 x 2^n. With this coding a -1 is for incipient cavitation, 0 for major and 1 catastrophic, according to the Falvey definitions. A number of **11,** to be seen in a later figure, would then indicate a damage potential 1024 times larger than the "catastrophic" of the 1983 Glen Canyon Dam flows.

At the top of the graph for the 5 m/s initial speed the actual cavitation damage from Holroyd (1990) Figure 5, in terms of relative depth, is shown by the shading. At the left of all three parts of the Figure are shown indicators for the initial flow depths corresponding to 300 (strong), 600 (high) and 900 (peak) m^3/s flow rates, corresponding to Holroyd (1990) Figure 2. The Falvey monograph does not give the initial flow speeds for the historic flow rates. The failure of the computer program to model the higher flow rates at the 5 m/s speed suggests that the actual speeds might have been between 10 and 20 m/s. For later comparisons the 10 m/s initial speed was selected as a reasonable value.

Cavitation damage is not the same as damage potential. Though there was only one major peak of damage near the 800 m location, the curves of Figure 2 indicate two peaks for damage potential, at the start and end of the circular transition from near vertical flow to near horizontal flow. Damage potential is greatly reduced in the circular bend because the centrifugal forces produce larger pressures, making cavitation less 1ikely. Of all of the dam profiles tested by the Bureau of Reclamation with this program, only the upper peak in damage potential in the Glen Canyon Dam spillway failed to be actualized. Furthermore, while there is less damage potential in the circular bend than in the transitions on either end, damage still occurred there, as illustrated in Holroyd (1990), Figure 11. A change from smooth concrete to a rough concrete surface (not shown) decreased the calculated damage potential.

Figure 2 also illustrates some of the theoretical behaviors discussed in Falvey (1990) and reviewed in Holroyd (1990). The shallow initial flow depths produce even shallower depths downstream. Friction limits the speeds of the shallow depths of water and therefore causes the steep gradient of damage potential with depth for initial depths of less than 2 m. The 20 m/s diagram shows that increasing initial depth actually *decreases* the damage potential because increasing depth increases static pressure and makes it more difficult for dynamic pressure reductions to reach values at which-water will vaporize. The effect of increasing initial depth on decreasing cavitation damage potential is especially strong in the circular curvature section between 700 and 800 m, where centrifugal forces add to the static pressure. This is a strong reminder that great depths of water will not cavitate. An ocean of water traveling across land at high speeds may be quite destructive, but it will not be by cavitation.

The Wide Spillway Simulations

With the behavior of the circular cross section profile of the Glen Canyon Dam Left Spillway established, the cross section was first modified to a rectangular profile with flat bottom and vertical sides of unlimited extent. The vertical profile was retained and the width was initially increased to 50 ft. The changes in the model outputs were relatively minor. The width was then increased to 100 ft. (305 m) to simulate a widespread flood going over the same vertical profile. The flip bucket was removed and a gently sloping approach to the top of the profile was added. In this way it was sought to minimize the model's sensitivity to the side walls of the channel. No limit was placed on the depth of the water in this wide channel, but the computer model itself indicated upper and lower limits to its ability to simulate the flows. Figure 3 shows the distributions of damage potential, coded as before, for only the 10 m/s initial flow speed, as a function of initial depth and downstream distance. The results are similar to Figure 2 but with less of a decrease in damage potential in the 700 to 800 m zone. Flow depths sufficient to reverse the damage potential with depth were not included in this simulation.

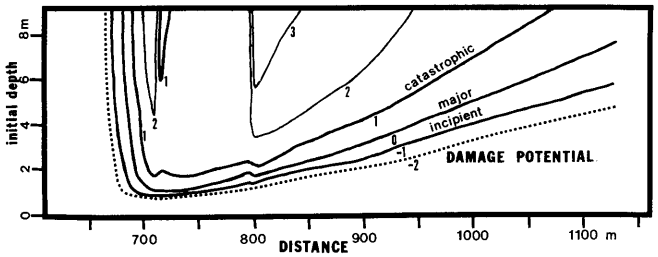

Figure 3. The distribution of the damage potential with initial depth and downstream distance for a 10 m/s initial flow speed. The damage potential is coded as in Figure 2. The Glen Canyon Dam left spillway profile was modified to eliminate the flip bucket at the end, add a gently sloping approach to the top of the spillway, and widened to a 1000 foot rectangular cross section with vertical walls.

The Semi-horizontal Simulations

Having established that wide flows can be examined and that they give similar results to the circular cross section investigations, the possibilities of cavitation over nearly flat terrain were examined. Input parameters were chaned to metric, with a width of 1 km. An artificial profile was designed which consisted of 5 km of nearly flat terrain having a constant slope of only 0.004. Then, to drain the water away from the semi-flat region, the terrain was given a parabolic profile matching the free fall arch of an object traveling horizontally at 500 m/s. Initial flow speeds of up to 100 m/s were used in the simulations and the conditions in the parabolic section were ignored. The water was aways decreasing its speed over the semi-flat portion and therefore increasing its depth to maintain a constant flow.

Numerous computer runs were made in order to map out the damage potential presented in Figure 4. In the Figure it is the *actual* water depth that is the ordinate and the *actual* flow speed for the abscissa rather than the initial conditions as in the earlier Figures. The logarithmic coding of the damage potential is again used. The solid lines give the locations of the calibrated "incipient, major, and catastrophic" conditions and the dotted lines the extrapolated values. It is seen that significant damage potential begins with shallow flows of about 30 m/s, according to this simulation. It increases rapidly with flow speed, remembering that the contour lines differ by a *factor* of two. It is also seen that the damage potential decreases with increasing flow depth. This is because the increased ambient pressure caused by greater depths remakes it harder for dynamic pressure fluctuations to reduce to the vapor pressure of the water.

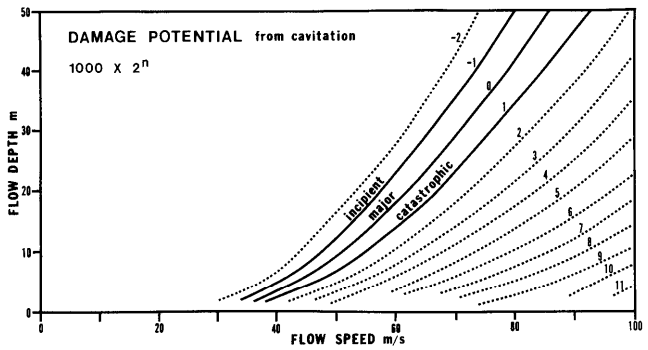

Figure 4. The damage potential for nearly flat terrain for actual, rather than initial, flow depths and speeds.

In creating this Figure, no consideration was made as to how such velocities might be achieved. Indeed, the rapid reduction of speed with downstream distance that appeared in these simulations indicates that viscosity and friction will prevent high speeds from being sustained at a slope of 0.004. Yet Figure 4 indicates that if there is some cause for water to exceed a speed in excess of about 30 m/s, then cavitation damage potential exists for even semi-flat terrain. The nearly flat terrain of this simulation was especially designed to produce a simplified diagram in which the speed threshold of cavitation damage potential and the normally inverse relationship of flow depth to damage potential were readily evident.

The Papago Creek (Grand Canyon) Simulations

There are an infinite variety of profiles that can be investigated with the model. For this report a natural channel was chosen to see if there were any conditions under which cavitation would occur if various flows of water were allowed to follow such a profile. In order to get depth and variety, a steep and generally straight side channel of the Grand Canyon of Arizona was chosen. The profile was along a line parallel to Papago Creek (about 36° 2'N, 111° 54' W), from the highway towards Solomon Temple, at an azimuth of 333°. The horizontal distance was the distance of the contours from the highway, not the integrated distance along the twisting channel. The resulting profile and the geologic strata, derived from a geologic map (Museum of Northern Arizona 1986), of the cross section are shown in the upper part of Figure 5 and Table 1. The elevations were taken from a 1:62500 scale topographic map of 80 feet contour interval. Though nearly 60 contours were available, only 40 could be used in the model. So 160 feet contours were used initially and then the intermediate contours were used in sections (generally flat) recommended by the software.

The contours of damage potential in Figure 5 have the same coded labels as the previous Figures. Though the contours are not always resolvable in this reproduction, what is important is their density and location. The middle drawing has a rugosity and initial conditions comparable to those in Figures 2 (center) and 3. Yet the damage potential generally equals or greatly exceeds that for the Glen Canyon Dam spillway profiles. The curve labeled 8 in Figures 4 and 5 indicates a damage potential exceeding 100 times the "catastrophic" conditions observed in the 1983 floods. The lower part of Figure 5 is probably more realistic for a natural channel roughness. Yet it also indicates the possibility of equal or greater damage from cavitation than observed in 1983 at the Glen Canyon Dam. As in Figure 3, the water depths were not increased to the level beyond which the cavitation potential would decrease. The cliff-like portions of the refile made the software issue complaints for depths greater than those illustrated.

Comparing the upper and lower parts of Figure 5 gives an indication of which parts of the profile are likely to cause cavitation damage. The highest damage

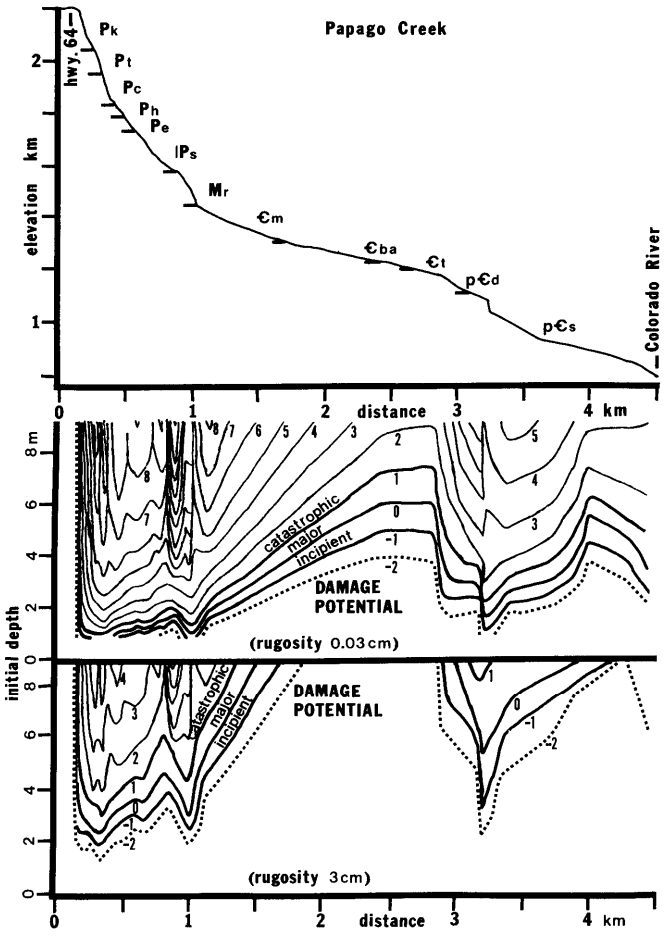

Figure 5. (Top) The vertical profile of Papago Creek and the geological strata exposed, using the symbols in Table I. The distribution of cavitation damage potential as a function of initial depth and downstream distance or a 1000 ft wide Papago Creek profile for 10 m/s initial flows speed. The damage potential is code as in Figures 2-4 for a smooth surface (middle) and rough surface (bottom).

potential occurs where water would encounter a negative radius of curvature for the surface. This condition reduces the ambient pressure (weight of the water above a point) much like a vehicle traveling over the same profile experiences a tendency towards weightlessness. But such locations can also inject air into the water stream if they are cliff-like, such as the Redwall limestone near the one km location.

Other locations for enhanced damage potential are where the water has a great speed from a recently rapid drop in altitude. On the other hand, the reduced damage potential from 2 to 3 km results from reduced speeds and increased flow depths caused by the more level terrain. In general, the damage potential is greatest where there are steep drops in the stream profile. This suggests that the heads of canyons can experience rapid removal of rock as a result of cavitation processes if such large flows of water spill into them without much ingestion of air.

The choice of Papago Creek was made to find out what a variety of rock strata would do, as represented by present profiles. Hard rocks will have semi-horizontal top surfaces and cliff-like edges. Softer shales will have intermediate slopes. If a large flow of water

Table I. The sequence of rock formations along the Papago Creek profile shown in Figure 5.

Symbol	Formation
P_k	Kaibab limestone
P_t	Toroweap
P_c	Coconino sandstone
P_h	Hermit shale
P_e	Esplanade sandstone
IP_s	Supai
M_r	Redwall limestone
$€_m$	Mauv limestone
$€_{ba}$	Bright Angel shale
$€_t$	Tapeats sandstone
$p€_d$	Dox sandstone
$p€_s$	Shinumo Quartzite

was to pass over the cliff edge in such an environment without ingesting much air, then cavitation-initiated rock destruction is likely to occur. The choice of Papago Creek was for convenience. It does not indicate any suggestion that a large flow actually occurred in that location. There is presently no way such a flow of water could arrive at the cliff edge and the size of the headwaters is trivial. However, the harnesses of the rocks during the carving of the Grand Canyon might have been similar to those observed today and reflected in the present erosion profile. A catastrophic flow of water, such as might result during the capture of the Colorado River through the Kaibab uplift, might encounter similar profiles. This computer simulation shows that there are indeed locations for cavitation processes to greatly accelerate the removal of rock.

Discussion and Conclusions

The previous article (Holroyd, 1990) summarized the physics of the process of cavitation. As considered in this paper, cavitation is the creation of water vapor bubbles within liquid water by the reduction of pressure to the vapor pressure of water at the temperature of that water. The term cavitation has been erroneously extended to include the damaging processes associated by the collapse of those bubbles.

The process of cavitation damage relating to water conveyance structures was explored with the help of a monograph on cavitation and the accompanying software packages. The software, qualitatively calibrated by assessments of historical damage to existing spillways, was used to map flow and cavitation conditions for the Glen Canyon Dam left spillway tunnel. After documenting the software behavior for known damage, the pro rams were used for other simulations. Changing from circular cross section to rectangular of 1000 feet width showed similar cavitation behavior. The simulation of wide, nearly flat, terrain illustrated the effects of water speed and depth on he cavitation process. It indicated that cavitation damage should be suspected for flow speeds greater than 30 m/s in shallow water. The simulated spill of water over the rim of the Grand Canyon indicated a potential for greater cavitation damage to the rock than the greatest damage observed in the 1983 floods.

The purpose of these initial simulations was to examine the cavitation process for a few profiles during conditions of water flow much greater than commonly experienced in recent floods. Though the monograph labeled the 1983 Glen Canyon Dam spillway damage as "catastrophic," the software was pushed to damage potentials over 100 and 1000 times as great, for conditions that have never been measured. The software cannot be calibrated for those conditions, but it still gives guidance for such extremes. As expected, flows in excess of those observed in 1983 can be expected to produce damage much more severe than that which created automobile-sized boulders out of sandstone bedrock during a several-week period. This suggests that great flows of water might have the potential for carving canyons even in hard rocks during several weeks rather than the slower thousands-of-years rates observed with normal erosion processes. Yet the simulations also showed that eventually cavitation damage potential decreases with increasing water depth.

This has been only an initial exploration of cavitation with software simulations. The variety of possible input conditions is practically infinite. There is opportunity for further research into numerous phenomena related to the process of cavitation. The software can be run on many natural profiles for water channels to explore the range of profiles and water flows that might lead to cavitation conditions. Of particular interest might be scenarios of catastrophic drainage of post-glacial lakes. There are several canyons which, if plugged, would support vast lakes upstream of them. A breaching of the dam, a natural ridge holding back the lake waters, could involve water speeds of sufficient to initiate cavitation damage. Thousands or millions of years are not necessarily needed for the carving of some valleys and canyons if the process of cavitation becomes involved.

Acknowledgements

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Appendix. Radius of Curvature

The program calculates the vertical radius of curvature for three pairs of consecutive stations (x_1, x_2, x_3) and elevations (y_1, y_2, y_3). For a subsequent calculation the first point is dropped when the next pair is entered. The radius of curvature is assigned to the middle point, like what is done for the calculation of a running mean of three points. The three points form a triangle whose sides a, b, and c can be determined by:

$$a^2 = (x_1-x_2)^2 + (y_1-y_2)^2,$$
$$b^2 = (x_2-x_3)^2 + (y_2-y_3)^2,$$
$$c^2 = (x_3-x_1)^2 + (y_3-y_1)^2. \quad (1)$$

Following a formula in Hodgman (1938) for the radius of a circle circumscribed around a triangle, the half perimeter, s, and a subsequent product, t, are

$$s = (a+ b + c)/2, \quad t = s(s-a)(s-b)(s-c). \quad (2)$$

To protect against illegal calculations, if c >= (a + b) or t =< 0, then the radius of curvature, R, is set to zero. Otherwise

$$R = abc / 4(t)^{1/2} \quad (3)$$

The sign of the curvature must then be determined, where concave upwards (center of curvature above the flow surface) is considered positive. This is accomplished by determining the line between the extreme points of the three coordinate pairs: slope, m, and intercept, i, and elevation of the line at the middle station, y_c, are

$$m = (y_3-y_1)/(x_3-x_1), \quad i = y_1 - mx_1,$$
$$Y_c = mx_2 + i \quad (4)$$

If $y_2 > y_C$, then R is set to be negative.

QUOTE

On a cursory look nothing much positive emerges when a survey is made of the relatively little written about religion by the most prominent figures of twentieth-century science. Planck, with his groping for a personal God, still belonged to an older school, which, however, shied away from historical revelation. Bohr's views on religion were those of Harald Hoffding, the Danish forerunner of William James. They amounted to the recognition of some purely natural aspirations in man complementing sheer rationality. In Schrodinger's Buddhism there was no room for a transcendental, personal God, let alone for His stepping into history through a specific revelation. The ***Physics and Beyond*** of Heisenberg contains no metaphysics worthy of that name. Its concluding note, the enthrallment of a Beethoven trio, is certainly beyond physics, but not at all beyond ***physis*** or nature. Pascal's fervent commitment to the God of Abraham, Isaac, and Jacob, revealing himself in Jesus, had no appeal for Heisenberg .

Others, **like** De Broglie and Dirac, kept a studied silence about religion, in accordance with the widely shared view that science alone is public knowledge, or a knowledge with objective validity, whereas religion is merely a private knowledge, that is, a respectable personal opinion at best.

Jaki, Stanley L. 1986. ***Chance or Reality and Other Essays.*** University Press of America. Lanham, MD p. 163.

PANORAMA OF SCIENCE

Evolutionist: Contradict Thy Ownself

It has been my experience that, as fallible human beings, each of us will sooner or later contradict himself. The creation/evolution foray seems to have produced a climate in which the phenomenon of self-contradiction is more prevalent than in any other definable facet of human debate. A leading evolutionary apologist has provided evidence of his own human fallibility in this regard. In this instance he has done so in the role of a latterday 'Darwin's bulldog':

> . . . each of Darwin's books played its part in the grand and coherent scheme of his life's work—demonstrating the fact of evolution and defending natural selection as its primary mechanism (Gould, 1978, p. 20).

Whatever Darwin may have "demonstrated" in his books, "the fact of evolution" was not among them. Even the erstwhile Darwinian seemingly had a change of heart about his hero's contribution. This applies not only to the primacy of natural selection, but also its very basis as an evolutionary mechanism:

> . . . Darwin acknowledged the provisional nature of natural selection while affirming the fact of evolution. . . . Yet amidst all the turmoil no biologist has been led to doubt the fact that evolution has occurred; we are debating how it happened (Gould, 1981, p. 35).

Creationists have occasionally accused evolutionists of plasticity in the application of evolutionary science. The passing of only three years, it would seem, had reduced Darwin's "primary contribution to the status of "provisional" and eliminated it as a "mechanism" of evolution. Yet, the "fact" of evolution remained intact. It would appear that evolutionary theory can be molded to fit even contradictory testimony. [The latter part of the last quote was written in the context of the debate between evolutionist gradualists and punctuationists.]

One of the most exploited and controversial aspects of the creation/evolutionism debate has been the fossil record. The entombed remains and preserved impressions of biological life in the sedimentary layers of the geological column have been used by evolutionists and creationists as evidence for their diametrically opposed positions. Numerous evolutionist disclaimers abound in the current literature as to the importance of the fossil record for evolution (i.e., Bennetta, 1987). Yet, one biologist has managed to "see" in the rocks that which creationists have consistently maintained is absent: Transitional forms are enerally lacking at the species level, but are abundant etween larger groups (Gould, 1981,

If one is to provide any meaningful evidence for alleged transitional forms, it would have to be at the level of the lowest taxonomic unit. Otherwise such testimony could only describe "gaps" in the record. Fossil gaps, of course, fit the creation model of origins well, but have caused volumes of apologetic to be written by evolutionists. Yet, it would appear that Gould was more than able, even if only inadvertently willing, to point up the "transformist illusion:"

> All paleontologists know that the fossil record contains precious little in the way of intermediate forms; transitions between major groups are characteristically abrupt (Gould, 1977, p. 24).

Gould is one of the more prolific evolutionist writers, but certainly not the only one who is guilty of self-contradiction. A well-known ecologist has demonstrated his own literary propensity for evolutionary 'hoof-in-mouth' disease:

> Creation and evolution, between them, exhaust the possible explanations for the origin of living things. . . . If species were created out of nothing in their present form, they will bear within them no evidence of a former history; if they are the result of historical development, any evidence of history is evidence of evolution (Futuyma, 1983, p. 197).

Most creationists would agree that creation and evolution are the only two contending philosophies as regards origins. The latter portion of the last quote, however, seems to be based upon prejudicial bias. Historical evidence by definition is unobserved in the context of origins. Therefore, the imposition of evolutionary interpretation upon evidence admittedly historical, must be done in a prejudicial framework. One must already ***believe*** evolution to be true prior to discovery of the evidence. Furthermore, inconsistency would seem to be the order of the day:

> In actuality, almost all creationist literature simply consists of attacks on evolution, rather than positive evidence for creation. To the creationists, any evidence against evolutionary theory apparently constitutes evidence in favor of creation (Futuyma, 1983, p. 176).

Yet, if only two alternative explanations of a particular phenomenon exist, it is only logical that evidence refuting the one, would precisely substantiate the other. The last two quotes have all the earmarks of another evolutionist 'no lose' proposition. An evolutionist can use any historical evidence to support evolution, but the creationist who refutes the evolutionary assumptions imposed on that same evidence is not free to use it in support of the creation model. Is that position then, supposed to convince anyone that the typical evolutionist is open minded?

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Bill Crofut and Raymond M. Seaman"

***Catholic Creation Ministries, P.O. Box 997, Jordan, NY 13080.**

Evolutionism: Genetic 'Egg'-Sasperation

Writing from the perspective of personal experience, a leading evolutionist of our time noted the disdain with which a leading evolutionist of the preceding generation was treated by his colleagues: "When I studied evolutionary biology in graduate school during the mid 1960's, official rebuke and derision focused upon a geneticist named Richard Goldschmidt" (Gould, 1977, p. 22). A leading Biblical creationist of our time wrote, with apparent incredulousness of the reason for the". . . official rebuke . . ." of the earlier evolutionist. He then went a step further by including the later evolutionist in his criticism: "According to Goldschmidt, and now apparently according to Gould, a reptile laid an egg from which the first bird, feathers and all, was produced" (Gish, 1978, p. 161). It would seem the reason for including the younger evolutionist in the accusation was the apparent admission of complicity: "I do, however, predict that during the next decade Goldschmidt will be largely vindicated in the world of evolutionary biology" (Gould, 1977, p. 22). That statement would certainly seem to lend a good measure of justification to the Gish accusation. Yet, he was taken soundly to task for it:

> Any evolutionist who believed such nonsense would rightly be laughed off the intellectual stage; yet the only theory that could ever envision such a scenario for the evolution of birds is creationism—God acts in the egg (Gould, 1981, p. 37).

We see two major flaws in Gould's testimony, which has all the earmarks of an emotional outburst. First, we cannot imagine any Biblical creationist, as Gish can be most aptly described, who is going to offer any ". . . scenario for the evolution . . ." of anything. Secondly, it also does not seem reasonable that a Biblical creationist is going to believe that Almighty God would hatch a bird from a reptile egg. Fiat Creation would preclude the necessity for such a 'divine' parlor trick.

It would seem reasonable that an evolutionist, or anyone else, who truly believed a bird could hatch from a reptile egg, should receive". . . official rebuke " This would seem all the more applicable to Goldschmidt since he was a geneticist. Still, the only valid way we know to vindicate Goldschmidt is to quote the man himself:

> . . . 0. H. Schindewolf . . . showed that the material presented by paleontology leads to exactly the same conclusions as derived in my writings, to which he refers . . . He shows by examples from fossil material that the major evolutionary advances must have taken place in single large steps, which affected early embryonic stages with the automatic consequence of reconstruction of all the later phases of development. He shows that the many missing links in the paleontological record are sought for in vain because they never existed: "The first bird hatched from a reptilian egg" (Goldschmidt, 1940, p. 395).

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Bill Crofut and Raymond M. Seaman*

***Catholic Creation Ministries, P.O. Box 997, Jordan, NY 13080.**

Reprinted CRSQ Volume 1

Introduction

The ***Creation Research Society Quarterly*** has been published since 1964 (26 complete volumes. Many of the early Quarterlies are out-of-print, yet these past issues contain articles of continuing interest and value. In an effort to make these volumes available, the Board of Directors has incurred considerable expense to reprint them. In order that those interested in good scientific creationist articles, sound criticisms of the evolutionary hypothesis, along with the needed literature citations accompanying the treatises will have a general idea of the contents of each volume, brief synopses will be written to appear in this and future Quarterlies.

Heritage of Creation Concepts

One of the outstanding features spanning all four Quarterlies of volume 1 was entitled "The Heritage of Creation Concepts: Selected Bibliography Showing the Continuity of the Creationist Viewpoint" written by Dr. John N. Moore (1964 a, b, c, d), former professor at Michigan State University, **CRS Board** Member for many years, Managing Editor in the early formative years of the Quarterly, and now a Fellow of the Society living in retirement in Florida. The need for such a bibliography was explained by Moore (1964a, p. 3) as follows:

> As soon as Charles Darwin's ***Origin of Species*** was published in 1859, criticisms and modifications plus alternative hypotheses and theories were presented by comtemporary scientests in many countries. "Opposing" formulations on Mendelism mutation an saltation occurred later and have led periodically to controversies in this post-Darwinian century.
>
> Today, many persons think there is general and broad acceptance of evolution among scientists working in many specialties. This impression of acceptance explains the purpose of this work, namely to show that a substantial segment of scientists over a long period of time tracing back to Linnaeus, Newton and Copernicus have taken issue, and continue to take issue, with evolutionary ideas in what has been called correctly "The Unresolved Conflict."
>
> Thus this present formulation does not inaugurate an argumentative position or initiate enumeration of pertinent objections by well-educated scientists, science teachers, or laboratory specialists. Efforts of members of the Creation Research Society are not spontaneous and isolated, but

belong in continuity with, and are common extensions of, efforts of previous scholars in other decades.

Yes, objections to Darwin's ideas have been continuous for more than one hundred years. Consistently, eminent scientists have written extensively about weaknesses, limitations, deficiencies, qualifications and consequences of evolution.

This bibliography contains 144 selected creationist, antievolutionary articles or publications with an occasional abstract plus explanatory paragraphs when necessary. Nine references "to the modern neo-Darwinian modern synthesis theory of evolution" (Moore, 1964a, p. 4) are given so that a reader can become familiar with the "evolution" of the evolutionary hypothesis.

Some Reasons for the Formation of CRS

Dr. Walter E. Lammerts, founder of the Society, first editor of the Quarterly, strong advocate of creationist research efforts, world-famous plant breeder, now a Fellow of the Society living in retirement in California, in his introduction to the first Quarterly (Lammerts, 1964a, p. 1) explained his interest in defending creationism and the need for the formation of the Society. Many of Lammerts' goals have been achieved in the first 25 years of publication of the Quarterly. See Gish, 1989 for a realization of the research goals. With very few funds and limited available time, scientists who are creationists have generated a solid body of scientific information in support of the creation model of science.

Selected Articles

John W. Klotz (1964, pp. 6-9) justifies the importance of creation studies from a Scriptural standpoint. The author explains why creation studies are at the center of understanding of Christianity. R. L. Harris (1964, pp. 10-12) discusses the Dead Sea Scrolls and their importance. Paul A. Zimmerman (1964, pp. 13-17) shows the bankruptcy of the spontaneous generation of life concept, one of the weakest, but often ignored, links of evolutionary thought. Modern studies of DNA and RNA continue to cast doubts on the undeniable improbability of spontaneous generation and the enormous faith a materialist must have in his naturalistic religion at this point. Strong scientific evidence is offered by Zimmerman against this most unrealistic view of atheistic evolutionists.

George F. Howe, one of the most productive creationists of the past 25 years offers "Paleobotanical Evidences for a Philosophy of Creationism" (1964, pp. 24-29). The well-documented study is divided into the following sections:

1. Complex forms frequently appear before the simple ones with no hint of evolutionary ancestry.
2. Supposedly "advanced" and primitive characteristics occur in the same fossil plant.
3. Modern forms frequently are identical or similar to remote fossil specimens.
4. Where supposed phylogenies (families trees) are postulated, significant gaps occur.
5. Some of the anatomical characteristics thought to be earmarks of only one particular group or set of groups have been found distributed in other supposedly nonrelated groups.
6. The entire problem of angiosperm ancestry has remained a complete mystery.

Frank L. Marsh, a pioneer creationist of our generation, presents a much-needed discussion of things that do not change in the biological world. So much has been made concerning change in evolutionary writings that the unchangingness of organisms is often blindly overlooked or ignored. In an article entitled "The Genesis Kinds in the Modern World," Marsh (1964, pp. 30-38) carefully gives evidence for ***fixity***. See also ***Variation and Fixity in Nature*** offered by CRS Books as an expansion on this theme. William J. Tinkle (1964, pp. 39-41) assigns natural selection a limited role in nature—possibly no more than that of conservation. Walter Lammerts (1964b, pp. 47-55) points out many scientific discoveries since 1859 which invalidate the evolutionary hypothesis. His article covers biological concepts as well as one of the first discussions in the Quarterly on evidences for a young earth.

Duane Gish (1964, p. 10-12) authored an article criticizing the idea of biochemical evolution. He uses the words of the opposition to show that there is no proof for molecular evolution. D. O. Acrey (1964, pp. 7-9) notes that radioactive dating methods cannot provide absolute age determinations. Assumptions that invalidate the methods as age indicators are presented. Thus the Society had finished its first year of publication as one of the outlets for publication of scientific information in favor of the creation model of science, something other journals of science simply would not allow. The Quarterly continues as a focal point for scientific creationist opinion still needed in this era of materialistic censorship.

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Emmett L. Williams*

***5093 Williamsport Drive, Norcross, GA 30092.**

* *

When fearing themselves unable to prevail, there are those who would prefer to see their opponent be disqualified rather than risk defeat in a fair contest. Such is the current strategy of the evolutionists. In the end all will lose and free inquiry will suffer.

Dudley J. Benton

Evolution: Factual or Fanciful?

Few issues have sparked as much controversy as the value of the fossil record to substantiate or refute evolution. Our personal view, after nearly a decade of reading, research, and correspondence, is that the geological column will only provide evidence for evolution for those who approach the empirical evidence with the idea that evolution is a fact. Of course, the evolutionists with whom we are familiar, would probably deny such accusation, but a ranking evolutionist geologist seems to have substantiated the claim:

> Paleontologists often claim that fossils tell us something. But fossils, by themselves, tell us nothing: not even that they are fossils . . . When a paleontologist concludes that he is dealing with a fossil and by implication with an organism, he already knows a great deal about that organism. He knows that the plants and animals which he encountered in the geologic past will have the characteristics required of them by the theory which he has presupposed in order to reach them (Kitts, 1974, p. 458).

Such a paleontological claim can reasonably be expected. No professional in any field is likely to deliberately undermine the bedrock upon which his entire career is built. True to form, one ranking paleontologist noted that certain fossils tell him a great deal:

> . . . paleontologists have discovered two transitional lineages of therapsids (the so-called mammal-like reptiles) with a double jaw joint—one composed of the old quadrate and articular bones (soon to become the hammer and anvil), the other of squamosal and dentary bones (as in modern mammals) (Gould, 1981, p. 36).

Yet, in the context of the debate between evolutionist gradualists and punctuationists, Gould admitted that his own views are also colored by preconceptions (Eldredge and Gould, 1972, p. 98-99). Such activity would seem to have been exposed as invalid.

> There is thus a fundamental ambiguity involved in the attempt to ascribe a function to a part of a fossil organism. We must be careful, however, not to attach a special methodological significance to this fact. Of *any* object whose activity has not been observed it can only be said that it *could have* fulfilled some function. It can never be said that it *did in fact* fulfill that function (Kitts, 1974, p. 462).

It would seem that Gould was guilty of taking liberties with which he was not scientifically entitled. We can think of no way he could have observed any activity of "therapsids." Still, he appeared to hesitate not in the least to assign future functions to fossil remains about which he could only speculate.

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Bill Crofut and Raymond M. Seaman*

***Catholic Creation Ministries, P.O. Box 997, Jordan, NY 13080.**

Evolution: A Cosmic Numbers Game

Creationists have often been labeled pseudoscientists by evolutionists. Yet, few evolutionists have taken the time to define the term: "The pseudoscientists . . . generally don't get out there and get their hands dirty studying actual wild animals, plants, and fossils" (Pine, 1984, p. 13).

Use of the term, "generally," would seem to indicate that the possibility exists for at least one exception. Not so, according to Pine who would only acknowledge, ". . . apparent exceptions . . ." Evolutionists then, by this particular definition, must be the only true scientists; those who get out there and get dirty hands. Still, according to an old adage, there's an exception to every rule. Consider two such examples.

The "big-bang" scenario* has become the accepted explanation for how our universe is the way it is. Such a proposal is not a reasonable explanation. Explosions do not generate order, but rather always disrupt the existing order. However, this inherent problem would seem to be only the tip of the iceberg.

A problem of much greater magnitude is that of the singularity. Supposedly, every object in the visible universe is receding from every other object at speeds that increase with distance up to nearly half the speed of light (Park, 1968, p. 351). That being the case, at some time in the distant past, all matter must have been condensed into a single point, the singularity.** The problem now becomes the origin of that highly-condensed point of matter. Theological implications are manifest. Yet, by definition, no evolutionist "scientist" can accept a theological explanation for anything observed in the natural world (Pine, 1984, p. 10). One of a consortium of speculations designed specifically to avoid giving God credit for creation of the universe has actually been described as a group of conjectures:

> The multidimensional scenarios are somewhat more difficult to visualize, if for no other reason than that, instead of the familiar 3-dimensional world of everyday life or the more esoteric 4-dimensional world of relativity, they deal with a world of 10 or 11 dimensions. (Don't bother trying to picture such a world—it can't be done. You have to rely on the mathematics.) (Trefil, 1984, p. 100).

Anyone conversant with current literature in the creation/evolutionism debate can only be too well aware of the amount of material written about the second law of thermodynamics. Creationists have long contended that the deleterious effects of the second law preclude any such notion as the increase in complexity demanded by the evolution model. Evolutionists, for their part, have expended tremendous amounts of time and energy in a feeble attempt at circumventing the second law.

***Editor's Note: For a bibliography on articles published in CRSQ on problems with the big bang hypothesis see the editor's note in the following book review: Jang, A. W. 1990. Book review of Quasars, redshifts and controversies. CRSQ 26:146.**

****Editor's Note: See Williams, E. L. 1983. The initial state of the universe—a thermodynamic approach in Mulfinger, Jr., G. (editor). Design and origins in astronomy. Creation Research Society Books, Terre Haute, IN. pp. 27-40.**

Those who would not make any pretense at circumventing the law of gravity seem to forget the definition of"law" when trying to dance around universal entropy; the measure of increasing randomness or disorder; the decrease in the amount of energy available for useful work.* Yet, such wishful thinkers have awarded the highest plaudits for speculative effort:

> Illya Prigogine, 60, has not actually worked in a chemistry lab for decades. But his research in thermodynamics at the Free University of Brussels has earned him both the Nobel Prize and the promise of fame far outside his own field. . . . Prigogine's insights will give biologists new grounds for learning how the first random molecules organized themselves into life forms (Anon., 1977, p. 87).

Still, for all the accolades, the master himself seemingly has burst the evolutionary bubble for those who will grasp at any straw. Furthermore, he did so in the context of his own research:

> . . . in a nonisolated system there exists a possibility for formation of ordered, low-entropy structures at sufficiently low temperatures. This ordering principle is responsible for the appearance of ordered structures as crystals as well as for the phenomena of phase transitions.
>
> Unfortunately this principle cannot explain the formation of biological structures (Prigogine, et al., 1972, p. 23).

***Editor's Note: For several articles on creation, evolution and thermodynamics see Williams, E. L., editor. 1981. Thermodynamics and the development of order. Creation Research Society Books. Terre Haute, IN.**

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Bill Crofut and Raymond M. Seaman*

***Catholic Creation Ministries, P.O. Box 997, Jordan, NY 13080.**

MINISYMPOSIUM ON VARIABLE CONSTANTS—VI*

CHANGING CONSTANTS AND THE COSMOS

GLENN R. MORTON**

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Abstract

Four different theories of variable fundamental physical constants are reviewed and compared. Special emphasis is placed on problems of interest to the creationist. The number of explanations for difficult and diverse diluvial problems available from these types of theories, as well as their application to the problems of light from distant galaxies and radioactivity, makes this field a most interesting one from the creationist perspective.

Introduction

Uniformitarianism as envisioned by Charles Lyell would exclude any possibility that any of the physical constants could ever have changed over time. Lyell viewed uniformitarianism as a methodology in which not only were the laws of nature the same throughout all time but even the rates of the processes were identical to the rates occurring today. In order to explain any observational data Lyell would only admit explanations which excluded any reference to the supernatural and used only present rates of processes. Any appeal to a change in a physical constant would be excluded on two counts. First, a change in a physical constant alters the form of natural law. As will be discussed below, a change in the gravitational constant requires either that energy not be conserved over time, or a radically different law of force than the one in use today, or that new energy fields be discovered or postulated (Bishop and Landsberg, 1976). Lyell would secondly reject a change of a physical constant on the grounds that it would alter the rates of processes in the past.

Modern views of uniformitarianism are much more relaxed about the issue. Requiring that the rates of all processes in the past be the same as those seen today is equivalent to having the earth be a perpetual motion machine in which the average rates of rainfall would be the same even billions of years ago when the sun was less luminous than today. This objection was pointedly raised by Lord Kelvin and it was because of his efforts that the constant rate aspect of uniformitarianism was dropped. Today modern uniformitarianism requires only that the laws of physics be the same today as the were billions of years ago. Changing any of the physical constants violates even this weaker form o uniformitarianism since the present would no longer be the key to the past. Thus even modern science has been reluctant to embrace the idea of a change in the physical constants.

Definitions

What are the universal fundamental physical constants? Basically they are values which are claimed to be fundamental to the structure of the universe. They are called universal constants because they are presumed to have the same value from place to place

***Parts I-V are in *CRSQ* 26:121-31; 27:6-15**

****Glenn R. Morton, B. S., 16075 Longvista Drive, Dallas, TX 75248.**

throughout the universe and throughout all time. The mass of the pendulum bob on my grandfather clock is constant. Ignoring such processes as oxidation, that mass will remain the same through all time. If I were to move my clock from here to another planet or star, the mass would still be the same. The mass of my pendulum bob however is not a fundamental constant because I have the power to change its mass by any of several expedients. I can cut it in half, dip it in acid or weld more mass on to it. It is not universal since various environments can alter its value.

The same thing cannot be said for the rest mass of the proton or electron which are two of the universal fundamental constants. The rest mass of every electron throughout the entire universe is identical to every other electron and thus the mass of the electron is said to be universal. Is it fundamental? We cannot alter the rest mass of the electron. But if we were able to alter that value or alternatively, if the value of the electron rest mass were different during different epochs of history, or if it were different in other galaxies, radical changes in the structure of the universe would be observed. Thus the rest mass of the electron is a universal fundamental constant of nature.

Davies (1982, p. 39) lists 13 fundamental physical constants. In addition to the rest mass of the proton and electron these are: electric charge on the proton, Planck's constant, speed of light, gravitational constant, weak force constant, strong force constant, Hubble constant, cosmological constant, cosmic photon-proton ratio permittivity of free space and Boltzmann's constant. In this article I will only discuss the effect of changing the gravitational constant, and permittivity. I will also discuss the effect of changing one nonfundamental constant, the permeability offree space, since it has been proposed as the cause of a change of radioactive decay rates by Setterfield (1981, p. 56). Finally I will discuss a theory of changing constants put forward by Barry Setterfield. This theory deserves special attention because it involves a change in six fundamental constants.

Are the constants constant? Uniformitarianism would answer in the affirmative. If the constants are not constant, then the laws of physics were different in the past. This ipso facto violates the premise of modern uniformitarianism that the laws of physics are the same. However, as has been pointed out many times, uniformitarianism is a self-imposed restraint upon how the geologic astronomic and biologic data is to be interpret. One does not prove that uniformitarianism is correct; one merely assumes that is and eliminates certain explanations and theories from consideration. However, merely assuming constant constants does not guarantee that in reality they are constant.

The values of the constants that we measure today are generally called constant. But in point of fact, we cannot directly measure the value of the constants for past time in the same fashion that present values are obtained; Because of this it is necessary to use indirect measurements and observations of the effects of a changed constant in order to determine whether the value was different. In many cases, the value of a given constant has only been directly measured for less than 100 years and one should ask if that is long enough for any change to manifest itself.

Change in the Permeability of Free Space

The first notable effect of a change in the permeability is an alteration of the speed of light. The speed of light is proportional to the inverse square root of the permeability. This relationship, which follows directly from Maxwell's equations, was derived by Maxwell (Barnes, 1977) without any assumption concerning the constancy of the speed of light. This relation is assumed to hold whether the speed of light is constant or not. Thus if the permeability was less by a factor of four in the past, then the speed of light would have been twice as fast as it is today. This implies that if creationists accept a variable permeability, then the light from distant stars can be explained.

A change in the permeability also would have some effect on the problem of radioactivity . There are two aspects of radioactivity which need solution. First, why do the ratios of parent to daughter isotopes occur in ratios which appear to indicate great age, assuming the constancy of decay rates. Second, the problem of missing isotopes needs a creationist explanation. The missing isotopes are radioactive nuclides which should exist on earth, assuming they had been originally created and assuming the earth is as young as creationists generally believe. For instance, silicon 32 has a half life of 650 years and should exist in detectable quantities if the earth is only 7,000-10,000 years old. In fact this isotope does not exist naturally on earth (Morton, 1982, p. 228). An obvious creationist explanation is that the rates of radioactivity decay were faster in the past. A change in the permeability would alter the rates of beta decay. The rate of beta decay is proportional to the fourth power of the speed of light (Segre, 1963, p. 355). If the speed of light were twice as fast due to permeability only and ***nothing else changed,*** then the rate of beta decay would be 32 times faster. Interestingly, without changing some other fundamental constant as well as the permeability, alpha decay would remain constant (Segre, 1963, p. 278). However, the change of permeability alone is not a very satisfactory solution to the problem of radioactive decay.

If radioactive decay occurs too rapidly, then one must consider another problem. Radioactivity produces considerable heat. The amount of heat given off by rapidly occuring radioactivity is most clearly seen in the explosion of a nuclear bomb. In a nuclear bomb, exceptional amounts of energy are emitted instantly. The conversion of this energy to heat produces the vaporization of materials as well as a damaging shockwave. Even though radioactive nuclides are not as concentrated in nature as they are in a bomb, if their rate of radioactive decay increases, then the extra heat generated will heat up the crust of the earth. Too fast of a rate of heat production could melt the earth. * If the decay curve postulated by Setterfield is extrapolated to the first week of creation, the amount of heat generated by such a rapid rate of decay would vaporize the earth. (Morton ***et al.,*** 1983, p. 65).

A change in the permeability also would have the immediate effect of altering the earth's magnetic field.

***Editor's Note: See Williams, E. L. 1990. Variables or constants? An introduction. *CRSQ* 26:124, footnote, first column for a different view of rapid radioactive decay.**

The field is directly proportional to the permeability and thus is inversely proportional to the square of the speed of light. Thus if the permeability were smaller in the past, the earth's magnetic field was also smaller.

A change in the value of the permeability is incompatible with energy conservation, if nothing else was altered. The energy density of a magnetic field is

$$\text{Energy Density} = \frac{B^2}{2\mu_0} \propto \frac{\mu_0^2}{2\mu_0} \propto \mu_0 \qquad (1)$$

where B is the magnetic induction and μ_0 is the permeability. B is proportional to μ_0 so the energy density is proportional to μ_0. Thus if μ_0 increases , then the energy density increases and if μ_0 decreases, the energy density decreases. When the total energy in the magnetic field is calculated, the total energy of the field is still proportional to μ_0. This means that a change in the permeability does not conserve energy. However this should not necessarily be considered a reason to reject changes in the fundamental constants since any change in any constant seems to violate conservation laws.*

There is a good possibility that any change in the speed of light, whether caused by permeability or by permittivity, would have the effect of altering the phenomena of the rainbow. This author has done some preliminary calculations which indicate that a change in the speed of light would cause a change in the dispersion of light passing through a water droplet. If this were the case then a change in the permeability would certainly have the potential for preventing the formation of a rainbow.

From the foregoing one can conclude that a change in the permeability can explain light from distant stars, the problem of radioactive dating and the missing isotopes, and may explain the rainbow. The difficulty with a change in permeability itself is that it cannot explain an alteration of alpha decay which is one of the primary processes of radioactive decay.

Change in the Gravitational Constant

The gravitational constant was one of the first fundamental constants to have been suggested as being variable (Dirac, 1939). He made the suggestion based upon some coincidences among certain physical relationships. Probably because of Dirac's credentials and the simple elegance of his reasoning, the gravitational constant has been a favorite candidate for variability. Dirac showed that the ratio of the electrical force to the gravitational force between an electron and proton in a hydrogen atom was approximately 10^{40}. He also noticed that the generally accepted age of the universe expressed in atomic units of time (the time necessary for light to traverse an electron) was also approximately 10^{40}. Dirac proposed that these two quantities were proportional. This would then require the gravitational strength to decrease inversely proportional to t, and would predict that G is currently decreasing at a rate of -6.6×10^{-9}%/yr.

The effects of a change in the gravitational constant are very dependent upon which theory of gravitational change one uses. If one assumes that only G changes and no other constants are involved, known as the primitive theory, then the effects are as follows:

1. The period and radius of an orbit will increase if G is decreasing with time. This means that the earth is further from the sun now than in the past and the moon is further from the earth. This obviously has implications for the temperature of the earth in the past. Another implication is that lunar occultations of stars will not occur quite as soon as predicted. Analysis of lunar occultation data has yielded the only positive evidence of change in G with estimates ranging from -7.2×10^{-9}%/yr to -8×10^{-9}/yr (Van Flandern, 1976; Wesson, 1980). When compared with the theoretical value, the agreement is remarkable. However other experiments have yielded negative results. *

2. The radius of the earth would expand. This would largely be due to relaxation of the gravitational compression of the earth.

3. If one requires energy to be conserved, then the Newtonian inverse square law of gravitation would have to be substantially altered (Bishop and Landsberg, 1976).

4. One topic which has received insufficient attention is that, if the gravitational constant was greater in the past and energy is not conserved, then the red shifts seen in distant stars could be due to gravitational redshift** rather than velocity redshift. Within the General Theory, the equations governing each phenomenon are identical (Misner, Thorne and Wheeler, 1973, pp. 187, 779).

5. The shape of galaxies should be altered with distance, due to the different gravitational force in effect when the light we see now left the galaxy (Wesson, 1980).

Several objections have been raised regarding a change in the gravitational constant. From a creationist perspective, the amount of increase in the gravitational constant necessary to compress the earth to the radii which expansionists suggest would make it difficult to understand how the bones of dinosaurs could have withstood the gravitational pull. On an earth half the present radius in size, every object would weigh more than three times what they weigh on the present earth. One must explain how a dinosaur weighing 70 tons on the present earth could have lived if it actually weighed over 200 tons. It does little good for creationist to advance a hypothesis which destroys all life.

Another objection is that G is really a non-entity within the General Theory of Relativity. Gravity is merely curvature of spacetime and is not a force in the usually understood sense of the term. Changing G requires that the curvature of spacetime everywhere change. As Dirac (1978, p. 78) aptly stated, ". . . there is no room in Einstein's theory for variation of G." That not withstanding, several attempts have been made to modify Einstein's work to allow a variable

***Editor's Note: There is a situation where conservation laws could vary as well as the constants involved without a loss of energy conservation. See Williams, E. L. 1990. Variables or constants? An introduction. CRSQ 26:127.**

***Editor's Note: See DeYoung, D. B. 1990. Changing constants and gravitation. CRSQ 26:130-31 for a discussion of the nonvariation of G.**

****Editor's Note: See Ettari, V. A. 1988. Critical thoughts and conjectures concerning the Doppler effect and the concept of an expanding universe. CRSQ 25:140-46 for a brief discussion of gravitation redshifts.**

G, some with quite bizarre implications (Van Flandern, 1981; Canuto and Hsieh, 1980). Canuto and Hsieh (1980) correctly note that Einstein's equations do not require a constant G, but only a constant product of G x M. They use this lesser constraint to answer the next objection to a variable G.

At one time it was felt that the solar luminosity would increase with increasing G to the extent that the earth would be roasted (Teller, 1948). In order for a changing G to be compatible with general relativity, one must assume that the product GM is constant. With that assumption the luminosity is approximately constant (Canuto and Hsieh, 1980). This item will become important when discussing Setterfield's views.

As for creationist problems, there are not many that a change in G would solve. Gravity is the most unique of the four forces known to physics. Grand unification theories have had more success in uniting the other three forces than they have had in including gravity.

Change in Permittivity

Morton (1979, 1980, **1981, 1982, 1983, 1986, 1987)** has investigated the effects and implications of a change in the value of the permittivity of free space. I postulated that at the time of the Flood the permittivity increased. Since that time the value has remained constant, and also prior to the Flood the value was constant. The permittivity is the mediator of all electrical interaction. As such it plays a very critical role in the affairs of nature. The effects of changing the permittivity are more widespread than the effects of changing the permeability. This is probably because the permittivity is more fundamental to the natural order. In the literature one often finds discussion of a change of the ratio of e/m where e is the electronic charge and m is the electron mass. In some situations this is equivalent to discussing a change in the permittivity.

The effects of changing the permittivity are as follows:

1. As in the case of the permeability, the speed of light would be faster in the past if the permittivity were smaller. The speed of light is proportional to the inverse square root of the permittivity. Thus if the permittivity was less by a factor of four in the past, then the speed of light would have been twice as fast as it is today. This holds promise of explaining how light from distant galaxies arrived on earth in creationist time frame, depending on how much the permittivity is postulated to have changed during the period of the Flood (with constant values before and after). The speed of light would have been faster before the Flood and slower after the Flood, but only having a variable value during the Flood.

2. A change in the permittivity would have a major impact on the problem of radioactive decay and the missing isotope problem mentioned above. Unlike the permeability which would also require changes in other constants to explain both types of radioactivity , a decrease in the value of the permittivity would increase the decay rate of both beta and alpha decay. Morton (1982) showed that a decrease in the value of the permittivity by a factor of 1648 prior to the Flood would explain why silicon 32 with a half life of only 650 years does not exist naturally today. A change in only one constant to explain both types of radioactivity seems simpler than having to change more than one fundamental constant.

A change in the value of the permittivity by only 2000 times would not have any associated heat problems. As mentioned above when discussing the change in the permeability, too drastic a change in the value of either permittivity or permeability would quickly melt the earth's crust. Thus any change in either constant must be moderate to avoid this problem.

3. As with the change in the permeability, a decrease in the permittivity might alter the dispersion of light in a water droplet. Thus the permittivity also might alter the rainbow. Thus the pre-Flood world may not have known the beauty of the rainbow.

4. Energy is not conserved. A change in the permittivity would affect the energy density of the electric field just like a change of the permeability affected the energy density of the magnetic field. It is this author's opinion that since only God can change a fundamental constant, energy conservation is not necessary unless the implications of the change require it. Also, a change in a fundamental constant can only be accounted for miraculously and therefore it is not a naturalistic phenomena.

These four alterations in nature are the only four effects that are shared by changes in the permeability and the permittivity. The next effects are those peculiar to the permittivity.

5. An atom emitting electromagnetic radiation would emit a more energetic photon if the permittivity were smaller in the past. At first glance this might appear to be detrimental to the theory. If elements emitting visible light today were in the past emitting gamma rays would it not seem reasonable that life would be killed? The answer surprisingly is no. If an atom were emitting a more energetic photon it would also absorb the more energetic photon and thus the effect would be negated. Also heat capacities of materials would be greater. The heat capacity is the quantity of energy per gram that a material must absorb for each degree rise in temperature. These factors should ameliorate any problem with a change in the wavelength of light due to a change in permittivity.

6. An increase in the permittivity would provide an explanation for the problem of explaining the heat released by condensing water vapor at the time of the Flood. Each gram of water (approximately 200 raindrops) releases 600 calories of heat when the water vapor condenses to form those drops. Dillow **(1981,** p. **269-72)** calculated the amount of heat given off by the vapor canopy when it condensed to water and found that if all the heat from a canopy (50 feet in thickness) were to be placed into the atmosphere at one time the temperature would rise 2100°C. Those who postulate a canopy should account for this heat. An increase in the permittivity would cause a huge absorption of heat as the electrons around each and every atom adjusted to its new radius. Quantum mechanics requires that energy be absorbed when an electron moves away from the nucleus. The increase in the permittivity would cause the electrons to be further from the nucleus and thus they would absorb much heat. The permittivity hypothesis is the only

creationist theory which can account for the absorption of enough heat at a rapid enough rate to allow for 40 days and nights of rain.

7. Using an equation for the luminosity given in Davies (1982, p. 54) one can determine that if the permittivity were smaller in the past, the sun would undergo a 40 fold increase in luminosity. This is a problem but less of one than that predicted by Setterfield's theory.

8. A change in the permittivity would cause the earth to expand via a different mechanism than the expansion caused by a change in the gravitational constant. The distance between the orbit of the electrons and the nucleus in an atom is directly proportional to the strength of the electric field. The stronger the electric field, the smaller would be the radius of the electron's orbit. Thus if the permittivity were smaller before the Flood, then each atom would have been smaller and thus the earth's radius would have been smaller. As the permittivity changed, the earth's radius gradually expanded.

An expanding earth explains many of the features of the earth's geology which are not explained by other creationist theories. These include the following facts:

1. The fit of the continental shapes into a solid outer covering for the earth if the earth's radius were smaller.
2. The expansion theory allows for the only numerical explanation for the thicknesses of the sediments observed on the earth (Morton, 1980). Since the sediment thicknesses apparently can only be numerically explained by a deluge, this fact presents tremendous support for our view of earth history.
3. Continental drift would present a serious heat problem if it occurred within the creationist time frame (Morton, 1981; Baumgardner, 1986). Baumgardner's estimate of the temperature rise is more realistic than Morton's but still it presents a serious thermal problem. The expansion of the earth would largely negate any large heat problem caused by the separation of the continents.
4. Expansion of the cart caused by a change in the permittivity would solve one of the most serious objections to secular theories of expansion, namely how compressive features formed on an expanding earth where only extensional forces should be found. Due to the differential expansion of different atoms and molecules, some regions of the crust might expand faster than the earth's average rate of expansion and thus produce, compressive forces (Morton, 1983). This is the most important feature of an expansion due to permittivity since this objection has generally caused people to reject expansion.
5. A decrease in the permittivity would strengthen chemical bonds. This would have two implications. The leg bones of dinosaurs would have been stronger, which would improve their chances of surviving on a smaller, more gravitating earth. As noted above, this is one possible objection to the expanding earth hypothesis. The second implication would be that thin overthrusts, which creationists have correctly pointed out as being too mechanically weak to exist, are explained. The basic objection has been that rocks are not strong enough to have been thrusted the distances observed. A decrease in the permittivity would make the rocks much stronger.
6. Dillow (1981) analyzed the flight characteristics of the Pteranodon and concluded that in order for the larger pteranodons to fly they needed a denser atmosphere. Dillow appealed to the vapor canopy as the cause of the denser atmosphere. A smaller earth would also have a much denser atmosphere.

Several other creationists have considered earth expansion as a solution to creationist problems. These include Baumgardner (1978), Unfred (1986), and Mundy (1988). Baumgardner and Unfred considered a change in permittivity as a cause of the change in earth radius, but Mundy did not mention it.

Setterfield's Views

Setterfield (1981) proposed a theory in which the permeability of free space changed, combined with an attempt to conserve energy. The decay of the speed of light is presented in a totally naturalistic manner in which the speed of light apparently had a built-in decline throughout earth's history. There is no divine intervention to cause this decline. A day and half after creation the speed of light is postulated to have been 150 quadrillion km/s, Morton *et al.* (1983); Akridge (1983); Aardsma (1988); Humphreys (1988); Brown (1988) and Holt (1988) have all detected major problems in this theory.

Setterfield postulated that since creation, the speed of light decayed in a log sine fashion and only in the past 30 years has the speed of light become constant. The permeability change is postulated as being the cause of the decay in the speed of light. If that were all that was postulated to have changed, the results would be as outlined above but the implications of a change in permeability alone are not very interesting to the creationist. It only solves the problem of light from distant stars and galaxies.

Setterfield added one other postulate to his theory which not only made the theorys implications interesting to the creationist, but also was the ultimate cause of criticism. He required that energy be conserved. This second postulate allowed him to advance an explanation of radioactive decay in a creationist framework but it also raised many inconsistencies whose solutions seem to require more and more constants to be variable. To date he has postulated that six fundamental constants are changing. These are the speed of light, mass, Planck's constant, gyromagnetic ratio, permeability and gravitation. Amazingly with all this variability in the universe the theory still only explains two creationist problems: radioactivity and the speed of light.

The inconsistencies published so far can be found in the above referenced articles. There is one inconsistency which has not been discussed in the literature and that concerns Setterfield's contention that the constant of gravitation has changed.

In a response to a criticism of the theory that a decrease in the mass of the earth would cause the past earth's rotation rate to increase to such an extent that the earth would break apart, he suggested that the

gravitational constant was proportional to c^4 (Setterfield, 1983). If true, then the orbital radius of the planets would remain constant. But due to a mathematical error he made in deriving this relationship the correct dependency is one of G on c^2. This would then require that the earth's orbit grow smaller as G changed, causing the earth to become hotter. A further probem arises because the luminosity of the sun can be shown to depend directly upon c. (See Appendix.) A four-fold increase in the speed of light results in a four-fold increase in the solar luminosity, or the amount of light emitted. According to Setterfield (1981), in 2,384 B.C. the velocity of light was five times faster, resulting in five times more light reaching the earth. At creation the sun would have been emitting 500 billion times more energy, thus scorching the earth and all its newly created life.

As is shown in the Appendix, to be consistent with Setterfield's view and to be physically correct, G must be assumed proportional to c^2. But that would violate Setterfield's assumption of energy conservation and would require a major revision of his theory. It would also mean that the force of gravity was proportional to the inverse of c^2. This would imply that on the day of creation the force of gravity was so low that the atmosphere would have escaped from the earth. Adam and Eve would have been able to jump from the surface of the earth, never to return. Thus one is faced with two horns of a dilemma: Either the earth is too hot or the earth has no gravity in Setterfield's view. Until these inconsistencies are solved, this hypothesis cannot be accepted.

Conclusion

The possibility that some of the fundamental constants have varied throughout earth's history should be given serious consideration by creationists. A change in a physical constant is more palatable to the creationist than to the actualist or uniformitarianist since possible changing constants are certainly non-uniform. As is evidenced, these changes appear fruitful in answering problems that previous creationist viewpoints have only been able to explain in an *ad hoc* fashion. Over the long term, it is difficult to argue with successful explanations.

How should we justify a change in a physical constant? We should not consider it simply as a naturalistic change. When one examines the history of science, one finds that gradually as more physical phenomena were explained by naturalistic means, God was more and more relegated to an irrelevant role in the affairs of nature. No longer was the Creator of the universe seen as an important part of that universe. This trend in science was a major factor in the secularization of society which we have seen in the 20th century. It seems very incongruous for the creationist who should be defending God's role in the universe, to also propose theories in which God is irrelevant. If we creationists wish to have science take a more open-minded position on the place of God in nature, then it is incumbent upon us to put God back into science. Our adversaries certainly will not.

Finally, since the changing of fundamental universal constants is fraught with potential perils, it would seem prudent to apply Ockham's Razor. This is basically a philosophical rule in science that the theory which uses the fewest assumptions and explains the most phenomena is the better theory. Table I shows the effects of changing various constants and the phenomena which would be explained by the changes. The reader can judge for himself.

Appendix

Setterfield uses a form of the gravitational potential which appears in the General Theory of Gravitation. It is,

$$\text{Potential} = \frac{G\,M}{c^2 r} \qquad (2)$$

Table I. Possible Effects of "Variable" Constants

If the postulated change provides an explanation for the phenomena, then the box will contain ayes or the direction of the altered value. If the postulate has no explanatory power for the phenomena, the box will contain a "no."

Phenomena	Permeability	Gravitation	Permittivity	Setterfield
number of constants altered	1	1	1	6
energy conserved	no	?	no	yes
speed of light	faster	constant	faster	much faster
radioactive decay	faster	?	faster	much faster
planetary orbital radius	constant	G > smaller G < larger	constant	depends
luminosity of sun	constant	constant	slightly larger	much larger
galactic shape	constant	altered	constant	depends on G
emitted wavelength	constant	constant	greater	constant
heat from 40 days rain	no	no	yes	no
earth expansion	no	yes	yes	no
shape of continents	no	yes	yes	no
sediment thickness	no	yes	yes	no
continental drift heat	no	no	yes	no
rainbow	maybe altered	constant	maybe altered	constant
overthrusts	no	no	yes	no
magnetic field	altered	constant	constant	altered

where G is the gravitational constant, M is the mass of the potential producing body i.e. the sun, c is the speed of light and r is the distance from the center of the sun to the point at which the potential is evaluated. This equation is only valid for the gravitational potential when the units of time used are geometricized units (Misner, Thorne and Wheeler, 1973, pp. 29-30). Time is represented in centimeters of light travel, not seconds. It is the square of the velocity of light which acts as the constant of proportionality. In this equation one inputs mass in conventional units and the potential is given in geometricized units. This equation is identical to the more familiar form of the equation in which the potential is not given in geometricized units, but in conventional units. The more familiar form is

$$\text{Potential} = \frac{GM}{r} \tag{3}$$

where the potential is given in conventional units.

Setterfield claims that in order for energy to be conserved, mass must be divided by the square of the velocity of light, and the potential must be constant. Thus following through the reasoning on both equations, albeit only equation (5) will be correct, we find that the potential in geometricized units is

$$\text{Potential} = \frac{G \times M_0}{c^4 r} = \text{Constant} = v^2 \tag{4}$$

and in conventional units of time (seconds) it is

$$\text{Potential} = \frac{G \times M_0}{c^2 r} = \text{Constant} \tag{5}$$

where in each case the dependence of M on c has been made explicit. M_0 is the present value of the solar mass. From equation (4) Setterfield concludes that G is proportional to c^4 and that the velocity of the orbiting planet is also constant under such a change (Setterfield, 1983, p. 67-68). The v^2 part of equation (4) is published in the reference article.

Setterfield makes a mathematical error in going from equation (4) to what he calls the Neo-Newtonian formulation. He multiplies both sides of equation 4 by m, and claims that

$$\frac{G \times M_0 \times m_0}{r} = \text{Constant} = (mc^2)v^2 = m_0 \times v^2 \tag{6}$$

where the dependence on c from (4) has been canceled. If equation (4) is equal to a constant then (6) cannot be constant since (6) is equivalent to:
Constant of equation (4) x m = Constant of equation (6). Since

$$m = \frac{m_0}{c^2}$$

then

$$\text{Constant of (6)} = \frac{G \times M_0 \times m_0}{r} = \frac{\text{Constant of (4)} \times m_0}{c^2}$$

Thus since the constant of (6) depends upon c, it is not constant. One has a choice: either the constant of (6) is constant or the constant of (4) is constant but both cannot be constant.
The force can be shown to be

$$\frac{G \times M \times m_0}{r^2} = \frac{\text{Constant of (6)} \times m_0}{c^2}$$

The force between the sun and the earth is inversely proportional to c^2 if G is proportional to c^4 and the constant of (4) is the true constant. From this it can be shown that the distance from the earth to the sun is also inversely proportional to c^2. Thus in Setterfield's view of gravity, since the speed of light was faster in the past, the distance from the earth to the sun must have also been much smaller.

Following the same line of reasoning from equation (5) which is the mathematically and physically correct equation, the only way for the radius of the earth's orbit to remain constant under Setterfield's views is for the gravitational constant to be inversely proportional to c^6 in geometricized units (or equivalently to the inverse fourth power in conventional units) with equation (6) equal to a constant. If (4) and (5) are constant then the force of interaction cannot be constant and hence the radius of orbits will change.

The latest thinking on the dependency of the luminosity with G starts with the relativistic assumption that

$$G \times M = \text{constant}.$$

Canuto and Hsieh (Equation 12, 1980) derive this relation from the standard relativistic equations. The radiant emittance (R_b) of a blackbody like the sun is

$$R_b = \sigma T^4. \tag{8}$$

where T is the temperature of the sun's interior and σ is the Stefan-Boltzmann constant. Zemansky (1968) gives the dependence of σ on other constants. Thus

$$R_b = \frac{2\pi^5 k^4 T^4}{15 c^2 h^3}. \tag{9}$$

where k is the Boltzmann constant and h is Planck's constant. The energy density of radiation in the sun is related to the emittance by (Zemansky, 1968)

$$u = \frac{4}{c} R_b. \tag{10}$$

Thus

$$u = \frac{8\pi^5 k^4 T^4}{15 c^3 h^3}. \tag{11}$$

According to Setterfield (Table 10, p. 64, 1981), k and the product of h and c are constant. Thus Setterfield's views would lead to the conclusion that the energy density within a star is constant.

Canuto and Hsieh (Equation 15, 1980) assume that the luminosity of the sun is equal to

$$L = \frac{1.33\pi R^3 u}{\tau}, \tag{12}$$

where τ is the photon diffusion time and R is the radius of the sun. Canuto and Hsieh (Equation 16, 1980) define τ as

$$\tau = \frac{R^2}{cl}, \tag{13}$$

where l is the mean free path of the photon. Defining the opacity of the sun as $K = 1/(l\rho_0)$ where ρ_0 is the density of the sun and substituting this into equation

(13) we find

$$\tau = \frac{R^2 K \rho_0}{c}. \quad (14)$$

Substituting this into equation (12) we find

$$L = \frac{1.33\pi Ruc}{(K\rho_0)}. \quad (15)$$

Now the product of K and ρ_0 within Setterfield's view must be constant. The reason for this is that ρ_0, the sun's density is merely the solar mass divided by the volume. Under Setterfield's assumptions the mass is proportional to the inverse of c squared. Since these two are inversely related to each other their product is constant. This follows from the constancy of the mean free path. Thus their product is put in parentheses. Canuto and Hsieh (Equation 18, 1980) show that:

$$kT \sim \frac{GM\rho_0}{R} \quad (16)$$

but within Setterfield's view where G is proportional to c^4, and M and ρ_0 are proportional to c^2, it is obvious that kT is constant. This confirms that u is constant and that there is no hidden dependency upon c.

Thus we are left with equation (15) as the dependency of the solar luminosity upon c. Even if the earth's orbit does not change its distance from the sun, the sun's emission of energy would quickly burn the earth if the speed of light increased as much as Setterfield has claimed. However, when one uses the correct variation of the earth's orbit with a change in the speed of light, it would imply that as the earth approached the sun, the sun would be intrinsically more luminous and therefore hotter.

There does not appear to be a consistent assumption which can change c and solve both of these problems. The dependency of solar luminosity on c is due to the photon diffusion time being less and is not due in any way to a change of G within Setterfield's theory. However, a correct view of the dependence of G on c implies that the pull of gravity felt by an object on earth would be inversely proportional to c^2.

If G is proportional to c^2 and mass proportional to the inverse of c^2 then the force of gravity

$$F = \frac{G_0 \times M_e \times m}{c^2 r^2}. \quad (17)$$

Where M_e is the mass of the earth and m the mass of an object on earth. This dependence of the force of gravity on c implies that the force of gravity was 150 quadrillion squared times smaller during the first week of creation. This is hardly compatible with a stable creation.

Acknowledgements

I am indebted to Dr. Eugene Chaffin for showing the direction to take on the derivation of the solar luminosity.

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Ideology emerged as a strong force in the seventeenth century, with the separation of religion and moral philosophy from science, in the attempt of Hobbes and Descartes to place all things, including ethics and politics, on a scientific basis. As scientific rationalism went its separate way from religion, ethics, politics, and humanistic subjects, the traditional distinction between values and facts was greatly eroded.

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MINISYMPOSIUM ON VARIABLE CONSTATNS--VII

ON THE VIABILITY OF VARIABLE CONSTANTS

JOHN BYL*

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Abstract

The feasibility and implications of variations in the fundamental constants are examined. Although such proposed changes appear at present to be strongly ad hoc, it is argued that this is not a fatal deficiency. The apologetic function of theorizing is briefly discussed. The distinction between operation and origin science is emphasized. It is suggested that more emphasis should be placed on the underlying philosophical issues.

Introduction

Recently there has been much discussion regarding the possibility that some entities normally considered to be fundamental constants are in fact time-dependent. Barry Setterfield (1981), in particular, has argued that the speed of light was much higher in the past. By developing this thesis he hopes to reconcile an apparently large universe with a young age.

The notion that some of the fundamental constants may be variable is not new. On the basis of measured values of the speed of light c, the suggestion that it is decaying was made at least by 1931 (de Bray, 1931), if not earlier. On theoretical grounds, it was proposed by Milne (1935, p. 292) and Dirac (1937) that the gravitational constant G varied with time. Gamow (1967) considered also the possibility that the electron charge e was time-dependent. This raises questions as to the reality and feasibility of changes in the fundamental constants, as well as the physical and philosophical implications of such changes. I will also discuss whether such apparently bizarre theories are worthy of consideration.

Empirical Evidence

Direct experimental measurements of variability of a fundamental constant would, of course, present the most compelling grounds for belief in such hypotheses. Unfortunately, none of the direct evidence is of a decisive nature. Norman and Setterfield (1987) have extensively analyzed historical measurements of c and have claimed to demonstrate an exponential decay. However, their analysis has been questioned, particularly with regards to the values of a number of crucial historical determinations of c. No less disturbing is the fact that over the last few decades, when very sensitive measuring devices are available, the decay seems to have stopped.

Although Van Flandern (1975) did measure a small linear decay in G, the effect is only about twice the estimated probable error. Again, the uncertainties are such that more accurate observational evidence is needed before definite conclusions can be drawn. I conclude that the empirical evidence is, at present, open to question.

Even if the variability of a fundamental constant can be observationally demonstrated, it is quite another matter to extrapolate this exponentially into the more distant past, as Setterfield has done. The hypothesis that the speed of light was virtually infinite six millennia ago must surely be regarded much more speculative than the mere notion of variability of c.

*John Byl, Ph. D., Department of Mathematical Sciences, Trinity Western University, 7600 Glover Road, Langley, B. C., Canada V3A 6H4.

The Possibility of Variability

In the absence of unambiguous empirical confirmation, are there other weighty considerations as to the feasibility of variable constants?

(a) The Problem of Induction

Scientists often take for granted that induction (i.e., the assumption that the laws of physics observed operating here and now are valid universally) is valid. At first sight induction may seem to argue against variable constants. However, the justification of induction is one of the outstanding problems in the philosophy of science. As David Hume pointed in 1739, there is no compelling reason for believing it. Induction cannot be justified by observation (since the unobserved universe is, by definition, unobserved) nor by logic (since there is no logical reason why the universe must behave uniformly). It may be the most convenient possibility, but that in itself does not guarantee its truthfulness. Thus, in this regard, we must leave open the possibility of variable constants, of which a miracle is just a special extreme case.

(b) Theological Objections

Are there perhaps theological difficulties? It has been asserted by the Dutch philosopher Herman Dooyeweerd and some of his followers that the cosmic law order is unchangeable in time. J. M. Spier (1966, p. 31), for example, interprets Genesis 8:22 to mean that God promised "that nature would conform to a constant law."

To this a number of comments are in order. First, the promises of God concerning his covenant with nature (e.g., Genesis 8:22, Jeremiah 33:25) refer directly only to a continuous succession of day and night, summer and winter, etc. God promises that there will be no more drastic catastrophes of the magnitude of the Flood. To infer from this that, say, the length of the day is invariable is to go beyond the text. Although numerous texts do refer to the unchangeability of God, these are always with regard to God's faithfulness towards man. They do not refer explicitly to an unchangeable law structure. Indeed, it is precisely because of God's unfaltering faithfulness that he sometimes modifies the normal sequence of cause and effect (e.g., the crossing of the Red Sea).

Second, even if God's laws were fixed, the same need not apply to our human formulations of them. It

may well be that what we consider to be a fundamental constant is actually a variable whose changes are controlled by deeper, divinely ordained, fixed laws. Note also that, if Genesis 8:22 is used as proof of the constancy of natural laws, the further implication is that before the Flood this was not the case. Indeed, some theologians have suggested a (discontinuous) change in the law structure after the Fall (and after the Last Judgment). I conclude that also on theological considerations there appears to be room for variable constants.

(c) Physical Objections

What about the physical implications? Does it not imply breaking fundamental principles, such as conservation of energy and momentum? It must be kept in mind that there is nothing sacred about the conservation laws. In classical mechanics such laws as those of conservation of energy and angular momentum can be derived from Newton's laws. But in allowing fundamental constants to vary we are making drastic changes to these laws and, consequently, the normal conservation laws may require reconsideration. For example, in a number of scientific papers where variation in G has been considered, it has been speculated that energy, mass, or angular momentum may perhaps not be conserved—not for all choices of units (Dirac, 1972). In steady state cosmology the postulation of the continuous creation of matter clearly violated the usual conservation laws. Similar challenges to conservation laws are presented by inflationary big-bang cosmology, in which it is hypothesized that the entire universe—with all its energy, mass, and entropy* —spontaneously appeared out of nothing.

Norman and Setterfield (1987, p. 29) do assume that, for appropriate choices of units, certain quantities are conserved (e.g., energy, magnetic and electric potential). But this requires further change in other fundamental constants. It is thus evident that conservation laws pose no insuperable objection to variation hypotheses: one can either modify the conservation laws or postulate compensating changes in other physical constants.

Saving the Phenomena

Given that changes in the fundamental constants are at least possible, let us next consider whether they can readily "save the phenomena" (i.e., account for the observational data). Can Setterfield's theory, for example, be made to fit the facts? It is clear that there are various consequences arising from the hypothesis of a varying c. We have seen that, in modifying and applying conservation laws, other fundamental constants are likely to be affected. There will undoubtedly also be further observational implications. For example, if light from distant objects was emitted when c was very high and rapidly decaying, this may well entail observable effects in such phenomena as stellar spectra or pulsar rates. A change in c and e (charge on the electron) may alter the stability of atoms, thus further modifying the radioactive decay rates.

Setterfield has dealt with some of these questions. But can he account for everything? In principle, at least, the answer is affirmative. According to the Duhem-Quine principle, a scientific theory is never tested by itself in isolation, but always together with a host of secondary theories. Thus any favored scientific theory can always be made to fit the facts by suitably modifying the auxiliary hypotheses. And hence, given sufficient ingenuity and some fancy theoretical footwork, it would seem that Setterfield's theory can always be rescued.

***Editor's Note: Entropy is not subject to conservation laws.**

Ad Hoc Theories

Of course, a theory that must be supported by artificial, ad hoc devices is generally not highly ranked in terms of plausibility. Nevertheless, however difficult it may be to demonstrate a particular ad hoc theory to be true, it is even harder to conclusively disprove it. In science there are no definite, objective criteria that enable us to readily distinguish true theories from false ones. Even ad hoc theories, particularly concerning the distant past, can not be proven to be false. Indeed history is replete with unlikely events that actually occurred.

Moreover much of origin speculation is of a decidedly ad hoc nature. Thus, for example, the recent inflated big bang model has been criticized for being excessively untestable and ad hoc (Oldershaw, 1988). Similarly, evolutionary scenarios for the origin of life, involving various unlikely recipes for primordial soup, seem equally artificial. Or consider Nobel Laureate Francis Crick's (1973) hypothesis that life arrived here via a rocket from outer space.

Why are ad hoc theories, in spite of their repugnant nature, still advanced? Primarily because, in the absence of better alternatives, they do explain the observations in terms of a favored theoretical or philosophical principle. Thus, in the above cases, the proposed theories are approved in spite of their ad hoc nature simply because they are still the best theories that satisfy certain imposed constraints (e.g., Biblical data, or a purely naturalistic account of origins). Of course, those who do not accept these (often implicit) restrictions have little incentive for accepting the proposed ad hoc theory. Thus Setterfield's model, ad hoc as it may be, does have the advantage of satisfying the Biblical framework. As such, at least to those who accept the authority of the Bible, it still is to be preferred over competing theories that do not.

The real difficulty that evolutionists have with creationists is not so much with the ad hoc nature of their theories as with their prior acceptance of the Bible and the restraints it imposes on theorizing. To quote just one prominent evolutionary spokesman: "the major reason why Creation-science is not genuine science is that its supporters have to believe, without question or dispute, in the literal truth of Genesis" (Ruse, p. 393). It is evident that the basic issue here is one of religious presuppositions.

Apologetic Considerations

One might object that ad hoc theories should still be avoided since a prime goal of creationists is to convince the unbeliever of the reasonability of Biblical events. It might then be argued that, rather than spending limited resources on seemingly unlikely theories, research should be concentrated on polishing up the details of the most promising model.

There are, however, dangers involved with staking too much on one model. First, the more elaborate the model, the more susceptible it is to observational disproof. Of course, it can always be patched. But should the model turn out to appear too implausible (in the eyes of the sceptic) then, in the absence of alternatives, its demise may well result in the subsequent rejection also of the Bible which it purported to support. Caution must be taken to avoid falling into the trap of justifying faith in the Bible on the basis of our ability to provide "scientific explanations" of Biblical events.

An instructive historical illustration of this is described by Allen (1963). In the 17th century, theologians were asked many scientific questions regarding the Flood. The Catholic theologians met scientific difficulties by declaring that the impossibility of explaining the mechanics of the Flood clearly showed that it was a miracle. But the Protestants, being anxious to prove that all of the Bible accorded with human reason worked out precise scientific solutions. Their failure to explain the details to the satisfaction of the critics eventually led to the inspired history of Noah being relegated to simply a myth. Do not forget that if a scientific model is to be judged acceptable by the unbeliever then it must satisfy criteria set by ***him.*** Since such standards are bound to be at heart unbiblical, the verdict is a foregone conclusion. Those who have rejected God can hardly be expected to objectively evaluate His Word.

Finally, rather than confronting the unbeliever with God's Word and the need for repentance, the above apologetic implies that the unbeliever is justified in rejecting Scripture until acceptable scientific explanations of it have been established. The Biblical data must be adopted as basic, as a non-negotiable article of faith. The trustworthiness of God's Word must not be made contingent upon our ability to explain it or prove it "reasonable" by human standards. Let the onus be on those who reject the accuracy of the Bible to demonstrate the alleged impossibility of Biblical events. And if the Biblical data are not readily explicable in terms of a scientific model this should merely serve to illustrate the inadequacy of human theorizing.

Multiple Theory Approach

Let us be clear then that our prime allegiance is to God and His Word, rather than to any human, scientific explanation of any portion of it. Granted that all scientific models are speculative and probably wrong, at least in their details, no undue emphasis should be placed on any particular model. Let us not be tied down unnecessarily: any theory in accordance with Scripture should be worthy of consideration. Better six sketches of possibilities than one detailed theory upon which too much trust is placed.

'In this regard, a multiple-theory approach to origins carries with it a number of advantages. The multiple model approach has more chance of finding good possibilities and underlines the fact that the observational data can be interpreted in many different ways. It cautions against accepting any model as the final truth. It emphasizes the subjective, conjectural element in model building, the great gap between observational data and theories that claim to explain the data.

Thus, for example, with regard to the light travel time problem, there are other possibilities. Perhaps light was created en route. Perhaps space is curved. Perhaps c is not time, but space-dependent. Consider, for example, the formula $c = c_o + A (V_o / V)^B$, where c_o is the speed of light near the Earth, V_o is the gravitational potential at the Earth, V is the gravitational potential at the point of space of interest, and A and B are chosen to make c very large in interstellar space. No doubt other possible solutions can be constructed. Which one is correct? Only God knows, and beyond that which He has revealed through direct observation and through His Word, we can only guess.

Origin and Operation Science

Recently the distinction has been made between origin science and operation science (Geisler and Anderson, 1987). The latter is concerned with repeatable events, the former with singularities such as creation. I believe this difference to be very important. Operation science is certainly justified by the cultural mandate (i.e., Genesis 1:28), in so far as its goal is that of useful application. Origin science, on the other hand, is chiefly concerned with conjectures about the distant past. Given the highly speculative nature of its theories, I question its cognitive value. In the absence of objective, valid epistemological criteria that would enable us to detect true theories of origins, origins science can be rated little better than an amusing intellectual parlor game: fun to play, perhaps, but hardly deserving of too much devotion.

Instead, further attention should be focused on the underlying philosophical questions. Here devastating offensives can be mounted against the alleged reliability of secular origin science. The secular scientific community should be challenged to acknowledge the highly subjective nature of theory construction, selection, and justification; to concede the major role in science played by religious and philosophical presuppositions; and to be less dogmatic about pronouncements regarding origins. Hopefully the recent book ***Christianity and the Nature of Science*** by J. P. Moreland, which gives an excellent overview of the philosophical issues pertaining to the creation/evolution debate, will help stimulate further thought and action in this direction.

Conclusion

It would appear that the current status of creationist variable constant theories is that they are largely ad hoc. But this in itself is not lethal. For all we know, they may still be close to the truth.

The main problems are those of epistemology: what do we take as our prime source of knowledge, how do we choose and justify theories, etc. We must accept the Bible as the inerrant Word of God on the basis of faith, as a fundamental presupposition, rather than on the basis of how well our models can account for the Biblical data. Consequently, we should present any model merely as a possible explanation of present observations in terms of Biblical events. However, a better defense of the faith against secular science is not a demonstration as to how well the Bible fits in with human theories and standards, but an exposure of the highly subjective nature of scientific theorizing,

particularly with regard to origins. Let us shift the creation/evolution debate to more philosophical lines, for at heart the battle is one of prior religious commitments.

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MINISYMPOSIUM ON VARIABLE CONSTANTS—VIII

A CHANGING VARIABLES MODEL FOR THE SPEED OF LIGHT

CAM DE PIERRE*

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Abstract

The speed of light is thought to be a fundamental constant of physics. This paper proposes a model for allowing the speed of light, c, to be changing with time. It is shown that a decaying exponential with the appropriate boundary conditions would accommodate the apparently constant value for c that modern measurements have provided, even if the value of c is changing.

Introduction

Science began when man attempted to systematically catalog repeatable experiences. Collections of observable, repeatable experiments led to the development of scientific models. These models provided a framework for understanding how the bits and pieces of experimental data fit together. A necessary condition for a model to be classified as scientific is that it be falsifiable. A model which is not falsifiable is usually classified as a tautology, whether true or false, and is not classified as a scientific model or theory.

Models can change as new data are gathered. If the new data results in only minor changes to the model, then the model is robust. If the new data requires major changes to the model, or the new data makes the model contradictory, or reliant on secondary assumptions to maintain its integrity, the model becomes weak and probably should be discarded.

Our present model of the speed of light, c, assumes that it is a constant parameter. There is a model which will allow us to consider c as a variable, and still give us a closely constant c at this time in history.

Conditions for Model Revision

Classical physics fails to explain the behavior of very small things (sub-atomic particles) and things which travel very fast (close to the speed of light). Because of this, the classical model was revised to account for high speed phenomena (relativistic mechanics), and further revised to account for very small particles (quantum mechanics). Whether or not relativity or quantum mechanics do describe what is really happening, the addition of these two ideas to the original classical model does seem to explain what cannot be explained apart from them. The quantum mechanical and relativistic models, however, are not independent of the classical model. The revised model does not negate the original model. The classical model still holds true for relativistically slow and quantum-relationally large objects.

If classical physics can undergo such a revision in its model, then perhaps our present models based on physical "constants" may be only an approximation of a better model which would use physical "variables" instead of "constants." The new model, however, cannot abandon wholesale, the previous model, just as quantum mechanics and relativity do not abandon classical physics. The revised model would accommodate the constant constants model within the framework of a larger superset called the changing variables model. The changing variables model would approximate to the constant constants model, given the right boundary conditions. Such is the case, for instance with relativity for slow moving objects, and quantum mechanics with large objects. They both a proximate to classical physics given the right boundary conditions, i.e., large and slow objects.

The Speed of Light as a Changing Variable

One such parameter which might be variable is the speed of light. If it is changing, then the change is very small. It is so small in fact, that it has evaded our most sensitive instruments. Changes of many orders of magnitude, however, may have occurred in the past. What sort of time relationship satisfies the condi-

*Cam de Pierre, 10425 Echo River Ct., Fountain Valley, CA 92078.

tions that the speed of light is barely changing at present, but in the past had very large changes?

Nature seems to prefer exponential time relationships, such as population growth or natural decay of radioactive isotopes. If the speed of light were to follow a decaying exponential, the original speed of light could have been much greater than it is today. If the speed of light is presently at the tail section of a decaying exponential, then any present change with time would be very small compared to the original speed. This decaying exponential model for the speed of light is chosen so that it approaches a constant value in the limit, rather than zero.

Uncertainty of the Speed of Light

As of 1972, the uncertainty in the speed of light was only 1.1 meters per second (Weast, 1975). A change of about one m/s in the last 18 years would be barely detectable. Since no change has been found, assume that the change has only been 0.5 m/s. The following exponential equation defines the model for the speed of light:

$$c(t) = c_0 e^{-t/\tau} + c_{inf}$$

where

c(t) = speed of light as a function of time,
c_0 = original speed of light at creation,
t = time since creation,
τ = time constant,
c_{inf} = speed of light after infinite time.

Since I assumed that the present change in the speed of light is not measurable with modern instruments, a value of 0.5 m/s less than the accepted value 299792456.2 ± 1.1 m/s was used for c_{inf}, i.e., a value of 299792455.7 m/s. Assuming that the size of the universe is 100 billion light years, the time since creation is 10,000 years, and that the time for primal light to reach the earth from the edge of the universe was one day, calculated values for the speed of light, c(t), were obtained as shown in Table I.

Figure 1 shows the speed of light as a function of time using the above model from 6 to 10,000 years after the creation of the universe.

Conclusion

The purpose of this paper was to show whether a changing variables model could be substituted for the presently accepted constant constants model for the speed of light. As shown, it can be done by adjusting the boundary conditions of a decaying exponential model. There presently seems to be no direct empirical evidence for this model, neither is there any way to refute it, so it does not qualify as a true scientific model. Perhaps one day our instruments will detect a change in the speed of light and revolutionize our way of thinking about physical constants.

Table I. Speed of light as a function of time since creation.

Time Since Creation [years]	Speed of Light, c(t) [meters/see]
1	1.094242E+22
1000	6.832396E+19
2000	4.266115E+17
3000	2.663741E+15
4000	1.663257E+13
5000	104150863143
6000	948233447.13
7000	303841289.44
8000	299817736.42
9000	299792613.55
10000	299792456.69

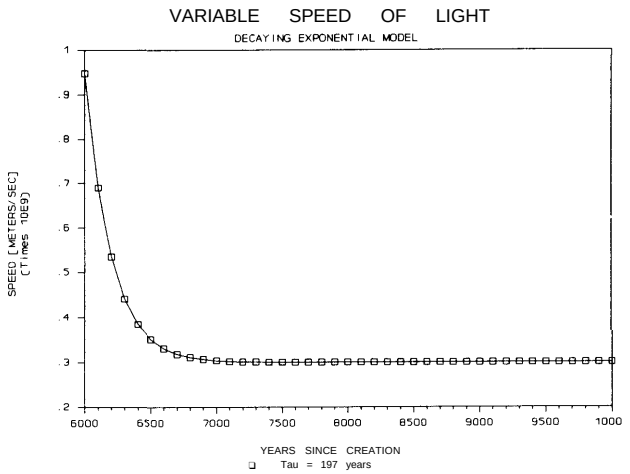

Figure 1. Speed of Light as a Function of Time.

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QUOTE

The thesis of the book is far-reaching and can be said to question the basic assumptions of modern life. This thesis can be easily stated: It is the triumph of the doctrine of nominalism as propounded by William of Occam in the latter part of the fourteenth century that put Western man on the wrong path. Such a doctrine had the practical result, Weaver argues.

> to banish the reality that is perceived by the intellect and to posit as reality that which is perceived by the sense. With this change in the affirmation of what is real, the whole orientation of culture takes a turn, and we are on the road to modern empiricism. . . . The denial of everything transcending experience means inevitably—though ways are found to hedge on this—the denial of truth. With the denial of objective truth there is no escape from the relativism of "man the measure of all things." . . . Thus began the "abomination of desolation" appearing today as a feeling of alienation from all fixed truth. . . . Man created in the divine image, the protagonist of a great drama in which his soul was at stake, was replaced by man the wealth-seeking and -consuming animal.

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BOOK REVIEWS

Twentieth Century In Crisis: Foundations of Totalitarianism by Larry Azar. 1990. Kendall/Hunt. Dubuque, IA. 317 pages. Paperback. $20.00.

Reviewed by Don B. DeYoung*

Larry Azar is no small-time writer: the book cover carries endorsements from Billy Graham Associates and also from former Education Secretary William Bennett. The author is a conservative philosopher with keen insight on the forces behind history, politics, and sociology. The book especially analyzes the rise of twentieth century totalitarianism during the dark age of Nazism. In this regard Azar makes some startling statements about the negative impact of evolutionary thought on the world. Creationists have been long accused of "seeing an evolutionist behind every tree or problem." In this case, however, Azar carefully supports his critical statements with over 300 references:

> The impact of evolution on human thought cannot be exaggerated (p. x).
>
> Darwinian evolution . . . shattered the very foundations of morality itself (p. x).
>
> "I regard Christianity as the most fatal, seductive lie that has ever existed" (a direct quote from Hitler) [p. 155].
>
> This doctrine of racial supremacy Hitler took at face value . . . He accepted evolution much as we today accept Einsteinian relativity (p. 180).
>
> Sixty-three million people would be slaughtered in order to obey the evolutionary doctrine that perishing is a law of nature (p. x).

Azar hammers at length on the impact of evolutionary thinking of Hitler and his henchmen. One section of the text is titled "Hitler's Justification of Racism: Evolution" (p. 179). A strong and serious challenge has been given to modern day evolutionists to refute Azar's analysis.

There was a philosophical foundation in place which made Darwin's ideas immediately successfu1. Herbert Spencer, Georg Hegel, Thomas Malthus—all played a part. Azar argues that evolution theory of Darwin's day was basically philosophical and biological (p. 55). In fact, the term "evolution" was not used by Darwin in any of the first five editions of ***The Origin of Species,*** though he was familiar with the word. Nor was the word used in ***Descent of Man*** or in Lamarck's writings (p. 55). It was philosophers who first popularized the word and applied evolutionary doctrine to their systems of thought. This far-ranging book discusses topics of interest to all. Teleology, or design in the Creation, is discussed under historical philosophy. Examples include geese which fly in V formation at a speed which optimizes energy efficiency (p. 43). Also explained is the mysterious way in which a person produces the correct amount of adrenalin for unexpected situations. Too much would be dangerous; too little would be useless. Where did the adrenal gland learn arithmetic, asks Azar (p. 45)? Aside from teleology, Azar is equally comfortable discussing nuclear energy: We have become nuclear giants and ethical infants (p. 228), abortion (p. 82) and child abuse: More brain damage is being effected through child abuse than through cerebral palsy (p. 294). This book provides excellent study for the armchair philosopher. It is also a useful supplement for conservative philosophy courses.

***Don B. DeYoung is Editor of the Quarterly.**

The Long War Against God by Henry M. Morris. 1989. Baker Book House, Grand Rapids. 344 pages. $21.95.

Reviewed by Clifford L. Lillo*

In his Foreword, David Jeremiah says, ***"The Long War Against God*** is the most comprehensive treatment of a single important subject that I have ever seen" (p. 10). The subject is war and Morris does not mince words in describing the nature of the war against God and in identifying the participants. The war is between creationists and evolutionists.

> The idea that a loving, wise, and powerful God used evolution—with its "struggle for existence" and "survival of the fittest''—as his method of creation is grotesque! (p. 58)
>
> The fiction that evolution has been proved scientifically to be true, is false! It is simply a belief system, devised for political or religious reasons (p. 90).

Who is the enemy in this war? Under the heading of "Evangelical Compromise" Morris says,

> Many orthodox, Bible-believing Christians might note at this point that the main-line churches and seminaries, controlled as they are by liberals, are filled with significant numbers of "unsaved" members, people who profess to be Christians but have never truly been "born again" through personal faith in the saving work of Christ (p. 101).

The concept that Christian leaders in churches and seminaries are actual enemies of God may cause gasps of astonishment and disbelief, but readers should let Morris provide the rationale for his claim. He says,

> The greatest tragedy involved in trying to compromise Scripture with evolution, of course, is that evangelical thereby are denying the very Word of God. Even the secularists can see this (p. 109).

He then quotes A. J. Mattell, Jr.,

> . . . Many Christians have taken the dishonest way of lengthening the days into millions of years, but the creationists make it clear that such an approach is nothing but a makeshift that is unacceptable Biblically and scientifically (p. 109).

Who are the other enemies? Morris says, "The logical and almost inevitable end result of evolutionism is atheism" (p. 109). He hastens to add, "Not all evolutionists are atheists, but evolution itself is atheistic, for the simple reason that its very purpose is to

***Clifford L. Lillo, BEE, MA, 5519 Michelle Drive, Torrance, CA 90503**

explain things without God" (p. 110). Along this line he also says,

> An even more compelling reason for equating evolutionism with atheism, however, is its essential inconsistence with the character of God and his incarnate Son, the Lord Jesus Christ (p. 112).

To clarify, Morris adds, "Not all evolutionists are humanists or atheists, by any means, but all humanists and atheists are evolutionists!" (p. 117)

In reality, many evolutionists admit that the theory of evolution did not begin with Darwin. Morris says,

> Darwin's great contribution to science was really quite trivial, as well as false. He neither originated nor proved his claim that natural selection could generate even one new species . . . (p. 160)

The war being fought is a war against God and creationists have many enemies. Readers will find much ammunition for the war in this book.

Wonderful Life: The Burgess Shale and the Nature of History by Steven J. Gould. 1989. W. W. Norton. 347 pages. $19.95.

Reviewed by Micheal J. Oard*

Steven Jay Gould professes a rather unreasonable dislike for creationists in his publications. But he also manages at times to pluck some sacrosanct plums from the evolutionary tree. In this book the plums are the shoehorn of certain evolutionary models based on preconceived beliefs, the Victorian idea of regress in the fossil record, the evolutionary bush of life, and the predictability of evolutionary progression. Whatever we creationists think of Gould, we must give him credit for his attempt to set the record straight on some long-held turf of evolutionary thought.

The book is purported to be a popular account of the discovery and reanalysis of the Burgess Shale fauna. But as with most of Gould's books, a dictionary is helpful. Biblical metaphors such as Armageddon are rather common. The book title was derived from an old Jimmy Stewart movie in which an angel replays the main character's past life without him to show how he has positively influenced others.

Gould's setting is the classic middle Cambrian Burgess Shale, 8,000 feet high near the top of a mountain in southeastern British Columbia. The main sedimentary deposit is only about eight feet thick and a city block long, but an amazing variety of animals have been discovered. The fauna were supposedly buried in a "turbidity current" or mudflow in an anoxic basin because the fauna show abundant signs of being buried rapidly. In the book, no sedimentary evidence for a mudflow origin was presented. If true, the mass flow must have been extremely gentle. Contrary evidence for this interpretation can be construed from the lack of juveniles, and the fact that most organisms are lying in their most stable hydrodynamic positions.

The story begins with the self-taught former head of the Smithsonian Institution. Charles Doolittle Walcott, who discovered the Burgess Shale. Due partly to burdensome administrative duties, but mostly to preconceived ideas about evolution, Wolcott pigeonholed the Burgess fauna within existing phyla of the Cambrian Period of geological time:

> Walcott proceeded to misinterpret these fossils in a comprehensive and thoroughly consistent manner arising directly from his conventional view of life: In short, he shoehorned every last Burgess animal into a modern group, viewing the fauna collective as a set of primitive or ancestral versions of later, improved forms (p. 24).

Wolcott's model was simply "increasing complexity and diversity with time." The standard evolutionary iconography of these concepts are a ladder and a bush. These images portrayed in thousands of textbooks are painted on the minds of both scientists and laymen. As will be shown, the Burgess fossils in no way support such a notion. Gould has exposed only the tip of the iceberg of evolutionary thought. Historical science is replete with examples of almost blind model-fitting. The classic four-ice-age model is but one example of this "reinforcement syndrome" (Oard, 1985, p. 178-79).

A substantial portion of Gould's book describes the painstaking reanalysis of the Burgess Shale fauna by Harry Whittington, Simon Conway Morris, and Derek Briggs at Cambridge University. Although the descriptions are rather detailed, Gould does his best to enliven the new discoveries. Whittington restudied the Burgess fauna by using a procedure of systematically peeling back the thin exoskeleton of each creature, revealing the form of the gills, and then peeling back the gill layer to reveal the legs or the bottom of the organism.

In chronological order Gould unfolds the drama of discovery of these weird soft-bodied creatures. ***Opabinia*** has five eyes, first described as an arthropod and very suggestive of an annelidan ancestor by Wolcott, but reclassified as almost totally unique by Whittington. One-inch long ***Hallucigenia*** is an animal in which it is very difficult to tell the front from the back, and which side is up. ***Wiwaxia*** looks like an artichoke with long vertical spines. The fossilized "jellyfish" from the Burgess Shale, originally described by Wolcott, turned out to be the mouthpiece of a two-foot long carnivorous animal, appropriately named ***Anomalocaris.*** Gould stresses the significance of this science-fiction-like creature:

> I could not have made up a better story to illustrate the power and extent of the Burgess revision than the actual chronicle of ***Anomalocaris—a*** tale of humor, error, struggle, frustration, and more error, culminating in an extraordinary resolution that brought together bits and pieces of three "phyla" in a single reconstructed creature, the largest and fiercest of Cambrian organisms (p. 194).

About 20 wonders from the Burgess shale have been described in the scientific literature, and this is only one-half of the truly unique creatures present. These animals were not isolated, but were found among the standard fossils from the Cambrian, such as trilobites, brachiopods, corals, sponges, algae, echinoderms, and mollusks. Recently, other Burgess-like animals have been found in other layers near the Burgess Shale and other parts of the world.

***Michael J. Oard, M. S., 3600 Seventh Ave. South, Great Falls, MT**

The significance of the Burgess Shale fauna is that all of these unique creatures suddenly appeared out of nowhere and practically all of them subsequently became extinct. The creatures are so unique that most of them can probably be classified as distinct phyla:

> In a geological moment near the beginning of the Cambrian, nearly all modern phyla made their first appearance, along with an even greater array of anatomical experiments that did not survive very long thereafter (p. 64) . . . The Burgess Shale includes a range of disparity in anatomical design never again equaled, and not matched today by all the creatures in all the world's oceans (p. 208).

The Cambrian explosion has become the Cambrian "big bang." The evolutionary bush of life has been turned upside down. It is like a Christmas tree with the trunk cut off. Although there are many more species living today, there were many more "phyla" in the Cambrian than now.

Gould only briefly attempts to explain this sudden great complexity in the Cambrian era. He essentially dismisses the Ediacara and Tommotian fauna of late Precambrian or very early Cambrian as being precursors to the Cambrian. He admits that Darwin's "favorite ploy" of the imperfection of the fossil record is hollow indeed, now that we know much more about the glaring discontinuity:

> Step way way back, blur the details, and you may want to read this sequence as a tale of predictable progress: prokaryotes first, then eukaryotes, then multicellular life. But scrutinize the particulars and the comforting story collapses (p. 60).

Many scientists have summarily dismissed this glaring inconsistency with evolutionary theory. Gould barely mentions the "acquisition of hard parts" hypothesis, which is often invoked. Few evolutionists have squarely faced the Cambrian explosion, not to mention the new Cambrian "big bang" and other large gaps in the fossil record. Evolutionist Rudwick (1963, p. 150-55) points out the likely reason why this long-standing great discontinuity has been minimized:

> Many recent authors have avoided the full force of the problem by underrating the magnitude of the contrast. An evident anxiety to preclude any causes of an extra-scientific or even extra-terrestrial nature has led them to underestimate both the sudden appearance and the "advanced" character of the Cambrian fauna . . . The problem must therefore be accepted as real; the evidence must be explained, and not merely explained away . . . The scarcity of infra-Cambrian [late Precambrian] trace-fossils suggests that the origin of the Cambrian fauna involved more than the mere acquisition of preservable skeletal structures . . .

Gould further points out that the picture of evolution painted by the Burgess Shale is not one of progress, similar to the Victorian idea that gave impetus to the theory of evolution. The picture is one of explosive diversity followed by decimation. The history of life is ***not*** one of increasing complexity at all. The Burgess fauna is already incredibly complex and specialized, not simple and general. And this Burgess pattern is repeated with conventional groups of fossils with hard parts, according to Gould. The reader may wonder why, if evolution was so volatile at the beginning, do we not see a similar pattern at many other later periods of geological time. Gould attempts to answer this question, but unsatisfactorily.

Since evolution is supposedly due to random genetic mutations, and natural selection is blind to the needs of the organism, Gould states that the current panoply of life is just one of many evolutionary possibilities from the Cambrian period. Gould uses the illustration of rewinding the "tape of life" back to the Cambrian and replaying the evolutionary drama. It is doubtful that anything like the present fauna would result. Human beings very likely would not exist. "Replay the tape a million times from a Burgess beginning, and I doubt that anything like ***Homo sapiens*** would ever evolve again" (p. 289). Gould admits that it seems impossible to predict which Burgess phyla would flourish and which ones would meet the grim reaper. What does the "tape of life" idea have to say about the evolutionary concept of parallel or convergent evolution, which Gould affirms as a principle of evolution in this book? Gould apparently cannot see the contradiction between the "tape of life" and parallel evolution.

The "tape of life" metaphor drives the futility of human life down another notch. Gould recalls past defeats to human worth:

> But, as Freud observed, our relationship with science must be paradoxical because we are forced to pay an almost intolerable price for each major gain in knowledge and power—the psychological cost of progressive dethronement from the center of things, and increasing marginality in an uncaring universe. Thus, physics and astronomy relegated our world to a corner of the cosmos, and biology shifted our status from a simulacrum [image] of God to a naked, upright ape.
>
> To this comic redefinition, my profession contributed its own special shock—geology's most frightening fact, we might say. By the turn of the last century, we knew that the earth had endured for millions of years, and that human existence occupied but the last geological millimicrosecond of this history—the last inch of the cosmic mile, or the last second of the geological year, in our standard pedagogical metaphors (p. 44).

To this delightful picture of human existence, we now must add that we were not even destined to evolve according to Gould:

> ***Homo sapiens,*** I fear, is a "thing so small" in a vast universe, a wildly improbable evolutionary event well within the realm of contingency. Make of such a conclusion what you will. Some find the prospect depressing; I have always regarded it as exhilarating, and a source of both freedom and consequent moral responsibility (p. 291).

At the end of the book Gould muses about the "fact" of evolution. Gould states why he believes evolution is a fact:

> We know that evolution must underlie the order of life because no other explanation can coordinate the disparate data of embryology, biogeography, the fossil record, vestigial organs, taxonomic relationships, and so on (p. 282).

This list is rather amusing since much evidence can be garnered to show that the interpretations of each piece of this data are at best equivocal. By embryology Gould must not mean the discarded "fundamental biogenetic law" of Ernst Haeckel, but something akin to the comparative anatomy of embryos—the idea that taxonomic relationships imply descent from a common ancestor. Creationists know that this "proof" of evolution can just as well be considered as showing similar designs by God for organisms that live in similar environments. We also do not have to explain away the thousands of exceptions to the evolutionary rule that "similarity implies descent." The vestigial organs on the list is surprising, since the more we know about science, the fewer vestigial organs remain. Of course Gould is well aware of the huge systematic gaps in the fossil record, which is the "trade secret of paleontologists." This in itself should falsify evolution to an open-minded person. There are many unknowns in biogeography, including questions as to what exactly is a species and differing interpretation of the data. Many creation scientists were once evolutionists and are not only familiar with this data, but also have examined both sides of the controversy. It is doubtful many evolutionists have examined both sides. Gould, like Walcott, has shoehorned the data into preconceived evolutionary pigeonholes. It is too bad he cannot see this; he would have abundant data for many more books.

Finally, Gould tries to lift historical science up to a par with the experimental sciences, like physics;

> But historical science is not worse, more restricted, or less capable of achieving firm conclusions because experiment, prediction, and subsumption under invariant laws of nature do not represent its usual working methods (p. 279).

Without the strict use of the scientific method, historical science is vulnerable to a host of assumptions that are usually difficult to verify and which depend on other assumptions. In reading Gould's appeal for scientific credibility, I recall W. R. Thompsons words in the introduction to a republished edition of Darwin's ***The Origin of Species*** (Thompson, 1956, p. xxiv):

> This general tendency to eliminate, by means of unverifiable speculations, the limits of the categories Nature presents to us, is the inheritance of biology from ***The Origin of Species.*** To establish the continuity required by theory, historical arguments are invoked, even though historical evidence is lacking. Thus are engendered those fragile towers of hypotheses based on hypotheses, where fact and fiction intermingle in an inextricable confusion.

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Rudwick, M. J. S. 1963. The infra-Cambrian glaciation and the origin of the Cambrian fauna. in Nairn, A. E. M., editor, Problems in palaeoclimatology. Interscience. New York.

Thompson, W. R. 1956. Introduction to *The Origin of Species.* **J. M. Dent and Sons. London, pp. vii-xxv.**

LETTERS TO THE EDITOR

Ichnofossils Exposed to the Elements

In reading the reports of Rosnau ***et al.*** (1989a; 1989b) concerning quasihuman, quasimammalian and dinosaur ichnofossils in the Kayenta formation near Tuba City, Arizona, a thought comes to mind. If these surface ichnofossils are indeed animal footprints, it appears that the formation in which they are located is quite young. It seems unlikely that these prints exposed to erosion, spalling and weathering could have survived for millions of years. Is this not a reasonable conclusion? Would Howe or Waisgerber care to comment on this observation?

References

CRSQ—Creation Research Society Quarterly.

Rosnau, P. O., J. Auldaney, G. F. Howe and W. Waisgerber. 1989a. Are human and mammal tracks found together with the tracks of dinosaurs in the Kayenta of Arizona? Part 1: A history of research and site description. *CRSQ* **26:41-48.**

_____ 1989b. Are human and mammal tracks found together with the tracks of dinosaurs in the Kayenta of Arizona? Part 11: A field study of quasihuman, quasimammalian and dinosaur ichnofossils near Tuba City. *CRSQ* **26:77-99.**

Emmett L. Williams
5093 Williamsport Drive
Norcross, GA 30092

Reply to Williams

Emmett L. Williams' conclusion regarding a probable young age for the Mesozoic Kayenta Formation, near Tuba City, Arizona is plausible because it could answer an enigma of which I have been aware for some time. The enigma concerns itself with how river systems in North America developed in varied rock formations of varied ages, in accordance with evolutionary geologic time.

For northern Arizona, in times past, the Grand Canyon of the Colorado River may have been created in less time than is generally believed. This would be due in part to greater erodibility over a short term within the Colorado River region. Greater erodibility in times past would have required (1) greater volumes of water in the river and its tributaries and/or (2) rock formations which were less consolidated and/or less cemented than each formation is today.

Regardless of the depositional history of a formation, it is axiomatic that any elastic formation such as the Kayenta Formation will be less consolidated and less cemented immediately after initial deposition than it would be at a later time. Hence the formation would be susceptible to greater erosion potential immediately after deposition than later.

Dr. Williams' suggestion that erosion of a terrain over millions of years would have resulted in removal of footsteps is definitely plausible. Time applied to a chemical or physical equation results in answers which will vary with the length of that time.

The relationship of erosion of formations to existing geomorphic conditions should be studied objectively by creationists. Study the properties of water, then apply those properties to evolutionary time and evolutionary formations. You will find enigmas cropping out everywhere.

William Waisgerber
P.O. Box 1115
Mt. Shasta, CA 96067

Moon Dust

A recent book by Isaac Asimov (1989) includes the author's first science essay published in 1958 which predicted the possibility that a spaceship landing on the moon would sink into a pile of meteoric dust 50 feet deep:

> But what about the Moon? It travels through space with us and although it is smaller and has a weaker gravity, it, too, should sweep up a respectable quantity of micro-meteors.
>
> To be sure, the Moon has no atmosphere to friction the micro-meteors to dust, but the act of striking the Moon's surface should develop enough heat to do the job.
>
> Now it is already known, from a variety of evidence, that the Moon (or at least the level lowlands) is covered with a layer of dust. No one, however, knows for sure how thick this dust may be.
>
> It strikes me that if this dust is the dust of falling micro-meteors, the thickness may be great. On the Moon there are no oceans to swallow the dust, no winds to disturb it, or life forms to mess it up generally, one way or another. The dust that forms must just lie there, and if the Moon gets anything like Earth's supply, it could be dozens of feet thick. In fact, the dust that strikes crater walls quite probably rolls down hill and collects at the bottom, forming drifts that could be 50 feet deep, or more. Why not?
>
> I get a picture, therefore, of the first spaceship, picking out a nice level place for landing purposes, coming slowly downward tail-first and sinking majestically out of sight (Asimov, pp. xvi-xvii).

NASA's failure to find large dust piles on the moon's surface is not attributed by Asimov to the young age of the earth but to the lack of oxygen atoms keeping the dust particles apart:

> Finally, the landing on the Moon, eleven years after I wrote this essay, really knocked out the matter of thick layers of dust on the Moon. That notion had been advanced by Thomas Gold and it was plausible (or I wouldn't have fallen for it) but it was wrong. The thing is that the dust on the Moon is accumulating in a vacuum. In air, oxygen atoms layer the surface and keep the dust particles apart. In vacuum, the dust particles stick together so that the surface is something like crunchy snow. But you can't win them all (Asimov, p. xvii).

A simple measurement will suffice to show how silly his explanation is. I have in my stock room a bottle of iron powder. Five cm^3 of this powder weigh 15.41 grams, yielding a density of 3.1 g/cm^3. A solid chunk of iron only has a density of 7.9 g/cm^3. Therefore, Asimov's 50 feet of dust, if turned into a solid crust would still have a depth of almost 20 feet!

Reference

Asimov, Isaac. 1989. Asimov on science, a 30-year retrospective. Doubleday, Garden City, NY.

George Matzko, Ph.D.
2902 Edwards Road
Taylors, SC 29687

St. Augustine and Genesis

Theistic evolutionists often use Augustine's name to support their non-literal interpretation of Genesis, but in fact he was very far from agreeing with their theories:

1. In direct contrast to those who wish to stretch out the six creation days into 4.5 billion years, Augustine thought six days an unnecessarily long time for God to take. So he resorted to Ecclesiasticus 18.1 (Greek) as his proof text, misunderstood the word 'koinei' ('in general'), and came up with the wrong translation: "He created all things simuhaneously" (Augustine, p. 325). He then tried to squeeze the six days into 'no time,' with a host of philosophical reasons.
2. Augustine certainly accepted Adam-and-Eve as literal history; he expresses no idea of God breathing 'spiritual' life into some kind of animal.
3. He argues, exactly as modern creationists do, that the God who turned water into wine, and Moses' rod into a serpent, instantaneously, does not need time to make man or any other creature.
4. Turning to his *City of God* we find that he accepted Noah's Flood as universal and a fact (Book XV, Chapter 27) and the heading to (Book XII, Chapter 10) is "Of The Falseness Of The History Which Allots Many Thousand Years To The World's Past" (Augustine, p. 340). He continues:

   > Let us omit the conjectures of men who know not what they say, when they speak of the nature and origin of the human race . . . they are deceived by those highly mendacious documents which profess to give the history of many thousand years, though, reckoning by the sacred writings we find that not 6000 years have yet passed (Augustine, p. 348).

5. Augustine insists that the ages of the Patriarchs are literally true and constitute a chronology (Book XV, Chapters 9-15).
6. Admittedly he did believe that thorns and thistles were part of the original creation, and evolutionists

can extract a crumb of comfort from this. But, by and large, there is no doubt that Augustine was a 'literalist' and a Young-Earth creationist.

Reference

Augustine. 1952. City of God in Hutchins, R. M. (editor). Great books of the western world. Volume 18. Encyclopedia Britannica. Chicago.

David C. C. Watson
31 Harold Heading Close, Chatteris
Cambridgeshire PE16 6TL, England

QUOTE

A moderate-sized protein may have 150 amino acids; the possible combinations of the 20 kinds in such a molecule are 10^{195}. This is a *very* large number; if the amino acid sequences in a prebiotic protein were gencrated by random processes, we could never hope to produce an given protein of this length on earth. It is estimated that there are about 10^{22} stars in the known universe. If each of these stars had a planet on which prebiotic syntheses were producing one billion different 150-amino acid proteins per second for five billion years, about 7.8×10^{25} combinations of amino acids would be produced—billions upon billions short of the total possible combinations. The likelihood of discovering a particular 150-amino acid combination by chance would still be miniscule. On earth we had only a billion years or less from the origin of the planet to the origin of life. We must conclude either that the particular proteins that exist on earth did not arise by random process, or that many amino acid sequences will lead to proteins having biologically interesting properties, so that the ones that happened to have appeared represent only one [sic? a few?] out of many millions of possible protein sets that could form the basis of living beings.

Ayala, Francisco J. and James W. Valentine. 1979. ***Evolving, the Theory and Processes of Organic Evolution.*** Benjamin/Cummings. Menlo Park, CA. p. 340.

The information is not new but the dilemma is both freshly and well stated. Interestingly, the authors opt for the first possibility in an ingenious scenario (p. 341) that they admit is speculative and try to show how proteins did not arise by random processes. They suggest "natural templates" such as clay minerals may have controlled the ordering of the amino acids! Oh well, give them a point for at least admitting the idea is no more than rank speculation. . . . An alternative presumably would be an early association of nucleic acid with amino acids—but this leads to the chicken-egg problem because nucleotide sequences can be translated into protein synthesis only when mediated with enzymes, themselves proteins. So which came first? DNA or protein? Although Stanley Miller's experiments provided a way for demonstrating synthesis of amino acids—there has been no synthesis of nucleotides. "The prebiotic synthesis of nucleotides has not yet been accomplished and this remains a problem. (p. 339).

John N. Moore

The Results of Science and Technology?

Paulding's distrust of fashion, progress—the whole complex of modern life-is never more evident than in the curious and revealing fantasy which he inserted in ***Letters from the South.*** The narrator has a dream in which he visits a strange land of the future, the "Isles of Engines." In the Engine Isles human life has been largely mechanized and all work formerly done by hand is now done by machines. The narrator encounters toothpick-making machines, steam corkscrews, steam grave diggers and steam washers. Not only have machines replaced manual labor, but machine-made men are rapidly replacing "anatomical men." Anatomical men are being taught to starve scientifically and to give technical explanations for their weakened condition. So desperate have things become that the machines, no longer content with eliminating people, have begun to eliminate each other. Railroads have replaced the canals and steamboats are fast replacing the railroad. Magnetic boats that travel a thousand miles per hour are fast replacing the steamboat. Every trace of intellectual or social life has disappeared. At the nearby Republic of Elsewhere—a thinly disguised England—the dreamer attends a "lecture" in the university town of Oxhorn. The lecture is on the evolution of bottle opening from the fingernails to the steamscrew. A concert of steam instruments terminates abruptly when one of the boilers explodes and nearly demolishes the audience. Those in the audience who survive are completely indifferent to the suffering of those around them. When the dreamer uses the word "courteous," he is told that such expressions have become "obsolete." The dreamer awakens as he is about to have his "boiler" patched. (Taylor, 1969, p. 241)

Reference

Taylor, W. R. 1969. ***Cavalier and Yankee: The Old South and American National Character.*** Harper and Row. New York.

QUOTE

A Swedish writer, Tage Lindbom, assesses the consequences of the Modernity that has prevailed since the Second World War:

> We have now to deal with a secularized generation for which material existence is everything and spiritual life is nothing. It is a generation for which all that is symbolic becomes ever more incomprehensible. It is a generation which no longer lives in a viable society, but in an institutionalized world where state, administrative, and industrial apparatuses raise themselves in front of the human person like an enormous pyramid. It is a generation which is in the process of eliminating from its consciousness the notion of the family. . . . It is now an affair of a generation which, in its ensemble, is incapable of discerning truth from lies, the true from the false, the good from the bad. The time of harvest is come for the Kingdom of Man.

Kirk, Russell. 1987. Obdurate adversaries of modernity. ***Modern*** Age. 31:206.

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Malthus on Population

Thomas Malthus (1766-1834) wrote a famous essay on population. Later he enlarged it into a treatise. Charles Darwin claimed that he got his idea of evolution by natural selection (Spencer called it survival of the fittest.) from reading the essay on population by Malthus. Alfred Russell Wallace, considered the co-author with Darwin in the natural selection theory, said he got the idea from reading Malthus.

The basic idea of Malthus is that a species can reproduce faster than its food supply can support it. Writing of human beings, he said, "Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio." But he applied this principle to other forms of life also, as he said a few sentences later, "Through the animal and vegetable kingdoms, nature has scattered the seeds of life abroad with the most profuse and liberal hand. She has been comparatively sparing in the room and nourishment necessary to rear them." Darwin and Wallace also applied the principle to all forms of life.

As some things are food or other things and as they themselves also require nourishment, this would imply that at the same time they increase by a geometrical ratio (as feeders) and also by an arithmetical ratio (as food for something else). Here is a paradox.

Bolton Davidheiser

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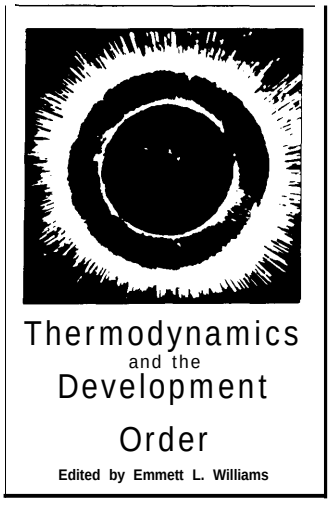

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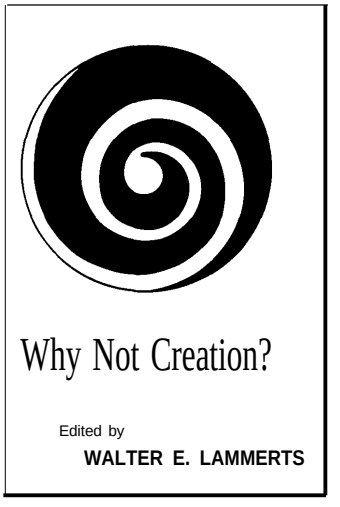

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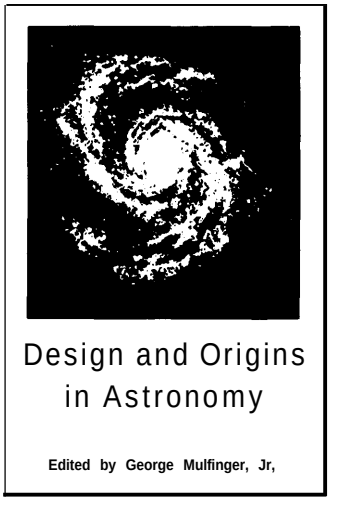

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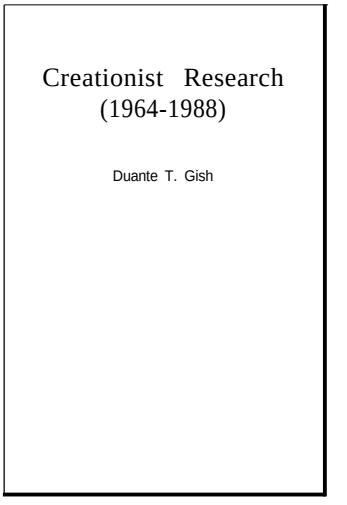

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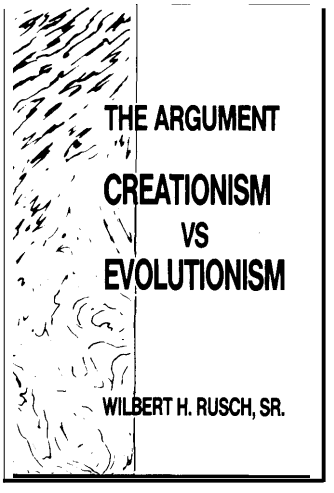

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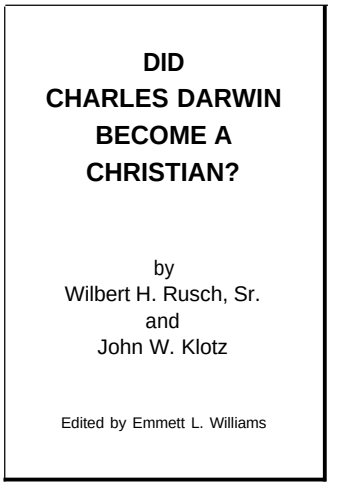

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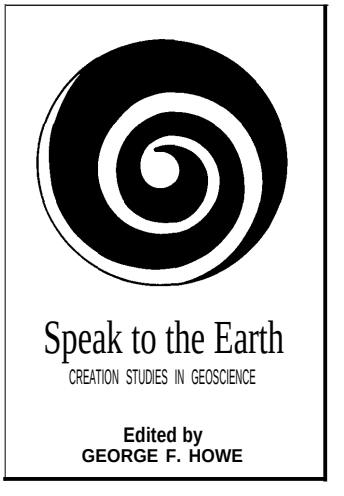

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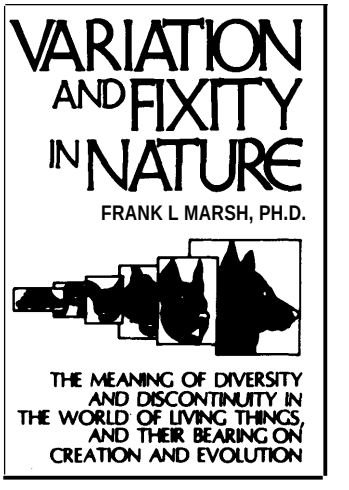

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