

Creation Research Society Quarterly

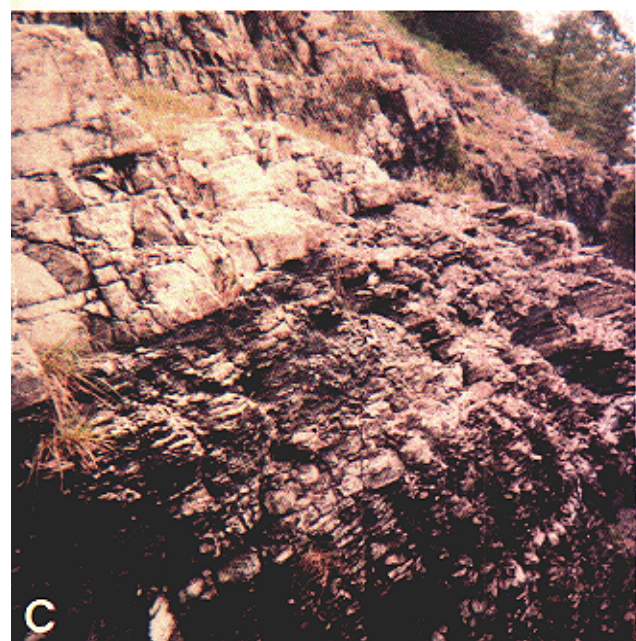
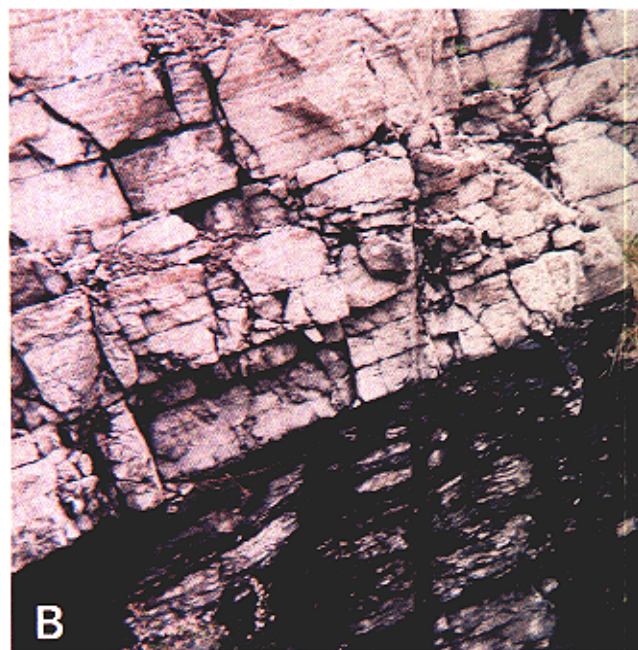
Haec credimus:

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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NUMBER 1



CREATION RESEARCH SOCIETY QUARTERLY

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Cover Photographs

- A. Roadcut between Wolf Creek Mountain and Rich Mountain on 177 south of Bluefield. The photograph shows the Silurian Clinch sandstone formation, responsible for supporting many of the ridges of the Valley and Ridge Province of Southwest Virginia.
- B and C. Hunter Valley thrust fault on US 23 about 0.6 mile south of the intersection with US 58/421, south of Duffield, Virginia. Cambrian shales and limestones overlie younger Devonian Chattanooga shales.
- D. Roadcut next to the service road for I 81 east of Wytheville, Virginia. Photograph shows the Cambrian Conococheague formation of laminated and stratulate limestones and dolostones, in the Kent window area.

See pp. 18-22 for a discussion of the geology of this area.

TABLE OF CONTENTS

Membership Application	3
Order Blank for Past Publications	4
Instructions to Authors	5
Editor's Comments	6
Minisymposium on Variable Constants The Difficulty in Obtaining Realistic Conclusions about Variable "Constants". Eugene F. Chaffin	6
World Views and the Metamorphic Model: Their Relation to the Concept of Variable Constants	10
Robert A. Herrman	
Good News from Neptune: The Voyager 2 Magnetic Measurements	15
D. Russell Humphreys	
A Preliminary Report on the Geology of Southwest Virginia	18
Eugene F. Chaffin	
An Introduction to the Possible Role of Cavitation in the Erosion of Water Channels	23
Edmond W. Holroyd, III	
Index to Volume 26 of the <i>Creation Research Society Quarterly</i>	33
Panorama of Science Evolutionism: A View Through Rose-Colored Blinders	35
Evolutionism: Bones and Stones of Contention	35
"You Are What You Eat".	36
Jonathan Edwards—Scientist	36
Evolutionism: A Charge Looks Back	37
Book Reviews (3).	38
Letters to the Editor (4).	40

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History The Creation Research Society was first organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a real need for an association devoted to research and publication in the field of scientific creation, with a current membership of over 600 voting members (with graduate degrees in science) and over 1100 non-voting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and now is recognized as the outstanding publication in the field.

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 man, 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 an historic 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 Saviour for all mankind. Therefore, salvation can come only through accepting Jesus Christ as our Saviour.

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QUOTE

It should not, therefore, be surprising that shortly before Chesterton referred in the *Autobiography* to his debate with Blatchford as a landmark in his life, he spoke of Darwinism as one of the chief carriers of the modern intellectual disease which, in the name of science, tries to undermine man's belief in his own freedom and responsibility.

Jaki, S. L. 1986. *Chance or reality and other essays*. University Press of America. Lanham, MD p. 67.

INSTRUCTIONS TO AUTHORS

1. Manuscripts shall be typed and double spaced.
2. An original plus two copies shall be submitted to the editor of the Quarterly.
3. All submitted articles will be reviewed by at least two technical referees. The editor may or may not follow the advice of these reviewers. Also, the prospective author may defend his position against referee opinion.
4. The editor reserves the right to improve the style of the submitted articles. If the revisions of the editor and referees are extensive, the changes will be sent to the author. If the changes are not suitable to the respective author, he may withdraw his request for publication.
5. Due to the expense involved, manuscripts and illustrations will not be returned to authors.
6. All references (bibliography) must be presented in the style shown in the Quarterly. If a prospective author is not familiar with the CRS format, the editor will furnish an example reference page.
7. All figures and drawings must be prepared professionally. No sloppy hand drawings or freehand lettering will be accepted. The editor reserves the right to approve submitted figures. Unacceptable illustrations will result in rejection of the manuscript for publication.
8. Any manuscript containing more than 25 pages is discouraged. If a topic cannot be covered to the author's satisfaction in this length of pages, the author *must* divide his material into separate papers that can be serialized in the Quarterly.
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10. Book reviews should be limited to 500 words or less. .

Editor's Comments

The minisymposium on variable constants continues. Please read the first three articles in this series in the March 1990 Quarterly. The Quarterly should be in every college and university library in the United States. Possibly some of our members would encourage acquisitions librarians in schools near them to subscribe to the Quarterly. The interest of the librarian may be increased if the subscription is donated by

the member. It is often necessary to discuss the matter with the acquisitions librarian to see if the individual will cooperate. Help the Society any way you can. It is hoped that you will find many articles and notes of interest in this issue. Please send me material to be considered for publication.

Don DeYoung, Editor

MINISYMPOSIUM ON VARIABLE CONSTANTS—IV*

THE DIFFICULTY IN OBTAINING REALISTIC CONCLUSIONS ABOUT VARIABLE "CONSTANTS"

EUGENE F. CHAFFIN**

Received 9 September 1989; Revised 9 November 1989

Abstract

A scale covariant modification of Newton's second law is combined with Bohr's model of the atom. If we suppose that physical "constants" have varied in a way consistent with this theory, then it leads naturally to an explanation of the red shifts in the light from distant galaxies. The model is offered as an example of how not only the "constants," but also the equations themselves are suspect in any endeavor to find the true laws of physics. In the second part of the paper, some limits on the variability of "constants" based on data from the Oklo reactor are examined. It is found that limits which have been published in the technical literature are more imaginary than real.

Introduction

The possibility that physical "constants" have changed should cause us to question whether the basic equations, Schrodinger's equation, etc. should be "corrected" to properly treat those changes (Chaffin 1986; Dirac 1973; Canuto 1981; Will 1984; Bishop and Landsberg 1976; Troitskii 1987). The anthropic principle is the fact that intelligent human life does exist, and that the universe is fashioned in such a way that this life is possible. The evolutionist, who starts with the Big Bang and traces evolution from elementary particles to man, claims that life exists because if it did not then we would not be around to observe the universe. To the creationist this argument seems rather weak since it leaves out God's creative design. But the creationist also wonders whether changes in the physical "constants" are possible without upsetting the balance that allows life to exist. It is easy to assume that the laws of physics should be written in the usual form, then to allow the constants to vary in these equations, and to do various derivations to show that inconsistencies result. But the larger question is whether the laws and equations may be altered in a way that is consistent with observation and experiment. For example, one might mention the way that the expression for kinetic energy changes when we change from classical physics to relativistic physics. As long as particle speeds are small compared to the speed of light, one hardly notices the difference. It may be that physical "constants" are really variables when referred to the true laws of physics, and that 20th century physics just has not succeeded in measuring the changes as yet. From this point of view, the theoretical physicist must strive to find new theories which are consistent

with the facts. Since the possible new theories are difficult to compartmentalize and examine, it is difficult to say when this investigation might end. But the success of just one theory of this type would illustrate my point. The term "scale covariant" refers to an equation maintaining the same form when the size of the space-time units is changed. A specific theory which breaks this scale covariance in a special way is offered as an example.

A Specific Theory

Let us examine a scale covariant modification of Newton's second law for a charged particle, q , attracted to a mass M and charge Q . Chaffin (1986) previously discussed the dynamical equation:

$$\frac{dp_r}{d\lambda} = -\beta \frac{\bar{G}Mm}{r^2} + \beta \frac{p_\phi^2}{mr^3} \quad (1)$$

involving the angular and radial momenta:

$$p_\phi = \frac{1}{\beta} mr^2 \frac{d\phi}{d\lambda}, \quad (2)$$

$$p_r = \frac{1}{\beta} m \frac{dr}{d\lambda}. \quad (3)$$

where $d\lambda$ is "proper time" with $d\lambda = \beta d\lambda$. Here β is a scale changing factor which in essence changed the G of Newton's Law of Gravitation. The equation (1) was shown to be scale covariant, i.e. it maintains the same form when β is replaced by $\theta\beta'$. To take into account electrical forces, one must add the equivalent of Coulomb's Law to the right side of equation (1). But we are only guessing when we decide whether to add it without a factor of or with to the n th power for $n = 1, 2, 3$, or whatever, since for $n = 1$ the

*Parts I-III are in CRSQ 26:121-31.

**Eugene F. Chaffin, Ph. D., 715 Tazewell Ave., Bluefield, VA 24605.

result would be the same as the usual Newton's second law. If we take $n = 1$, we get a scale covariant theory which basically gives the same results as the usual theory. But for $n = 0$, i.e. no factor of w we obtain:

$$\frac{dp_r}{d\lambda} = -\beta \frac{GMm}{r^2} + \beta \frac{p_\phi^2}{mr^3} - \frac{qQ}{4\pi\epsilon_0 r^2} \quad (4)$$

To interface this equation with experiment, we might let q be the electronic charge, and Q the proton charge, i.e. the hydrogen atom. We could then use the Bohr model of the atom, suitably modified to allow β to vary. As usual, the gravitational force would be too weak to be of any consequence as far as atomic spectra are concerned. For circular orbits, we have:

$$\frac{dr}{d\lambda} = 0 \quad \text{so that} \quad p_r = 0, \quad (5)$$

hence

$$\beta \frac{p_\phi^2}{mr^3} = \frac{e^2}{4\pi\epsilon_0 r^2}, \quad (6)$$

$$p_\phi^2 = \frac{e^2}{4\pi\epsilon_0} \frac{m_0 r}{\beta}. \quad (7)$$

From Bohr's quantization of angular momentum we then have:

$$p_\phi = n\hbar \quad (8)$$

where $\hbar = h/2\pi$ = the usual Planck's constant divided by 2π and $n = 1, 2, 3, \dots$. This gives the electron-proton separation as:

$$r = n^2 \frac{4\pi\epsilon_0 \hbar^2}{e^2 m} \beta \quad (9)$$

so that this changes with β . (But the size of the atom also depends on the center of mass motion.) From equation 7 for the angular momentum it follows that:

$$\frac{1}{2\beta} mr^2 \left(\frac{d\phi}{d\lambda} \right)^2 = \frac{1}{2} \frac{e^2}{4\pi\epsilon_0 r} \quad (10)$$

Since r is constant for a circular orbit, then the left-hand side of equation (10) is also constant for such an orbit. Hence it also follows that the following expression, which we likewise call the "energy," is also a constant of the motion:

$$E = \frac{1}{2} \beta \frac{p_\phi^2}{2mr^2} - \frac{e^2}{4\pi\epsilon_0 r}, \quad (11)$$

and that:

$$E = - \frac{1}{2} \frac{e^2}{4\pi\epsilon_0 r} \quad (12)$$

Substituting equation (9) for the electron-proton separation gives:

$$E = - \frac{1}{2} \frac{me^4}{n^2(4\pi\epsilon_0)^2 \hbar^2} \frac{1}{\beta} \quad (13)$$

Hence, the quantity usually called "energy" will change with β . This means that atomic spectra will change. To compare with observation, we recall that light from distant galaxies is shifted toward the red end of the spectrum. This light corresponds not only to great distances, but also to past epochs in time. Hence, if β

were different in the past, which amounts to a different ratio of electrical to gravitational force strengths, then this might account for the red shifts of extragalactic spectra.

Rust (1974) studied the curves of photometric magnitudes versus time for 36 Type I supernovae in various distant galaxies. These were essentially all the supernovae at great distance for which accurate data were known and published. He found that the results did not agree very closely with the expansion of the universe hypotheses based on general relativity. He also examined some rather bizarre theories to see with what the results did agree. The question of the best theory remains open, awaiting better data and better analyses. The improved analysis of de Vaucouleurs and Pence (1976) failed to change Rust's basic conclusion. Hence, whether equation (13) is at variance with theory also seems to remain an open question.

The above theory is incomplete in that it provides no way to theoretically determine the function β . This function controls essentially the size of the Coulomb constant $k = 1/4\pi\epsilon_0$ with respect to the gravitational constant G . It has nothing to do with whether these laws are inverse square laws, at present. One aspect of Mach's principle states that the mass of particles may depend on the distribution of distant galaxies in the universe (Hoyle and Narlikar, 1971 and Canuto and Narlikar, 1980). One might speculate that the function β may be determined similarly.

In summary, it might be asked whether this incomplete theory offered here results in a change in the speed of light. James Clerk Maxwell (1954) [actually Maxwell wrote this some time before 1891 since the book cited is a reprint] showed that the speed of light depends on the ratio of electrostatic units to electromagnetic units, that the dimensions of this ratio are L/T , i.e. length over time, the mass canceling out. The scale change of the type introduced here may be viewed as a change of the mass units (see Fulton, Rohrlich and Witten, 1962). It is essentially for this reason that this model leaves the speed of light unchanged, provided the length and time units are defined in a way that does not depend on any masses. However the modern atomic clocks depend on the frequency of light emitted by cesium atoms, and the meter is now defined (since 1983) so that the speed of light is exactly 2.99792458×10^8 m/s (Sears, Zemansky and Young, 1987). Because of equation (13) it may be inferred that the frequencies of cesium light, and thus the second, will change with β according to the modern definitions. Hence the meter will also change in order to keep the defined value of the speed of light constant. Thus these definitions seem to require the speed of light to remain the same while the length and time scales change.

The Oklo Data are Inconclusive

Will, 1984; Irvine, 1983a, b; Shlyakhter, 1976 have cited evidence provided by the Oklo natural uranium reactor that purportedly shows that the strong and weak nuclear forces have not varied relative to the Coulomb force. Shlyakhter's approach starts with the Breit-Wigner formula for a capture cross section:

$$\sigma_c = \frac{A/v}{(E - E_0)^2 + \Gamma^2/4} \quad (14)$$

where v = velocity of incident particle,
 A = a constant,
 E = energy of incident particle,
 Γ = level width,
 E_0 = resonance energy.

Samarium 149 is produced as a result of fission and has a very large resonance peak at $E_0 = .0976$ electron volts (Mughabghab and Garber, 1973). Shlyakhter assumed that, in order to reproduce the measured Samarium isotopic concentrations from Oklo samples, the above capture cross section had to be within three standard deviations of the present day value. From this he deduced that E_0 could not be shifted more than .05 electron volts relative to a nuclear potential well of depth 50 MeV. Assuming a linear variation of the strong coupling constant g_s between the Oklo reactions two billion years ago and today, he derived a limit:

$$\frac{1}{g_s} \left| \frac{dg_s}{dt} \right| \leq 5 \times 10^{-19} \text{ year}^{-1}. \quad (15)$$

This approach suffers from four weaknesses:

- 1) The age of the reactor is assumed to be two billion years. If the age is only a few thousand years, the limit on the variability of g_s drops by half a dozen orders of magnitude.
- 2) The variation of g_s is assumed to be linear, and no possibility of episodic or transient variations is taken into account.
- 3) As is shown in Figure 1, variations in temperature cause shifts in the neutron energy distribution. This causes the effective capture cross section to vary due to the change in overlap of the resonance curve with the neutron energy distribution.
- 4) The data were never matched to the actual Samarium data, at least if they were, the results were not reported in Shlyakhter's paper. Apparently, it was just **assumed** that the data showed that the resonance could not have shifted.

Irvine (1983a, b) also studied the Samarium isotopes, concluding:

A shift of less than 0.01 eV in the position of a neutron resonance in a potential well 50 MeV deep over 2×10^9 years, represents a variation of less than one part in 10^{19} per year.

It is interesting that, although Shlyakhter's paper appeared some seven years before, and reached almost the same exact conclusion quoted above, neither of Irvine's papers contains reference to Shlyakhter's work. In addition, Irvine stated that:

With the integrated flux fixed at 10^{21} neutrons cm^{-2} the Sm-149/Sm-147 abundance ratio requires that the Sm-149 thermal neutron capture cross section during the operation of the Oklo reactor must have been within 10% of the present day value.

On August 6, 1985 I sent a letter to Professor Irvine outlining my own calculations which showed no such stringent requirements. (I was at the time unaware of Shlyakhter's paper.) My letter has never been answered.

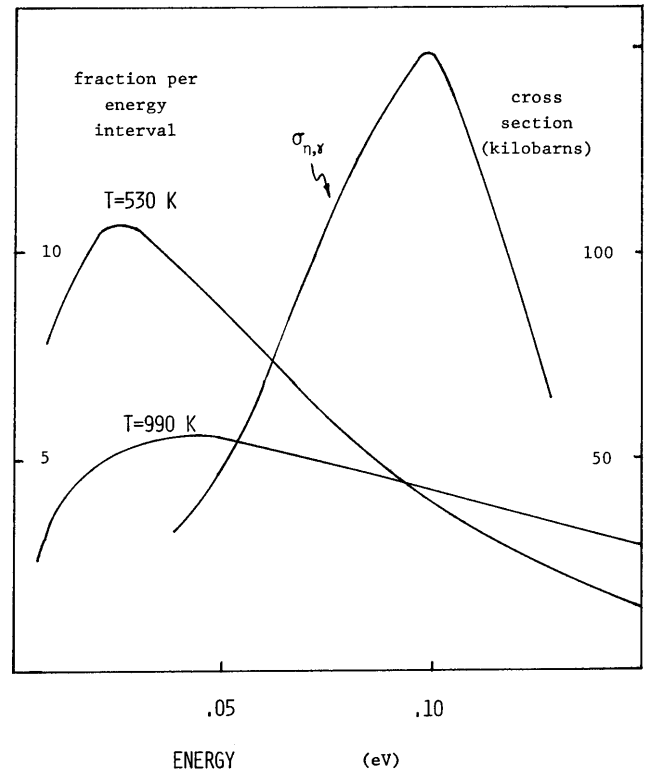


Figure 1. The neutron energy distribution is shown for two different temperatures together with the Samarium-149 capture cross section versus energy. Since the Oklo reactor's temperature would have varied and the exact values are unknown, it is difficult or impossible to find the exact amount of absorption Sm-149.

My calculations show that the measured Sm-149, U-235 and U-238 concentrations (data for Echantillon SC52 1472 near the center of reaction zone 2 taken from Holliger, Devillers and Retali, 1978) are consistent with 1. a young (six thousand year) age for the Earth, and 2. a value of the capture cross section equal to the modern value under certain assumptions consistent with the data.

Let me outline the procedure for my calculations. Since Sm-149 is 13.8% of naturally occurring Samarium (Knolls Atomic Power Company Chart of the Nuclides, 12th revision, 1977), we must assume that the initial Sm-149 concentration was not zero. It happens that for the small neutron flux levels and small reaction duration times which are consistent with the young Earth model of Chaffin (1982; 1985) an appreciable fraction of the initial Sm-149 concentration would probably survive the nuclear reactions and still be present in the ore today. Hence we must not make the mistake of assuming that the production rate of Sm-149 through fission would equal its loss rate through neutron capture. In a reactor, most of the Sm-149 formed is produced by the beta decay of Pm-149, which is in turn a fission fragment produced in 1.04% of all U-235 fissions. In the following I will ignore the possibility of diffusion, which is not a good assumption (Chaffin, 1985; Naudet, 1978), but the implication of this section that the Oklo data are inconclusive can only be strengthened if diffusion is a factor. Hence, the rate of change of Pm-149 concentration is

the difference between the production rate via fission and the decay rate via beta-minus decay:

$$\frac{dN_{\text{Pm-149}}}{dt} = \gamma^{149} \epsilon N_{\text{f}}^{25} \phi_{\text{th}} - \lambda_{\text{pm}} N_{\text{Pm-149}} \quad (16)$$

where $N_{\text{Pm-149}}$ = Pm-149 concentration

$$\gamma^{149} = .0104$$

ϵ = fast fission factor

N_{f}^{25} = uranium 235 concentration

σ_{f}^{25} = thermal fission cross section in U-235

ϕ_{th} = thermal neutron flux

λ_{pm} = decay constant of Pm-149

The rate of change of the Sm-149 concentration is the difference between production via decay of Pm-149 and loss via neutron capture:

$$\frac{dN_{\text{Sm-149}}}{dt} = \lambda_{\text{pm}} N_{\text{Pm-149}} - N_{\text{Sm-149}} \sigma_{\gamma}^{149} \phi_{\text{th}} \quad (17)$$

where $N_{\text{Sm-149}}$ = Sm-149 concentration
 σ_{γ}^{149} = thermal neutron radiative capture cross section for Sm-149

Under the assumptions outlined above, these equations may be solved for the Sm-149 cross section, giving:

$$\sigma_{\gamma}^{149} = \gamma^{149} \frac{\sigma_{\text{f}}^{25} N_{\text{f}}^{25}}{N_{\text{f}}^{\text{Sm-149}} - N_{\text{f}}^{\text{Sm-149}} \text{EXP}(-\sigma_{\gamma}^{\text{Sm-149}} \phi_{\text{th}} d)} \times \frac{1}{1 - \left(\frac{\gamma^{149} \sigma_{\text{f}}^{25} N_{\text{f}}^{25} \phi_{\text{th}} / \lambda_{\text{pm}}}{N_{\text{f}}^{\text{Sm-149}} - N_{\text{f}}^{\text{Sm-149}} \text{EXP}(-\sigma_{\gamma}^{\text{Sm-149}} \phi_{\text{th}} d)} \right)} \quad (18)$$

where $N_{\text{f}}^{\text{Sm-149}}$ = the initial Sm-149 concentration
 d = duration time of the nuclear reactions
 $N_{\text{f}}^{\text{Sm-149}}$ = final Sm-149 concentration.

Since the initial Sm-149 concentration is unknown, we might ask whether there are any values of this, the thermal neutron flux, and d which are self consistent with the equation above, and the modern answer of 41000 barns at 68°F. The answer is that reasonable values will satisfy the equation: duration time, d , equal to a fraction of a year, the thermal neutron flux near 10^{15} neutrons/cm² sec, and Sm-149 concentration near 10^{17} atoms per gram of ore. However, from the fact that various assumptions satisfy the data, we must conclude that the Oklo data are insufficient to decide whether the Sm-149 cross section has varied, and therefore whether the strength of the nuclear force has varied with respect to the Coulomb force.

Summary

A specific theory has been offered which allows the strength of the Coulomb force to vary relative to the gravitational force. It shows no contradiction with observation thus far, but shows promise in possibly explaining the red shifts of distant galaxies. Claimed limits on the variability of the nuclear force coupling constant, derived from Oklo data, have been examined and rejected.

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QUOTE

Thus Augustine's conversion must have had not only that deeply liberating personal effect of which he tells us in the *Confessions*, but also the effect of supplying for his philosophy "the other half," hitherto missing. Beginning with Aristotle's prime mover, he now sees further that God is creator of everything, the origin of all existence because he is existence itself, the maker of all essences, a good God whose created things are all good, a God who annihilates nothing but cares for, and saves, being. Thus to the total ancient philosophy, Augustine adds (a) the personal God, (b) the goodness of God and of all created natures, (c) the Christian faith in the recovery of the original goodness of creation by grace, beyond temporal-spatial existence.

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MINISYMPOSIUM ON VARIABLE CONSTANTS—V

WORLD-VIEWS AND THE METAMORPHIC MODEL: THEIR RELATION TO THE CONCEPT OF VARIABLE CONSTANTS

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Abstract

In this paper, the D-world model is used to discuss four scientific method presuppositions, involving linguistic concepts, that should be radically altered prior to the selection of any theory that incorporates variations in assumed universal constants. The metamorphic-anamorphosis model is re-introduced as an appropriate theoretical construct that is consistent with the four altered presuppositions.

Introduction

Prior to the formation of the Creation Research Society, some researchers developed models for the effects of a gravitational field that were simple modifications of Newton's theory. Indeed, modifications of this type can be traced to the late 1800's. In the first part of this paper, I discuss such a model—the Bastin-Prokhovnik model. This model should be, at least, of historical interest and possibly attractive to members of the CRS since, as judged by recent articles in the Quarterly, many of this model's conclusions are in accordance with a rejection of certain aspects of an Einsteinian philosophy of science.

With respect to this model, I introduce a hypothetical scientist named Thor. Thor's underlying world-view is discussed and a description is given of four presuppositions that many scientists appear to embrace. It is shown that if the velocity of electromagnetic radiation is not an invariant, then Thor, in order to retain his world-view and presuppositions, would need to alter extensively his speculative theories.

Following our investigation of Thor's predicament, certain linguistic concepts associated with the *D-world model* are re-introduced. It is pointed out that this mathematical model contradicts Thor's four presuppositions and rationally implies that a new set of four more realistic assumptions is more appropriate. The *metamorphic-anamorphosis* model is re-introduced as a general scheme that satisfies these four altered presuppositions. Moreover, even though it is not necessary, this model would be partially verifying if any change in the so-called universal constants could be detected.

As an added feature to this article, a short "glossary" has been included as an appendix so that the reader need not consult some obscure or not widely distributed reference. If a term within the main body of this article is italicized the first few times it appears, then it also appears in this glossary. On the other hand, if I have defined a term within one of my Quarterly articles it will probably not be included within this glossary.

The Bastin-Prokhovnik Model

In order to eradicate many philosophic ramifications encountered within the original derivations of the Special Theory of Relativity, A. J. Bastin (1960) has as-

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sumed, as a fundamental postulate that is not derived from some other theory, that gravitational effects are propagated as a form of communication between material bodies with the same velocity, c , as that of electromagnetic communication in a vacuum. He then lets m'_0 be a gravitational point mass at rest with respect to some fundamental observer and m_0 be a gravitational point mass in relative motion v towards the mass m'_0 . Bastin's law of gravitational force F is:

$$F = \frac{Gm'_0m_0}{d^2} \left(\frac{c+v}{c-v} \right)^{\frac{1}{2}} \quad (1)$$

where G is the gravitational constant and d is the linear distance between the point masses. In section 8 of the Bastin paper, the postulated equation (1) is more rigorously justified. Further, in this model $G \propto 1/(Rc^2)$, where R is an assumed *substratum* radius of the universe. S. J. Prokhovnik (1967, p. 68) incorporates Bastin's modified Newtonian expression (1) into a *substratum theory* using the cosmic (i.e. *substratum*) time notion T and a uniform Hubble type substratum expansion law that requires $R(T) = \omega T$, where ω is a universal constant. Thus for two constant and fundamental gravitational point masses m'_0 and m_0 the gravitation "constant" does not have such a nonvarying character but rather

$$G \propto 1/(Tc^2) \quad (2)$$

Under this Bastin-Prokhovnik theory T is, at present, 10^{10} yrs.

When $v \ll c$, then the Bastin expression (1) is closely approximated by Newton's. Thus, in the case where our Sun has mass M and the Earth has mass m , the Newton theory of gravity yields the period of rotation of the Earth about the center of mass as $t = (2\pi a^{3/2})/\sqrt{G(M+m)}$. Even though it is generally agreed that the number $(M+m)$, 5000 years ago, was slightly larger than it is today, for comparison sake, assume it is constant.

The Bastin-Prokhovnik model is a Newtonian substratum model and such a Newtonian substratum has also been used by Surdin (1962) to obtain relativistic expressions for perihelion precession and gravitational EMR (i.e. electromagnetic radiation) deflection; but, nevertheless such models have the usual drawback of whether or not the substratum should be assumed to exist in reality. After examining the basic simplistic structure one might conclude that this model's particular substratum behavior should not be deemed as

objectively real in character. This modeling technique cannot be differentiated from that advocated by Lorentz. In 1906, Lorentz altered the notion of the mathematical model by stating that such models should be viewed as only partially realistic. Lorentz (1952, p. 31) states his type of Copenhagen interpretation relative to his ether notion:

I should add that, while thus denying the real existence of ether stresses, we can still avail ourselves of all of the mathematical transformations . . . We need not refrain from reducing the force to a surface-integral, and for convenience's sake we may continue to apply to the quantities occurring in this integral the name stresses. Only, we must be aware that they are only imaginary ones, nothing else than auxiliary quantities.

I also point out that the objects termed as photons as originally stated in the Einstein's photo-electric theory were only to be assumed imaginary entities. Since the Bastin-Prokhovnik model is intended as a prototype, it's useful to invoke for this model the most conservative substratum approach and assume that the numbers R , T and the substratum expression $R(T) = \omega T$ do not correspond to objective reality.

Scientist Thor

Scientist Thor considers himself a world authority on the applications and conclusions associated with the Bastin-Prokhovnik cosmology. He attributes the vacuum velocity c_v for the propagation of gravitational effects as being always equal to the in vacuo velocity c of EMR as necessary since he has developed an EMR theory similar to that of R. A. Waldron (1989) that corresponds to the propagation of gravitational effects with the effects of EMR. Further, he has developed a technique for measuring c for EMR using some type of laboratory instrumentation independent from his theories. He discovers that over a period of 300 measurements made at the starting time of 12 noon on 12 July 1989 and ending at 12 midnight (local time), as measured by a mechanical clock, that the velocity of EMR had decreased slightly.

Why does Thor appreciate Bastin-Prokhovnik type models? His appreciation comes from the fact that all of the dynamic properties of the Special Theory of Relativity and almost all of the verified consequences of the General Theory can be deduced from such models without invoking the incomprehensible, to him, concept of absolute time dilation or length contraction. There is, however, one critical aspect of Thor's philosophy of science that he has not expressed formally. His writings are carefully edited so as to contain no indication that he subscribes to a particular world-view exterior to his scientific discipline. In Herrmann (1985b), it is argued that belief-systems and their deduced world-views are the hidden motivating factors that govern theory selection. The assumption is that a theory conjoined with a world-view must not yield a logical contradiction. To achieve this, Thor must couple his theories with four immutable, and often considered as minor, presuppositions.

(i) Human beings have the ability to comprehend and will eventually describe in human languages all of the true laws that govern the cosmos. This includes

the laws that govern the development of individual natural systems.

(ii) A uniformity of nature; which is equivalent to stating that there are theories (possible yet unknown) expressible in a human language, that embrace human logical processes and that are correct in their predictions of natural system behavior for all of cosmic time.

(iii) A natural order or harmony concept; which is equivalent to stating that many, but not all, developing natural systems display a describable uniformity or order that is acceptable and comprehensible to his scientific colleagues.

(iv) In the absence of a theory that predicts why a quantity might vary, then scientists are allowed free speculation.

Even though it is not possible to extrapolate beyond Thor's experimental time interval with any certainty; Thor, in order to sustain his belief-system, does so by exponentially extrapolating his data to 5,000 present day years into the past. He assumes that the length of the major axis, a , of the approximately elliptical orbit of the Earth is approximately a constant, due to a requirement of his theories that the heat falling on Earth be approximately the same 5,000 years ago as it is today. Using the above model, and his complete trust in his uniformity of nature concept, it follows that the period of rotation of the Earth about the center of mass is $t = K(cT^2)$, in general, where K is a constant. Let c_i denote the velocity of EMR 5,000 of our present day years ago and c the velocity as measured at 12 midnight on 12 July 1989 by Thor in his laboratory. Thor claims that $c_i \approx 5c$. Then letting t_i denote the period of rotation 5,000 present day years ago and t_n a present day year in time as Thor conceives of it, it follows that t_i is very nearly $5t_n$. Using this result, Thor concludes that his selection of the Bastin-Prokhovnik model is inappropriate, not because it may be incorrect, but rather this result contradicts a hidden conclusion unmentioned by Thor—a speculative conclusion that scientist Thor desperately wants to establish logically from an assumed extrapolated behavior. In particular, he needs a theory that does not contradict his belief that over the past 5,000 present-day years the unit a "year" has remained approximately constant.

Unless there is a bona fided revelation, individuals seem to find it difficult to alter even the most innocuous portions of a belief-system, then to accommodate (i)-(iv) above Thor needs to alter his theory or find a different one that includes a continuous time varying EMR velocity, a description for a cause of such velocity changes that will predict the variations he has measured within his laboratory, an approximation for Newton's theory of gravity and does not, when extrapolated, contradict other conclusions he wants to establish theoretically. Indeed, there are literally hundreds of different speculative cosmology theories that cannot be differentiated one from another within a laboratory setting and I am sure that Thor could fill many journal pages with his arguments for the acceptance of one of these as it relates to his speculation on the behavior of c .

I point out that considering such speculation as somehow significant or objectively real in character has only occurred within the scientific research com-

munity within the past 137 years. Faraday (1852) apologizes to his audience for his speculations on the possible physical reality of his lines of force and informs them, due to the fact that he speculates, that he will only publish his remarks in a “nonscientific” journal rather than in the *Philosophical Transactions*. The view as to whether or not to categorize as objectively real what was once called metaphysics, but is now simply termed as “theory,” has vacillated since Faraday’s pronouncements; but, as I have argued, it is mostly dependent upon a world-view that one is attempting to force upon a populace that is not aware of the fact that such speculation cannot be scientifically verified.

A World-View Model

It is not often that one finds in a research publication a statement in the very first paragraph relative to the researcher’s philosophic world-view. However, I did find in the paper by Tipler the statement that he would, first of all, reject a cosmology pilot wave interpretation of quantum mechanics since any such approach would require a clear division of systems into observer and observed and that: “Such a split is quite impossible in cosmology, for there is nothing outside the universe.” (Tipler 1984, p. 188).

I have recently published (Herrmann 1984; 1985a,b; 1986b,c) some findings based upon the **D-world** (i.e. deductive-world) model, a model that is now called the NSP-world model (Herrmann, 1987). I emphasize that this model is a mathematical model that employs only the most accepted modeling methods. Further, I note that certain terminology that appeared in the original published papers has been altered to make the model as unbiased as possible. As I discuss the relation of the **D-world model** to the possible variation of the assumed universal constants, the newer terminology will be introduced and specifically correlated to the older expressions. Notice that this model is slowly being successfully applied to interesting scientific questions (Herrman, 1989). It even yields a more fundamental cause for the Barnes instantaneous feedback axiom (Barnes, 1983, p. 86). But what has not been fully appreciated is exactly what this model establishes relative to Thor’s world-view and that in Herrmann (1986b, p. 196) the *metamorphic* portion of this model would be partially verified if one could establish that even one of the universal constants had altered.

What the D-world model has to say about theories, logic and other linguistic concepts is not scientific speculation. The D-world properties are established rationally by mathematical reasoning—the same reasoning processes used to arrive at the most basic of scientific conclusions. But the D-world is a special type of substratum theory and you cannot eliminate this substratum mathematically. If you utilize mathematical models in any manner to describe natural system behavior, then this substratum world exists, at least, in uninterpreted symbolic form. From the speculative point of view, all atomic theory is also a substratum theory in that there appears to be no direct evidence—evidence that impinges upon one of the five senses—for the existence of the assumed elementary particles. One can totally reject the quantum physical model for subatomic behavior by rejecting

portions of the mathematical structure itself or consider other interpretations and, thereby, develop alternate theories that predict the same verified consequences (Simhony, 1987; Barnes, 1983). If the basic necessity for science is communication through application of any symbolic language, then the D-world exists as an abstract entity. Moreover, for me, I have considerable personal and sensory evidence that the **pure D-world model** does correlate to an objective reality. However, I acknowledge that some scientists still have retained an actual free will. Hence, as done by Lorentz, Bohr, and many present-day individuals, you can, of course, freely reject the objective reality of the pure D-world as its implications are discussed by deeming it as extraneous or simply parametric in character.

As to the basic structural assumptions, the mathematical modeling technique uses only the most accepted axioms of modern **Zermelo-Fraenkel set theory**. The fundamental linguistic rules that scientists employ to communicate findings and the most simplistic axioms for logical deduction are embedded into a mathematical structure. In Hermann (1986b), the propositions generated by this model are interpreted in two different ways. One interpretation discusses hidden D-world processes and entities that sustain, guide and are the possible building blocks for universes, in general. The second interpretation, which I consider more significant, is often ignored. This second interpretation specifically implies that Thor’s statements (i), (ii), (iii) and (iv) are false within the D-world. Using the mathematical methods in Herrman (1986a), it is established (Herrman 1986b, c; 1987) that Thor’s world-view needs to be radically altered and replaced by the following:

(i)’ Human beings do not have the ability to comprehend and will not eventually describe in human languages all of the true laws that govern the cosmos. This includes the laws that govern the development of individual natural systems.

(ii)’ Nature is actually ultra-uniform (i.e. superuniform) in character. There does exist a complete set of rules and processes that would give a correct prediction of all natural system behavior with respect to cosmic time assuming that such behavior is not interfered with by human intervention. However, the rules can never be written in any human language and their application requires the use of an ultralogic (i.e. a supermind process) that cannot be duplicated by any creature within the universe. Further, no form of human intervention can alter certain D-world properties—properties that will continue to govern system development.

(iii)’ There is an ultra-natural harmony and order within the universe. Every natural system, even those that relative to human comprehension are classified as chaotic or random in behavior, is endowed with a harmony and order to their development that is far superior to anything that can be achieved by human endeavors (Herrmann, 1989).

(iv)’ Speculation must be constrained. Scientists should admit that many of their speculative theories and the so-called methods of indirect verification exist for the sole purpose of fostering hidden aspects of personal world-views and that other speculative theories associated with competing world-views are just

as meaningful scientifically. Furthermore, when we employ the D-world model to investigate the linguistic aspects of human comprehension and knowledge, then it strongly suggests that science as a discipline should be restricted to small cosmic time periods that embrace the NOW. That speculation as Faraday (1852) wrote: ***Should ever be held as doubtful and liable to error and change . . .***

The D-world model also implies that the true nature of the cosmos can be greatly appreciated and marveled at by mankind-intuitively-even if we are only able to describe system behavior in but general terminology rather than in minuscule detail. We can appreciate a theological interpretation which specifies that there are no chaotic natural processes from the Creator's viewpoint, but that every natural system changes under the guidance of ultra-harmonious laws that display, magnificently, an intelligence of immeasurable magnitude when compared to that of the created.

The Metamorphic-Anamorphosis Model

In Herrmann (1986b), the concept of the **metamorphic model** was restricted to long term developmental processes and is fully discussed there, in section 5. The conclusions reached in that section are associated and consistent with statements (i)'-(iv)'. Moreover, they are applicable to any discussion of a present day variation in what was thought to be a universal constant. Indeed, the possibility of universal constant as well as first-principle alterations, in the far past, is specifically cited (Herrmann, 1986b, p. 196) and used to develop the implications of the metamorphic model—a model for sudden changes that can appear to occur instantaneously throughout a natural system. As seen in Herrmann (1989), such variations need only be considered as “sudden” from the human point of view. They can actually be described as ultra-continuous (i.e. supercontinuous) and ultra-smooth variations from the D-world viewpoint. If such variations can be verified within the laboratory to have actually taken place, then this gives strong indirect evidence that such variations have occurred previously. Observe that such variations can be accompanied by subtle changes in first-principles.

The **anamorphosis effect** transpires after each such variation. As an analogue model, we need simply consider any natural system as a time dependent system interior to an **anamorphoscope**. This anamorphoscope takes all natural-world informational transmissions that are “distorted” by the first-principles or unaltered universal constants prior to a metamorphosis and conforms them, in a ultra-uniform manner, to what would afterward be considered as “normal” transmissions patterns. This particular interpretation is not the only D-world possibility. However, if accepted, it shows on the one hand that extrapolating a set of data beyond an immediate time interval is scientifically inappropriate, no matter how successfully the data fits some hypothesis. On the other hand, this interpretation supports the concept of the ultra-uniform and ultra-natural harmony and order within our universe described in (ii)' and (iii)'. The mathematical model actually describes, in general terms only, remarkable and marvelous processes that conjoin the seeming discordant time dependent system developments. These processes

are simplistic notions within the D-world, but beyond all natural-world attempts to either replicate or comprehend in detail.

Now Thor could have accepted his original variation of the Bastin-Prokhovnik model by simply accepting, without any further analysis, that c had decreased, in say discrete steps, to c_i . For, if he had but bothered to do so, he would have discovered that all of the verified conclusions of his original theory with the c_i substituted for c still hold true. Further, if it were not for the fact that it would contradict his world-view, than he could include the metamorphic model with the anamorphosis effect as a cause for the variation of c . Unfortunately, Thor has never considered such a possibility.

Conclusions

Even though the first lectures that used the D-world model to interpret and analyze both scientific and theological questions were given in 1981 and the first theological publication appeared in March 1982 (Herrmann, 1982), and even though at that time criticism was extremely favorable and the processes were considered by some as revolutionary, in actuality, few scientists have investigated the mathematical methods nor have they carefully considered how this model affects their pronouncements. Since its introduction many individuals have discovered that its ramifications contradict their long held world-views and they often attempt to escape from its conclusions by ignoring the model's existence. Some even reject its findings, without analysis and thereby display their own ignorance, when they claim that such analytical results cannot possibly be obtained rigorously, but must come from some mental aberration. Recall that the D-world model has distinct scientific and theological interpretations. And, indeed, this proposed substratum world need not carry any theological interpretation.

If it is not verified that some universal constants have altered, then this does not eliminate world-view statements (i)'-(iv)'. You can reject them only by assuming that they do not refer to objective reality, but the possibility that such a substratum world exists can no longer be denied on the grounds that no such scientifically acceptable model exists. If it is not verified that some universal constants have altered, then the speculative metamorphic model may have no laboratory verification and some, who do not have personal evidence available, may reject its reality. The rejection of the metamorphic model and the corresponding anamorphosis effect or, indeed, other similar portions of the D-world model will have no effect upon statements (i)'-(iv)' as long as science communicates by means of any form of symbolization.

It is unfortunate that within creation science literature there is a tendency to embrace Thor's world-view without concern as to its obvious theological implications. In light of the world-view model as partially described by statements (i)'-(iv)', when any creation model, from the so-called “Big Bang” to the metamorphic model, is discussed and analyzed, it is increasingly important that theoreticians consider openly how their hypotheses and conclusions reinforce a world-view that is exterior to the canons of their scientific discipline; in particular, a world-view that entails a grandiose view of human intelligence. It

is hoped that if variations of universal constants are detected, due consideration be given to models, such as the metamorphic, that sustain a more realistic view of the proper relationship between mankind's cognitive nature and that of the Creator.

Glossary

D-world model: Originally, the deductive-world model was applied to questions relative to the discipline termed as logic. A special mathematical structure—a nonstandard structure—is constructed using the modern ideas of nonstandard analysis. Rules are stated that correspond certain abstract mathematical entities to the natural world of human linguistics, while a host of other entities correspond to new linguistic terms. This yields a mathematical model for a new theory of linguistics and logic that incorporates the standard and customary concepts. From the technical viewpoint, the “model” is usually considered to be what is obtained when these rules of correspondence are applied. From the popular viewpoint, the term “model” is often thought to include the entire theory deduced from the mathematical structure where the abstract entities are interpreted in terms of the old or new linguistic terms. After the original rules of correspondence were described, it was realized that a second interpretation was possible. This interpretation corresponds certain linguistic concepts directly to old and to new physical terms. The expression D-world model used in this article is the popular concept of a model—the entire theory generated by the rules of correspondence—coupled with both the old and new linguistic and physical terms.

Anamorphoscope: Originally, an optical device that restored an image that was distorted by an anamorphosis device. For this article an anamorphoscope takes all natural-world informational transmissions that are “distorted” by the first-principles or unaltered universal constants prior to a metamorphosis and conforms them, in a ultra-uniform manner, to what would afterward be considered as “normal” transmission patterns. This concept is further explained under the idea of an anamorphosis effect.

Anamorphosis effect: Originally, an anamorphosis was an image produced by an optical system that rendered the image unrecognizable unless viewed by a proper restoring device. For this article, this effect can be very subtle. It refers to the following scenario. At a particular moment of cosmic time, certain universal constants or even natural laws are altered throughout a natural system. Any information transmitted prior to this cosmic moment but perceived within the natural system after the alteration occurs, will be “distorted” to conform to the altered universal constants or natural laws. Thus, depending upon human awareness prior to the alterations, it might not be possible to determine whether such alterations have occurred by means of any laboratory experimentation carried out within the influenced natural system and after such a cosmic moment.

Anamorphosis model: This is a model that incorporates the possibility that an anamorphosis effect could occur.

Metamorphic model: This is a model for a sudden alteration or change in any aspect of a natural system that occurs at a particular moment of cosmic time

throughout the system. But, the sudden change need not be considered as sudden from the viewpoint of a substratum theory that incorporates a different time scale. Moreover, the change can vary from catastrophic to minute in character. It need not incorporate any change in any universal constants or natural laws, but could simply result in what might be perceived in the natural world as a missing portion of system development. This portion would, however, not be missing within the substratum world.

NSP-world model: This is the D-world model with concentration upon the physical interpretation.

Pure D-world model: This is the portion of the D-world model that does not correspond to the ordinary human linguistic concepts nor to the standard physical theory. Rather, this is the portion that corresponds entirely to the new linguistic and new physical terms.

Substratum: When a model is constructed a portion may be declared to be a substratum. On the other hand, such a declaration need not be made. When a substratum is declared, it is considered to be an underlying structure or foundation for a natural system and from which a natural system derives its special character. Generally, for a particular theory, no consideration is given to considering a substratum of a substratum. Often a substratum is not analyzed in any great detail and it can be considered as either objectively real, as an auxiliary construct, or partially real and partially auxiliary in character. For EMR, the ether is often declared to be a substratum. For the Prokhovnik cosmological model for special relativity, the unrealistic substratum is an imaginary construct for our universe where it appears to be isotropic and “smoothed-out” to a family of “fundamental observers” all of whom also obey the Hubble Law for uniform expansion. These fundamental observers may be considered as locations within an appropriate geometry. For the D-world model, the substratum is the pure D-world portion.

Substratum theory: This is any theory that has been declared as having a portion of the theory generated by a substratum.

Zermelo-Fraenkel set theory: This is the formal name given to the most well-known theory of sets. Almost any standard book on set theory is an exposition of Zermelo-Fraenkel set theory.

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GOOD NEWS FROM NEPTUNE: THE VOYAGER 2 MAGNETIC MEASUREMENTS

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Abstract

The Voyager 2 magnetic measurements at Uranus and Neptune have confirmed the predictions of a creationist theory on the origins of planetary magnetic fields. The unusual tilt and offset of the fields found at each planet can be explained by a simple extension of creationist ideas. In contrast, Voyager's magnetic data makes great problems for evolutionary theories.

Voyager's Findings

On August 25, 1989, the Voyager 2 spacecraft passed Neptune and made the first measurements of that planet's magnetic field. The Neptunian field is tilted 50° with respect to the rotation axis and offset by 0.4 R (R = Neptune's radius = 22,700 km) towards the south pole (Tsurutani, 1989). This is the second oddly tilted and offset field Voyager has found, the first being that of Uranus in 1986 (Ness, 1986.).

Neptune's magnetic dipole moment (a measure of the strength of the source) turns out to be 0.13 gauss R, or 1.5×10^{24} Ampere-meter ($1 \text{ Am} = 1000 \text{ gauss-cm}^3$). Again this is similar to the dipole moment of Uranus. The two planets seem to be fraternal twins; both have nearly the same radius, mass, and magnetic features. Like their gigantic brethren, Jupiter and Saturn, Uranus and Neptune each appear to have an exterior ocean of gas and fluid surrounding a solid core. A major difference between the twin planets is that the rotation axis of Uranus is tilted nearly into its orbital plane, whereas the direction of Neptune's rotation axis is more nearly normal. Figure 1 and Table I show the similarities and differences.

Review of the Creationist Theory

The Voyager measurements confirm a prediction I made six years ago (Humphreys, 1984) that Neptune's magnetic dipole moment would be "of the order of 10^{24} J/T " ($1 \text{ J/T} = 1 \text{ Am}^2$). Also in 1984 I made a similar prediction for Uranus, which was similarly confirmed (Humphreys, 1986b). I made these predictions on the basis of my hypothesis on the origins of planetary fields, which was that (1) the raw material of creation was water (based on 2 Peter 3:5, "the earth was formed out of water and by water"), and (2) at the instant God created the water molecules, the spins of the hydrogen nuclei were all pointing in a particular direction. The tiny magnetic fields of so many nuclei would add up to a large magnetic field of the right magnitude. By the ordinary laws of physics, the nuclear spins would lose their alignment

within seconds, but the magnetic field would preserve itself by starting an electric current circulating in the core of each planet. By the same laws, the currents and fields would preserve themselves with only minor losses as God rapidly transformed the water into other materials. After that, the currents and fields would gradually decay over thousands of years (Barnes, 1971, 1973).

To calculate the original fields by this theory, we only need to know the masses of the planets, which have been accurately measured. To calculate the present-day fields, we need to know the size and conductivity of the planetary cores, and the age of the solar system. Using existing models of the cores (Smoluchowski, 1983) and the tight-chronology Masoretic text age of 6000 years (Niessen, 1982), I estimated present magnetic moments of $(2 \text{ to } 6) \times 10^{24} \text{ Am}^2$ for Uranus, and similarly for Neptune. However, because Smoluchowski did not have much data on which to base his core models for Uranus and Neptune, I widened my prediction to "of the order of 10^{24} Am^2 ," by which I meant that the magnetic moments would be between 10^{23} and 10^{25} Am^2 . Both planets came within these bounds. If the present field of either planet had exceeded the maximum original magnetic moment according to my hypothesis ($8.2 \times 10^{25} \text{ Am}^2$ for Uranus and $9.7 \times 10^{25} \text{ Am}^2$ for Neptune), my theory would have been definitely falsified.

Performance of the Creationist Theory

The Sun, Moon, and all eight of the measured planets (Voyager will not visit Pluto) have present magnetic moments under the maximum values my

Table I. Physical Features of Uranus and Neptune
(Allen, 1973; Ness, 1986; Tsurutani, 1989)

Feature	Uranus	Neptune
Magnetic Dipole Moment (10^{24} Am^2)	3.0	1.5
Angle Between Spin and Dipole Axes (Degrees)	60	50
Offset of Magnetic Dipole (Radii)	0.3	0.4
Inclination of Equator to Orbit (Degrees)	98	29
Inclination of Orbit to Ecliptic Plane (Degrees)	0.8	1.8
Mass (10^{26} kg)	0.868	1.027
Radius (km)	2.3470	2.2716
Average Density (g/cm^3)	1.58	2.30

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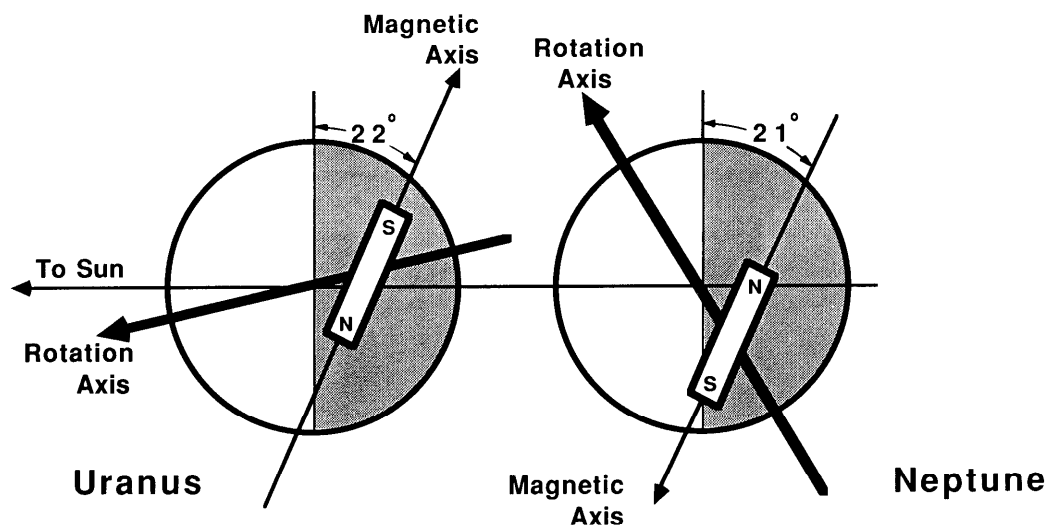


Figure 1. Tilts and offsets of the spins and magnetic fields of Uranus and Neptune. The pole labeled “S” on each internal magnet corresponds to the north magnetic pole of the Earth. The large angle between magnetic and rotation axes means that the magnetic poles of each planet are near its geographic equator. The magnetic axes sweep out a conical path around the rotation axes. There is a point in the northern sky, common to both planets, toward which the magnetic axis of each planet points (within a degree or so) once a day, as shown.

theory would allow, although Jupiter comes close to that value. Seven of the 10 present magnetic moments are a substantial fraction of the original values. Venus, Mars, and the Moon have practically no field at present, but rock samples from the Moon show that in the past it once had a field nearly as high as the calculated original field (Humphreys, 1984). The present magnetic fields of all 10 of these bodies come within the bounds set by present models of core sizes and conductivities. Extrapolating the measured decay of Earth’s field roughly 6000 years into the past gives remarkable agreement with the calculated original field (Humphreys, 1983), especially if we account for the losses due to reversals of the geomagnetic field during the Genesis flood (Humphreys, 1986a). In short, all of the solar system magnetic data we now have support this theory of magnetic field origins. Since the essential features of my theory—origin by water and a short timescale—are based on the Bible, the new data support a straightforward biblical view of origins.

However, the creationist theory still faces some tests. Igneous rocks from Mars and the cold side of Mercury should show evidence of strong magnetic fields in the past, if anyone ever goes to collect them. Mercury’s predicted decay rate (about 0.12% per year) is so fast that future space probes might be able to detect a decrease. And we must be able to explain the remarkable tilts and offsets of the Uranian and Neptunian magnetic fields.

A Creationist Model for the Tilts and Offsets

Such explaining is an easier job for the creationist than the dynamo theorist. For example, the creationist can consider the possibility that the solid core of either planet could be the source of the field, whereas the dynamo theorist cannot (see below). Since the field source is offset, this hypothesis would imply that something has displaced the solid core away from the planet’s center. A likely possibility is the accretion of

material sometime after creation, the same material that blasted craters on the surface of nearly every object in the solar system. Such material would sink down through the vast oceanic exterior and accumulate around the core. If this material resting atop the solid core were *denser* than the core, the situation would be unstable. Eventually, as more and more dense matter arrived, the solid core would be displaced; it would shift away from the center. From the magnetic data, there would be enough accreted material to displace the solid core by roughly 1/3 of a planetary radius—a massive change in the moment of inertia.

The direction of the solid core’s displacement would be random. If the displacement were away from the planetary spin axis, the resulting moment of inertia change would cause the fluid part of the planet to wobble ponderously, tilting the planetary spin axis in a complex series of motions like a processing gyroscope. The spin axis would eventually stop tilting when it was lined up with the centers of mass of the solid core and the accreted material, the most stable configuration. This would explain why the present offset dipoles of both planets are presently on the spin axes. In the case of Uranus, the original displacement of the core may have been toward the equator, causing its great 98° tilt. In the case of Neptune, the initial offset may have been more toward its south pole, resulting in its less severe 29° tilt.

In either case, however, the solid inner core (with the magnetic field locked into it) would tend to maintain its original direction of spin, like a gigantic gyroscope (Figure 2). After some time, the spin of the solid core would slow down, and it would begin to rotate about the planetary spin axis. However it would maintain the 50° or 60° angle with the spin axis it had at the outset of the catastrophe, and so the magnetic axis would sweep out a cone-shaped path around the planetary spin axis, as it does today. In other words, the tilt of the magnetic axes with respect to the

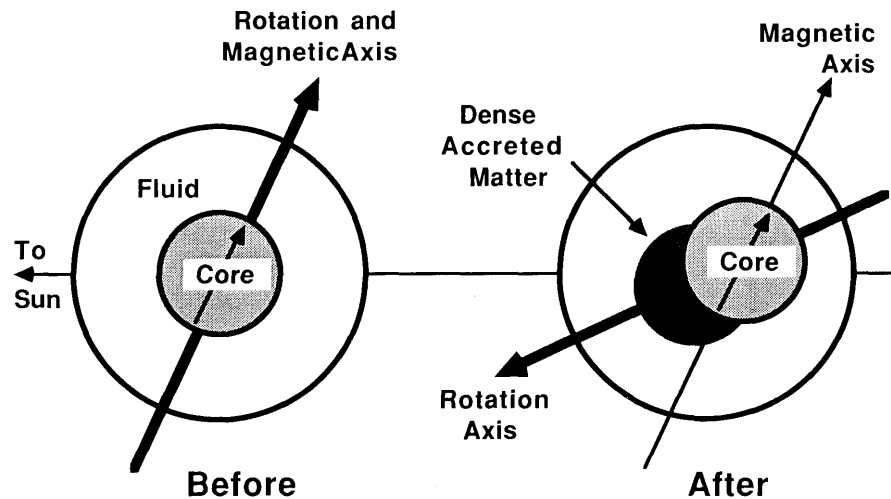


Figure 2. Separation of the magnetic and rotation axes of Uranus. Accreted material denser than the core sinks to the center and displaces the solid core, into which the magnetic field is locked. The sideways core displacement causes the rotation axis of the fluid to tilt leftward into the orbital plane, during which time the angular momentum of the solid core keeps the core pointing upward. Eventually the solid core begins rotating around the rotation axis, but it maintains its 60° tilt between magnetic and rotation axes.

planetary spin axes would be a relict of the original orientations of the planets. This would explain why, ignoring polarity, there is one point (within a degree or so) in the northern sky to which the magnetic axis of each planet points once a day, as shown in Figure 1. Other variations of this model are possible, particularly ones with detailed calculations of the various torques and precession involved.

New Dilemmas for Dynamo Theories

In contrast to the creationist theory of magnetic origins, evolutionary "dynamo" theories have fared poorly in the solar system, running aground particularly on the Moon, Mars, and Mercury (Humphreys, 1984), and in predictions for Uranus and Neptune (Dessler, 1986). But explaining the magnetic results for those last two planets is going to be very difficult for the dynamo theorists (Kerr, 1989). A solid core cannot have the fluid convection flows they believe could maintain a magnetic field for billions of years. Thus they must have the origin of the field in the fluid around the solid cores. The fluid is probably not very conductive electrically, which is a difficulty for dynamo theories. In the case of Uranus, there does not appear to be much heat energy to drive the convection flows. Dynamo theorists must explain why there is a source only on *one* side of each planetary center, not symmetrically on both sides. And they must explain the tilt of the magnetic axes, because in all dynamo theories the magnetic axis is closely related to the spin axis. Before the Neptune encounter, dynamo theorists asserted that the Uranian tilt was due to our good fortune in catching a magnetic field reversal in the act of flipping. However they cannot make that claim for *both* tilts, because according to the evolutionary timescale for reversals, it would be extremely unlikely that two planets would be so well synchronized. As one commentator put it, "Two odd magnetic fields is one too many" (Kerr, 1989). Thus the Voyager data are making difficulties for the dynamo theorists.

The Value of the Space Program to Creationists

It often seems unfair that evolutionists receive billions of taxpayer dollars to further their programs while creationists seemingly must do their research on a much smaller scale. Yet the exploration of space shows that God has been unfolding much bigger plans behind the scenes. Voyager, Viking, Mariner, Venera, and other billion-dollar spaceprobes have opened our minds. None of us ever quite imagined the mystery and beauty that lay in these worlds which were previously beyond our ken. Creationists have nothing to fear from new knowledge of the universe. Every new bit of information, including the magnetic data, simply enhances the ability of the heavens to show forth the glory of God.

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A PRELIMINARY REPORT ON THE GEOLOGY OF SOUTHWEST VIRGINIA

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Abstract

A description is given of the Valley and Ridge Province of Southwest Virginia, including thrust faults, thrust blocks, folded mountains, and windows or "fensters" present in the region. Interpretations which various geologists have given to the area are discussed. These include descriptions of the Cumberland Overthrust, the Kent Window east of Wytheville, as well as other areas. I discuss the plate tectonics (continental drift) scenario as it has been applied to the region, and offer an alternative scenario involving the Genesis Flood, gravity slides, and other agents. I point out the missing strata from the Pennsylvanian, Permian, Triassic, Jurassic, and Cretaceous Periods, and most of the Cenozoic Era. I discuss the inconsistency of this with establishment defined geological time.

Introduction

The state of Virginia's established stratal record is separated from east to west into five, south (or southwest) to north (or northeast) trending, physiographic provinces: Coastal Plain, Piedmont, Blue Ridge Mountains, Valley and Ridge, and Appalachian plateau (Figure 1).

This preliminary report will discuss the Valley and Ridge province of Virginia, and offer an alternative, anti-evolutionary, anti-historical geological picture of the origins of the area. A more general creationist description of the Southeastern USA and a mountain building episode (Appalachian orogeny) were given by McQueen (1987).

The Valley and Ridge Province differs from other Virginia physiographic provinces because it is underlain principally by establishment defined early Paleozoic carbonate and elastic strata. Also these strata are significantly folded and faulted. Fold and fault structures can be traced from southwest to northeast for hundreds of miles across Virginia and adjoining states (Frazier and Schwimmer, 1987, p. 324 and Figure 2 of this report.)

In particular, a description of a geological "window" in Wythe county Virginia along with other windows will be given as an example of a possible creationist explanation of the area. A geological "window" or "fenster" from the German word for window, is: "A circular or an ellipsoidal erosional break in an overthrust sheet whereby the rocks beneath the overthrust are exposed" (Bureau of Mines, 1968, p. 1239). An overthrust sheet is: "The block, above a low-angled fault plane, which has been displaced a matter of miles" (p. 783). An overthrust is: "A thrust fault with low dip and large net slip, generally measured in miles" (p. 783).

Geologist have mapped and described a number of thrust faults in the Valley and Ridge province (Frye, 1986). These faults apparently brought older Paleozoic strata onto and over younger Paleozoic strata. In some areas subsequent processes of erosion removed parts of the older strata to reveal younger strata via a geological window.

Thrust Faults Discussion

The faults in Virginia's Valley and Ridge Province are not the tremendous, miles long supposed overthrusts such as Wyoming's Heart Mountain, Montana's

Lewis, and Switzerland's Glarus overthrusts that have been discussed in creationist literature by Whitcomb and Morris (1961), Lammerts (1966, 1972), Burdick (1969, 1974, 1975, 1977), and Morton (1987). Hence, even if we accept the Whitcomb and Morris interpretation of those overthrusts, the best interpretation of these lesser examples may not be obvious. Note that discussion of other wrong order formations, and the presence or absence of evidence for thrusting, was given by Slusher (1966) and Burdick and Slusher (1969). Howe (1972) discussed and photographed some overthrusting of pavement caused by the San Fernando earthquake.

Virginia's thrust faults are examples of reverse faults. Reverse faulting occurs when a hanging wall has moved upward with respect to the footwall. A hanging wall is commonly defined as a wall of rock on the upper side of an inclined vein or fault. A footwall lies along the lower side of that inclined vein or fault. Thus, contrasting normal faulting is to be considered present when the hanging wall moves downwards past the footwall. Reverse faults abound in the Valley and Ridge Province of southwest Virginia. Those faults which have been mapped and named include the Fries, the Blue Ridge, the Spurgeon, the Pulaski-Staunton, the Max Meadows, the Poplar Camp Mountain, the Claytor, the Cove Mountain, the Saltville, the Narrows, the St. Clair, the Richlands, the Boissevain, the Copper Creek, the Clinchport, the Hunter Valley, the Wallen Valley, and the Pine Mountain faults (Frye, 1986; Bailey, 1984; Bartlett and Webb, 1971; Marshall, 1959; Harnsberger, 1919; Cooper, 1939; Butts, 1927; Wentworth, 1921; Rich, 1934).

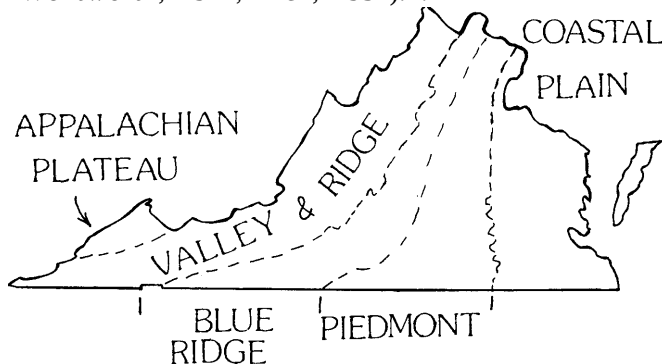


Figure 1. The map of Virginia, showing its division into the Appalachian Plateau, Valley and Ridge, Blue Ridge, Piedmont, and Coastal Plain Provinces.

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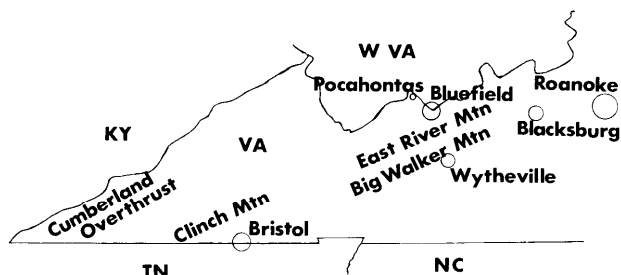


Figure 2. A map of Southwest Virginia showing prominent cities and geological features.

In southwest Virginia the surface expressions (traces) for these reverse faults trend from southwest to northeast until the Roanoke bend. At the Roanoke bend, the fault traces turn to trend more northerly to parallel the axial length of Shenandoah Valley. Except for the Pine Mountain fault, which is terminated abruptly by cross-faults (the Jacksboro fault on the southwest and Russells Fork fault on the northeast), they generally just "die out" or "fade away." The reverse faults appear not to be terminated or offset by vertically inclined cross (slip or transcurrent) faults. If reverse faulting in the Valley and Ridge Province were created by deeply seated stresses moving from southeast to northwest, then one would expect to find in the field a greater number of vertically inclined, offsetting cross faults of miles displacement. Plate tectonics theory indicates the necessity for movement of underlying basement rock as well as overlying Paleozoic strata. Thus the Pulaski Thrust Fault could not be mapped so nearly straight, but would be offset in places.

Consider the Cumberland overthrust block (Figures 3 and 4). This block of establishment acknowledged allochthonous rock is delimited by the nearly straight edges (traces) of various faults. Along its northwest side is the Pine Mountain thrust, along the southeast is the Wallen valley thrust, along the southwest is the Jacksboro tear fault, and along the northeast is the Russells Fork tear fault. The Cumberland overthrust block has been reported to have been displaced northwesterly a distance averaging six miles (Wentworth, 1921). The Cumberland overthrust is situated at the extreme northwest side of the Valley and Ridge province, abutting the Appalachian Plateau province. In the Appalachian Plateau province, near surface strata are assigned to younger Paleozoic formations which are considerably less folded and faulted than are older Paleozoic formations within the Valley and Ridge province.

It is suggested that a reasonable interpretation for more intensive folding and more severe faulting within the Valley and Ridge province is that (1) there was uplift of the Blue Ridge province, (2) concurrent downdrop of the Appalachian Basin, westerly beyond the Appalachian Plateau province, followed by (3) gravity sliding of Valley and Ridge strata downwards northwesterly, from the crest of the Blue Ridge province towards the Appalachian Plateau. Only at the far northeasterly and southwesterly ends of this structural and stratal sequence was compression and skewing sufficient to produce tear (transverse) faults such as the Jacksboro and Russells Fork tear faults.

Plate Tectonic/Historical Geology Interpretation

It is stipulated that plate tectonic (continental drift) paradigms are widely accepted by academia currently. One description concerning the origin of the Valley and Ridge province was offered by Frye (1986). Thus in late Ordovician time the Taconic orogeny caused the Smith River allochthon to move over the Blue Ridge province, doubling the crustal thickness. The area that was to become the Valley and Ridge province sank to depths beyond where sunlight could penetrate. As a consequence of crustal sinking here, later sediments were deposited periodically in the form of sands and muds.

West and southwest of Virginia, marine waters remained shallow enough for carbonate (limestone and dolostone) deposition to continue. The broad syncline with the Clinch sandstone, which today covers East River Mountain (a mountain which trends southwest to northeast) and Big Walker Mountain (a long folded mountain running the same direction) and some other lesser folds were formed during this time. Later during Silurian and Devonian times, warm shallow seas returned to deposit carbonate sediments. Then came another mountain building episode, the Acadian Orogeny. During the Acadian Orogeny, a second attendant deepening of the continental sea occurred within the future Valley and Ridge Province, as a second microcontinent docked on North America.

By Mississippian time the latest deepened basin was nearly filled with sediments, and then came the Alleghanian Orogeny, a third uplift of a repeated cycle of crustal uplifts and attendant crustal down-dropping along Appalachia. At this time the Iapetus Ocean lay to the east of what would be the future North America. The Iapetus Ocean was closed and the supercontinent, Pangaea, was formed. Then during Triassic time, the modern Atlantic ocean and Gulf of Mexico came into existence and western and eastern continents began to take shape. Apparently sedimentation processes ceased within the Valley and Ridge Province during and after Triassic times.

The Problem of Missing Geologic Time

According to stratigraphic data (Frazier and Schwimmer, 1987) deposition of sedimentary strata ceased within most of the westerly half of Virginia after the Mississippian Period. Younger (coal bearing) formations generally were deposited to the west, within the Appalachian Basin of which westernmost Virginia is considered a part. Thus within most of the westerly half of Virginia, there is lost virtually all evidence of the existence of the Pennsylvanian, the Permian, the Triassic, the Jurassic, and the Cretaceous Periods, and most of the Cenozoic Era. A major exception would be Ice Age deposits along

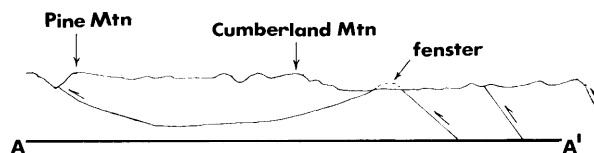


Figure 3. A cross section showing the Cumberland Overthrust Block along the line A—A' of Figure 4.

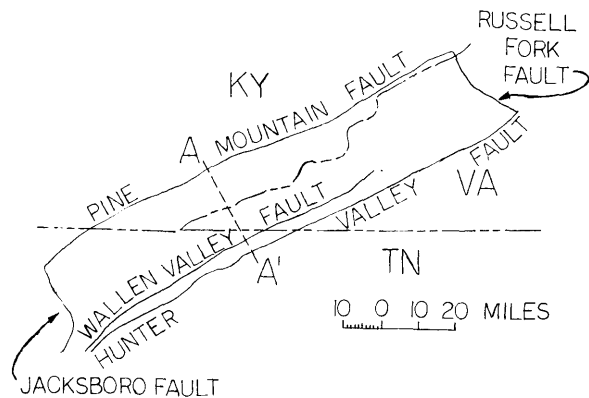


Figure 4. The Cumberland overthrust block, which appears to have been thrust from southeast to northwest. The Pine Mountain, Wallen Valley, and Hunter Valley faults are thrust (reverse) faults whereas the Jacksboro and Russell Fork faults were Tear or Cross faults.

with associated fossils, which are particularly well known within and near Saltville, Virginia (Bird, 1985).

In the opinion of the writer, the accounting of lost geologic time in any state is generally ignored by the geological profession. Lost geologic time is not readily explainable via geological evidence because the evidence is missing. Thus professional explanations which have been offered regarding missing time are decidedly speculative and subject to revision. Burdick (1977) documented the evolutionists' attempted use of overthrusts and quiet periods to obliterate strata.

Missing strata in the Valley and Ridge Province includes those that should have been deposited during the age of the dinosaurs (the Permo-Mesozoic). In the western United States, dinosaur fossils are plentiful in beds assigned to the late Jurassic Morrison formation. These strata are thought to be principally fluvial (continental) in origin, as opposed to marine. Since the Valley and Ridge Province supposedly possessed a continental environment after Pennsylvanian times, why do we not see dinosaur laden fluvial strata anywhere to the west of the Blue Ridge Province? For creationists, the presence of a geologic hiatus within the Valley and Ridge Province calls into question the very existence of establishment geological time. Can any scientist believe that all of the evidence for sedimentation and erosion within the province, from the Permian Period to the latest part of the Cenozoic Era, can be so completely removed?

Bailey (1984) refers to a type of poorly-sorted sandstone made up of sharp-edged grains, called graywacke. Graywacke is commonly encountered in Appalachian coal mining operations. It is believed that the source for these deposits was unstable terrain. Thus rapid deposition of sliding materials did not allow for sorting of the materials by either marine or continental waters. Based on existing evidence, a chain of volcanic mountains supposedly existed to the east of the coal bearing regions of what is now Kentucky, Tennessee, West Virginia, and extreme western Virginia at the time organic material was being deposited and coal was being formed. Why is it that such geologically older evidence exists while evidence for later geological activity is missing from the Valley and Ridge Province?

A chronological alternative to this time problem was given by Waisgerber 1987. Waisgerber concluded that Paleozoic, Mesozoic, and Cenozoic Eras need not represent consecutive intervals of geologic time. For example, in the Grand Canyon region of western United States, supposedly successive Paleozoic and Mesozoic strata reveal within each locality formations indicative of (1) deep marine environments, overlain by (2) near-shore and non-marine formations, followed by (3) on-shore, wind blown deposits, (4) overlying marine formations, with or without (5) beds containing coal. The Paleozoic and Mesozoic strata elsewhere in North America may well represent sequences that respond in part to concurrent environments rather than geologic time. Other comments on the effect of different environments can be read in the paper by Howe (1987) and others in the Minisymposium on Orogeny.

A Preliminary Interpretation of the Cumberland Overthrust Block

The following is an interpretation of the Cumberland overthrust which is believed to be consistent with creationist/diluvialist/young earth ideas. As already mentioned, the thrusts are thought to have been produced by gravity slides downward northwesterly from the Blue Ridge Province. The Blue Ridge Province may have been higher and the Valley and Ridge Province, steeper in slope, in times past due to uplift under the Blue Ridge Province. The Cumberland overthrust block of southwest Virginia, eastern Kentucky, and northeastern Tennessee began its motion by ramping up to the Chattanooga shale and then thrusting forward along this very weak shale formation. The formation may well have been saturated at the time. The thrust block was originally topped by Silurian Clinch sandstone and then Chattanooga shale.

Then Mississippian formations and Pennsylvanian formations (including Harlin and Wallins Creek coal beds) were deposited along the lip of the thrust block and also to the northwest of it. These Carboniferous beds hide the lip of the block and render uncertain an exact distance for overthrusting. Wentworth (1921), Butts (1927), and Rich (1934) concurred in estimating an average of six miles for this thrust block. A maximum of 10 miles is suggested for the southwest part along the Jacksboro Tear. A minimum of two miles is suggested near the Russell Fork Tear fault, along the northeast part of the block. Younger Mississippian and Pennsylvanian formations seem to have been moved about two miles on elements of the Chattanooga shale by continued northwesterly movement of the block.

The Wallen Valley and Hunter Valley faults to the southeast were also produced about this time. An anticline existed between the Wallen Valley fault and the Carboniferous deposits further northwest. The anticline was created because the Cumberland block ascended up and over strata within the Chattanooga shale. The crest of this anticline, the Powell Valley Anticline, was subsequently eroded away, forming what is now the Powell River valley, southeast of Cumberland Mountain. Erosion exposed the fault line and windows (fensters) discovered by Butts in the 1920's near Rose Hill, Virginia (Figure 3; Butts, 1927,

Plate 2). It could be that some Mississippian strata subsequently covered the crest of the Powell Valley Anticline. Current evidence for such a covering is not known.

Preliminary Interpretation of Other Portions of the Area

I have already mentioned the Wallen Valley and Hunter Valley thrust faults. The Cumberland overthrust block brought Clinch sandstone to the surface. The Clinch Sandstone is an erosion resistant, ridge forming formation responsible for the existence of Wallen ridge northwest of the Wallen Valley thrust fault. The next block, southeast of the Cumberland Overthrust Block, appears responsible for a syncline being brought to the surface. The Clinch sandstone associates with this syncline also. This syncline lies under Powell Mountain and Newman ridge. Farther southeast, one crosses in succession the Clinchport fault, the Copper creek fault, the Saltville fault, and (crossing into Tennessee) the Pulaski fault. All of these bring early Cambrian Rome Formation strata or Honaker Formation strata over younger Paleozoic formations (Frye, 1986; Bartlett and Webb, 1971).

Clinch Mountain, situated between the Saltville and the Pulaski faults, is another southwest to northeast trending ridge underlain by erosion resisting, ridge forming Silurian Clinch sandstone. Except for Quaternary deposits, this area, which is southeast of Cumberland Mountain and the Cumberland overthrust, does not yield formations which are younger than the Mississippian Period. Coal has not been found here; it exists farther to the northwest. Also, known thrust faults here reveal displacements measuring in thousands or even hundreds of feet rather than on the order of miles (Bartlett and Webb, 1971). Consider another traverse through the Valley and Ridge province. This traverse, or cross section, commences at the state line in the Pocahontas-Bluefield, Virginia area through a point two miles east of Wytheville, Virginia. The Appalachian plateau lies northwest relative to Bluefield, Virginia. There, Pennsylvanian formations exist along a southwest to northeast trending line, southeast of Pocahontas, and parallel to the Abbs Valley anticline. The Pocahontas Number 3 coal seam, as much as 15 feet thick in some places (Harnsberger, 1919), was responsible for the prosperity of Pocahontas, from 1883, when economic mining began, to the mid-part of the 20th century and beyond.

In this region, southeast of Bluefield, lower Cambrian rocks have been thrust over and onto Mississippian formations via the St. Clair Fault. East River Mountain, Buckhorn Mountain, Rich Mountain (which is really the same as Wolf Creek Mountain except for a man-made cut through a pass made for Highways I 77 and US 52), Big Walker Mountain, Cove Mountain, and Draper Mountain are geomorphically related ridges which are underlain by the ubiquitous former, the Silurian Clinch sandstone. Overthrusting along St. Clair, Narrows, Saltville, Cove Mountain, and Pulaski Faults, and other thrusts to the southeast, contributed to raising these ridges. Existing less significant ridges not underlain by Clinch Sandstone are supported by Mississippian Price sandstone or other ridge forming strata (Frye, 1986). The aforementioned thrusts appear to have been moved northwesterly on either elements

of the Cambrian Rome Formation, the Ordovician Martinsburg formation, or the Devonian Chattanooga shale. Exceptions are where the strata cut across other formations as they ramp up to the next higher decollement. The faults appear not to extend down south-easterly to reach and involve the Precambrian basement rock (Frye, 1986).

Field Observations

A few miles east of Wytheville, Virginia there is an interesting window or fenster, the Kent Window, which appears to verify the structural geology of the region. Marshall (1959) interpreted existing geological conditions to be the result of the lower Cambrian Rome formation being thrust northwesterly over younger formations along the Pulaski thrust fault. Processes of erosion then removed a significant part of the thrust block. Thus within a geological window, about two miles in width, between Max Meadows and Wytheville, there is revealed younger Paleozoic strata of the footwall of the block. Higher ridges to north, east, south and west, are underlain by older Paleozoic formations of the hanging wall block. After Marshall mapped the area, he hypothesized the need for deformation by compressive forces which produced initially a recumbent overturned fold. Then continued application of compressive forces resulted

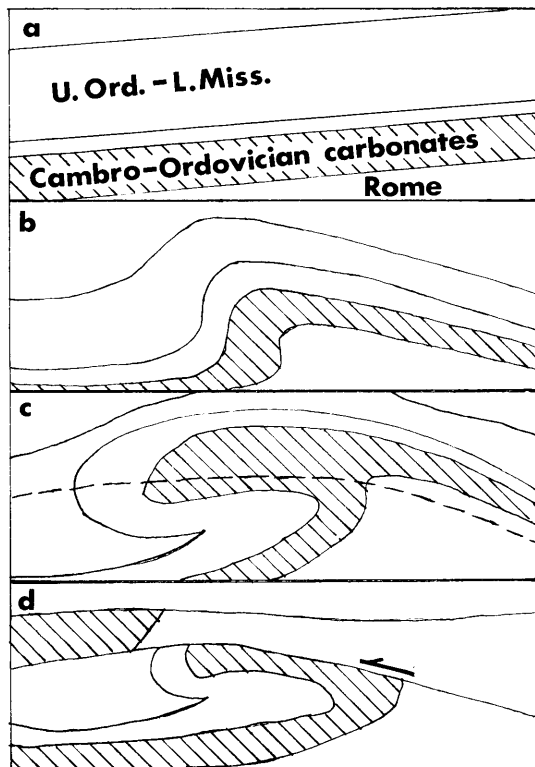


Figure 5. An interpretation of the Kent Window area, differing from that of Marshall only in placing more emphasis on gravity sliding rather than compression. The time frame would also be in agreement with creationist ideas. Part a shows the sediments as they would have deposited, before the uplift under the Blue Ridge Province started the gravity slide. Part b shows the resultant formation of anticline. Part c shows the recumbent (overturned) anticline and the formation of a shear zone along the dotted line. Part d shows the shearing off of the top part of the recumbent anticline. This brought the Rome formation into contact with the rocks now exposed within the window.

in shear zone. Thrusting along the Pulaski fault upwards northwesterly resulted in the removal of the upper part of the recumbent anticline (Figure 5). The Rome formation was described by Marshall as red, green, and yellow shales and siltstones with intercalated impure limestones and dolomites. Younger formations native to the area are principally carbonates. These are assigned to the Elbrook, Conococheague, Beekmantown, Mosheim, Lenoir, Feltzer, and Liberty Hall Formations.

Marshall did not find any part of the Rome Formation to be resting on Precambrian basement rock. Rather Rome Formation strata rests directly on younger Paleozoic formations with a tectonic breccia separating the subjacent younger formations from a superjacent older Rome formation. I have visited and studied the area, and Marshall's conclusions appear logical. A question remains however: Did such geological activity require millions of years to produce the current Valley and Ridge Province?

Conclusion and Summary

The Valley and Ridge province can be interpreted within a catastrophic Flood deposition of the Cambrian Rome through Mississippian formations along a southwest to northeast trending strip which is presently about 30 miles wide, followed by gravity slides due to the basement rock being uplifted with a crest near the Blue Ridge. Pennsylvanian and later formations are not found in this area, with the exception of very recent Quaternary deposits along the flood plains of streams and valleys. This is inconsistent with the necessity of millions of years of geologic time.

The gravity slides might be blamed on the uplift or swelling of the Precambrian basement, cresting at the Blue Ridge. Morton (1986, pp. 75-76), discussed the possible mechanisms for thrusting. He rejected a Hubert and Rubey mechanism where a layer of high pressure water partially supports the weight of the upper thrust block and allows sliding. The reason is that the water should spew out once the block cuts the surface.

Valley and Ridge Province thrust faults may have occurred while the Cambrian to Mississippian Flood deposits were still saturated. Thus the weak shales of the Chattanooga Shale (or other weak shale formations) were further weakened by saturation. Bailey (1984) points out that silt and clay are not easily set in motion, but once started (as in California mud slides), and the particles are separated from each other, the smaller particles will flow along easier and settle out with greater difficulty. Bailey states: "... movement of a thoroughly wetted clay can occur at an angle as low as 1 degree." (Bailey, 1984, p. 31).

Morton's criticism of Hubert and Rubey may be overcome by hypothesizing that all of the rocks in both the hanging wall and the foot wall were also saturated. Thus when the formation reached the ground surface, water would continue to associate with rocks in the hanging wall, the foot wall, and the fault zone. The driving forces behind gravity sliding would continue to move the hanging wall until such a time as resisting forces brought the sliding to a halt. Folding of strata would precede thrusting. In my opinion such scenarios as discussed above are more

consistent with a Flood model. The scenarios appear not to support millions of years of induration of the sediments, followed by thrusting. Gravity sliding appears more consistent with rapid, dynamic (catastrophic) activity, and not with slow evolution of both the Earth and its inhabitants.

Acknowledgements

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AN INTRODUCTION TO THE POSSIBLE ROLE OF CAVITATION IN THE EROSION OF WATER CHANNELS

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Abstract

The process of cavitation in water has been involved in the damage of many types of man-made structures. Shock waves and water jets caused by the collapse of cavitation bubbles can clean, dent, or even pulverize materials of many types, including concrete and metals. The physics of cavitation damage is reviewed. Flow speeds greater than 30 m/s appear necessary for cavitation damage, but thereafter the damage potential can increase rapidly, perhaps at rates proportional to the sixth power of velocity. Major damage can occur with flow depths of only a few meters. Damage potential decreases with flow depth because increasing pressures make it less likely that internal water pressures can be dynamically forced to become less than the vapor pressure of water. Cavitation damage is greatly lessened as the air content of the water is increased, suggesting that cavitation damage is unlikely to be found in "white water" rapids. The roughening of water channel surfaces also decreases cavitation damage by slowing the flow speeds and thereby increasing flow depths for constant flow discharge. Damage initiated by cavitation can provide opportunities to accelerate the rates for normal erosion processes as water plunges into the holes created by cavitation.

Cavitation Damage at the Glen Canyon Dam in 1983*

After a winter of near-normal snowfall in the basin of the Colorado River the snowpack was rapidly increased by spring storms in 1983. The record snow pack was then subjected to abnormally warm conditions, causing a rapid melt. The result was flooding in many portions of the Colorado River Basin. In response to the unusual flow of water into the system of dams and reservoirs, water had to be released rapidly from reservoirs to make room for the new water that was soon to arrive. In addition, the height of the Glen Canyon Dam spillway gates, near Page in northern Arizona, was increased by over two meters to create additional storage capacity. These measures were sufficient to limit the damage by the flood waters to the spillway tunnels at that dam.

Water was initially released past the Glen Canyon Dam through four bypass tubes, later through the left spillway, and sometimes through right spillway as well. The dam is shown in Figure 1 spanning a narrow canyon cut into the Navajo sandstone formation. Behind it is Lake Powell. In front of the dam is the water plume from the four bypass tubes and the larger flow through the left (when looking downstream) spillway tunnel. Flows through the left tunnel began on 2 June, at rates of up to 571 m³/s (20176 ft³/s). After about 24 hours at the high rate, rumblings were heard from the tunnel. An inspection showed that damage characteristic of a process known as cavitation was occurring in the 12.5 meter diameter spillway tunnels. Flows were reduced for about a week, but the coming flood waters necessitated a resumption of high water flows, peaking briefly during a test at 906 m³/s. Concrete and rocks torn from the tunnel walls could be seen being ejected by the high flows. In late July flows were reduced below 100 m³/s. A histogram of the total hours at the several flow rates during June and July 1983 is shown in

Figure 2. Lesser flows were released through the right tunnel during that period.

Later inspection of the tunnels revealed large caverns* excavated through the one-meter thick reinforced concrete liner and up to nine meters into the sandstone rock. Figure 3 shows a view looking downstream into the largest cavity (10 m deep, 12 m wide, 37 m long). The ladder and the workmen help provide a scale. Boulders as big as automobiles were excavated by the water from the bedrock and some of them remained in the tunnel downstream of the damage. The largest, which had to have been lifted out of the 10 m deep hole, is visible at the top of Figure 3 blocking part of the 12.5 m diameter tunnel. Others are seen in Figure 4 at the exit of the tunnel known as the "flip bucket."

The vertical profiles of the left and right spillway tunnels are shown in Figure 5. The full profile of the left spillway tunnel is shown in Figure 5a from the spillway gates at the upper left to the "flip bucket" at the right. (The flip bucket is a curving profile at the end of the spillway that launches the water into the air. The energy of the water is then dissipated when it falls into a filled plunge pool in the river.) The right tunnel has a similar profile but a shorter length in the horizontal portion. The damage in both tunnels occurred in the region of the dashed box in Figure 5a. The damage locations and extents are indicated by the dotted shading along the bottom of the profiles of the right (b) and left (c) tunnels. The extent of damage to the side walls is shown by the dashed lines. It was found that the damage was initiated by a process known as cavitation and enlarged by erosion.

Understanding the Process of Cavitation

Cavitation is the creation of gaseous phase bubbles in a liquid as a result of a decrease in pressure. The creation of the bubbles themselves is relatively harmless. If they choke the flow in confined conduits, like tubes, then the blockage is more of a nuisance. It is the *collapse* of bubbles that can cause structural dam-

*The details are from Falvey, 1990; Bureau of Reclamation, 1984; personal discussions with Bureau of Reclamation engineers and examination of internal newsletters, drawings, and exhibits.

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*Editor's Note: For readers interested in cavern formation in limestone see Williams, E. L. and R. J. Herdtklotz, 1977. Solution and deposition of limestone in a laboratory situation II. *CRSQ* 13:192-99.

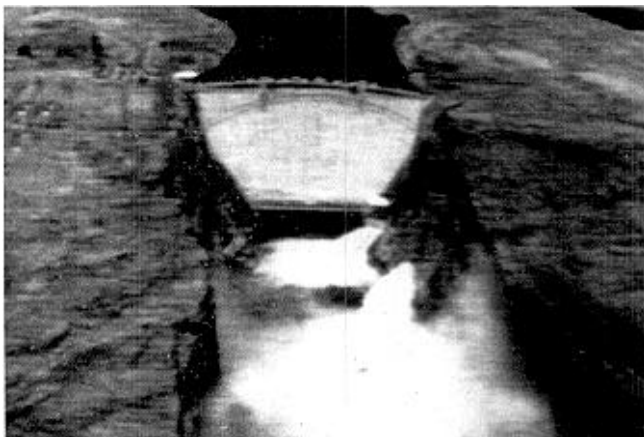


Figure 1. An aerial view of the Glen Canyon Dam of northern Arizona during operation of the by-pass tubes and the left spillway. A highway bridge spans the canyon in front of the dam. (From Bureau of Reclamation video)

age to surfaces that are in contact with the liquid. The collapse will cause powerful shockwaves and possible minute jets of water that impact 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.

Severe structural damage, comparable to that at Glen Canyon Dam, had occurred in 1941 to the Arizona spillway of Hoover Dam. As a result, the Bureau of Reclamation began studies of the cavitation process about a decade later. While cavitation damage at the Glen Canyon Dam in 1983 was the largest observed at structures designed and operated by the U.S. Bureau of Reclamation, damage occurred at other facilities during that flood season and at other times. The Bureau 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 struc-

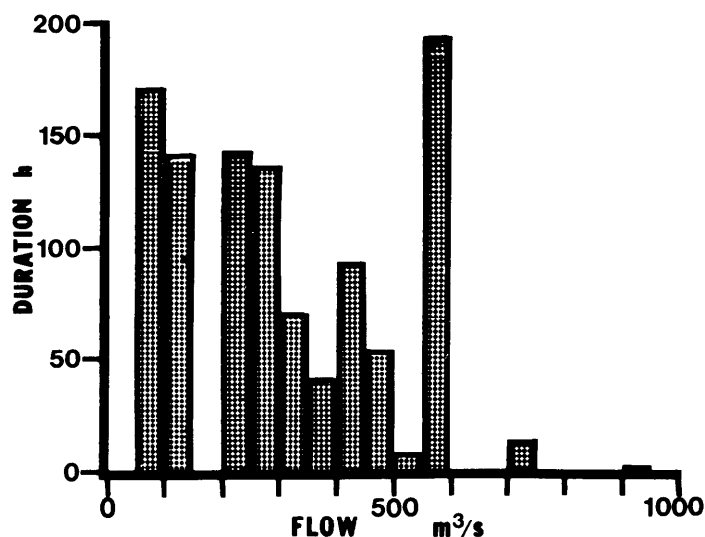


Figure 2. A histogram of the total hours at the several flow rates during June and July 1983 for the left spillway of the Glen Canyon Dam.

tures. Falvey (1990) suggests that water heads (indicating the energy available from elevation changes) in excess of about 45 m and flows in excess of 30 m/s are suspect for the potential for producing damage to structures by cavitation.

It was found possible to control the curvature of spillways in the design process so as to minimize the possibility of cavitation damage. But redesigning and modifying structures that were already constructed was potentially too expensive. It was eventually found that the injection of air bubbles into the water flow stopped the damage under normal operating conditions. The bubbles provided nuclei, or sites, on which water vapor cavitation could grow. They then caused a major reduction of the speed of sound in the water, limiting the shock wave pressure intensities generated by the bubble collapse. Finally, the total collapse of the bubbles, containing vapor surrounding a core of air, could not be possible. After the vapor had condensed back to liquid, the air core of the bubbles acted as a shock absorber or cushion to eliminate the high pressures of total collapse. It was also found that a uniform roughness lessened damage by increasing the boundary layer thickness and decreasing the flow velocity at the bumps that would ordinarily initiate cavitation.

The Bureau then summarized its experiences with cavitation by producing a monograph (Falvey, 1990). It thoroughly explores the state of knowledge of cavitation as it relates to the water conveyance structures typically built and managed by them. For a more detailed treatment of the basic concepts of cavitation, Falvey recommends Knapp, *et al.* (1970). Part of this paper is a review of the Falvey monograph?

I will digress from a strict discussion of cavitation at numerous points. The purpose is to relate the process to other phenomena which may be more familiar. Necessary equations are found in the Falvey monograph, though some of the more important are reviewed in the Appendix. 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 gave guidance on the possibilities of cavitation damage to water channel surfaces during flow conditions greatly exceeding those experienced during the 1983 floods. The results of these simulations will be presented in a subsequent article.

The Vapor Pressure of Water

While cavitation can occur in many liquids under the proper conditions, the Falvey monograph and this paper are restricted to cavitation in water. For a more comprehensive study in the change of phase between

*Along with the text, giving all relevant equations and some calibrations using actual structures, the publication includes a set of 5.25 inch floppy disks for use on an IBM compatible microcomputer. The original program code is provided 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.

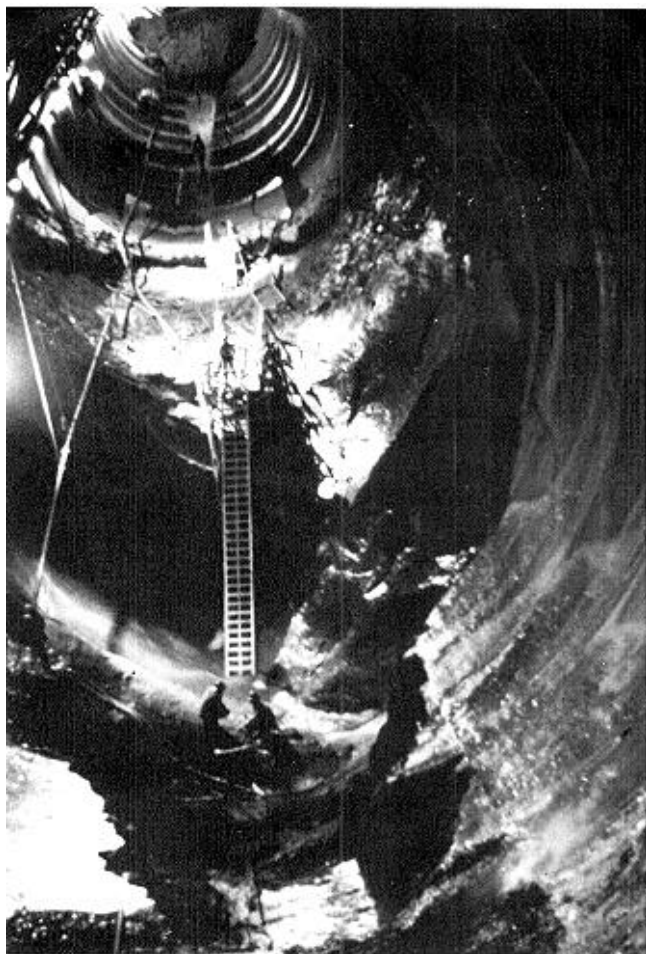


Figure 3. A view of the greatest cavitation-initiated damage in the left spillway tunnel of the Glen Canyon Dam, near Page, Arizona. The tunnel diameter is 12.5 meters; the ladder into the 10 m deep hole and the workmen provide additional scales. The largest surviving water-excavated boulder partly blocks the tunnel at the top of the view. (Photograph by Bureau of Reclamation)

liquid and vapor for water and the interaction of the phases of water with air, the reader can consult one of numerous standard textbooks in thermodynamics and physical meteorology (e.g. Byers, 1959). The concept of vapor pressure is vital to the understanding of cavitation processes. The brief descriptions below are not intended to convey a complete explanation of the process.

The saturation or equilibrium vapor pressure of water is the gaseous pressure of water vapor in equilibrium with a flat water surface at the same temperature. It is normally measured in the absence of other gases, but as described by Dalton's law, the presence of most other gases does not affect the water vapor pressure. In a mixture of gases and vapors, the total pressure is the sum of the partial pressures (or vapor pressures) of each gas. The vapor pressure of water increases with temperature, as described by Clausius-Clapeyron equation and is presented in numerous tables, such as in List (1963). That relationship is graphed in Figure 6a from -50°C through the normal melting and boiling points to the critical point at which the distinction between vapor and liquid vanishes. For interest, the vapor pressure of water above

a flat ice surface is also presented in Figure 6a, while that for the liquid surface is extended to temperatures at which water is supercooled (colder than 0°C but still liquid). The vapor pressure is presented on a linear scale between -25 and 50°C in Figure 6b to provide more easily readable values for normal environmental temperatures. Figure 6c presents the difference between the vapor pressures over supercooled water and over ice, using the short scale in the bottom center.

Water boils at the temperature at which the vapor pressure equals the total atmospheric pressure. As the atmospheric pressure is decreased, as at higher elevations, water boils at lower temperatures. The boiling temperature of water can be increased by increasing the pressure in the vessel containing the water and vapor, as in a pressure cooker. The production of work by steam engines is done by the conversion of heat to steam (vapor) pressure.

Water (liquid) can also be made to change to the vapor phase by reducing the atmospheric pressure to below its vapor pressure at a given temperature. Water (liquid) can be made to evaporate if it is in contact with air whose water vapor partial pressure is less than the vapor pressure of the water at that temperature. Hot water evaporates more rapidly into the dry air than cold water because the higher vapor pressure of hot water creates a steeper vapor gradient, and therefore diffusion rate, at the air-water interface. The evaporation of water causes a transfer of energy from the liquid water to the water vapor in order to give the vapor molecules sufficient kinetic energy to escape from the liquid. The liquid is thereby cooled by the evaporation.

These effects can be illustrated in an interesting laboratory demonstration. A dish of water is placed in a Bell jar connected to a vacuum pump. The pump is then turned on, reducing the atmospheric pressure in the jar. When the pressure is reduced to and below the vapor pressure of the water, it will "boil" vigorously. The observed process is really cavitation, involving the decrease of pressure, rather than heat induced boiling. If the jar is continuously pumped,

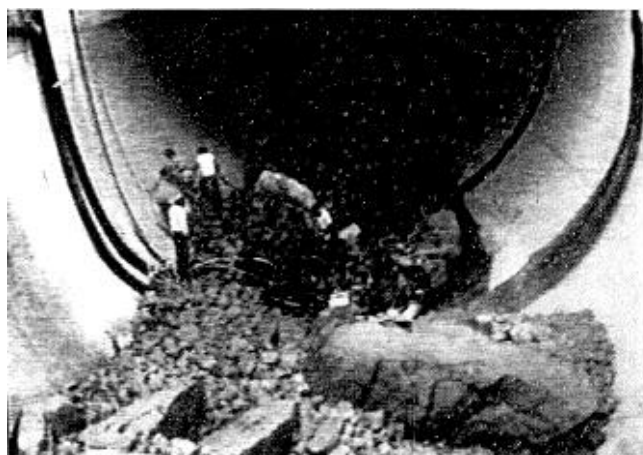


Figure 4. Other large boulders were excavated by the water and deposited at the end of the left spillway tunnel. The 12.5 meter diameter of the tunnel and the workmen provide a scale. (From Bureau of Reclamation video).

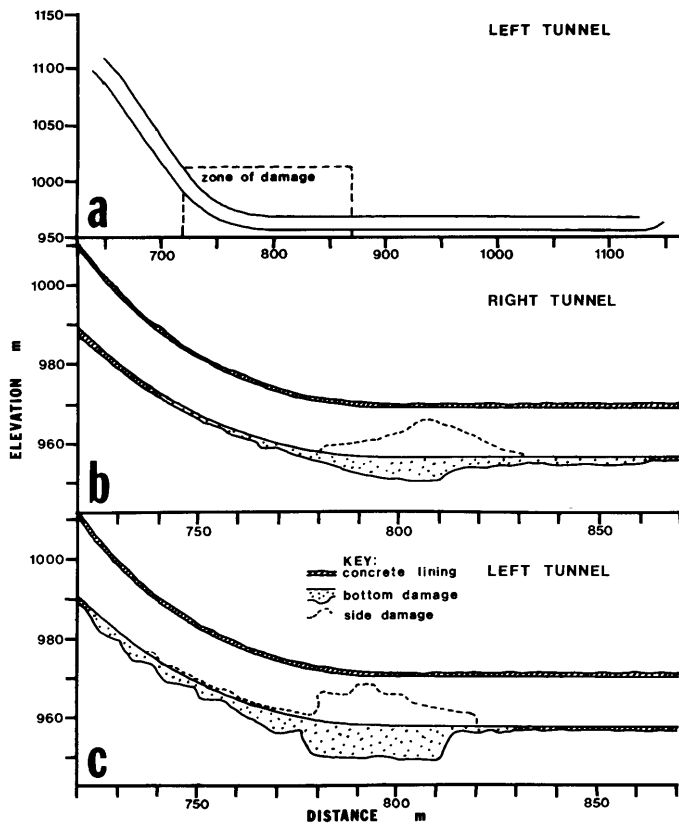


Figure 5. The vertical profile (a) of the left spillway tunnel of the Glen Canyon Dam. The damage extents and locations for the right (b) and left (c) tunnels are indicated by the dotted shading. The side wall damage extent is shown by the dashed lines.

eventually the dish of water is chilled so much by evaporative cooling that it freezes to ice.

Air is saturated with water vapor if its partial pressure of water vapor is equal to the vapor pressure of water at the temperature of the air. It is unsaturated if the partial pressure is less and supersaturated if it is greater. Water can be evaporated into unsaturated air. Evaporative cooling during the process is responsible for the operation of swamp coolers used for cooling in dry climates. It is also responsible for the cool air associated with summer showers (Holroyd, 1986) and the downbursts that have caused aircraft to crash.

The opposite of evaporation is condensation. Meteorologists can measure and describe the water vapor content of the air by the concept of "dew point" or "frost point." They are the temperatures at which water vapor will condense if unsaturated air is chilled. When a surface is provided that is colder than the dew (or frost) point of water in the air, then some of the vapor will condense out of the air until the vapor that remains adjacent to the surface has the pressure equal to the vapor pressure of water at the surface temperature. The condensation will be as ice if the surface is both colder than 0°C and the surface can nucleate the formation of ice; otherwise only supercooled water will be deposited on such a cold surface.

The difference between the two vapor pressure curves in Figure 6a, for vapor above ice and above supercooled water and graphed in Figure 6c, is responsible for the growth of most snow and therefore

for much of the precipitation that falls to earth, even in the form of rain. Vapor molecules near the surface of an ice particle are at a lower vapor pressure than the water molecules near any surrounding supercooled water droplets. This pressure difference drives the water molecules from the liquid droplets to condense from the vapor onto the ice. The molecules can go from liquid to vapor to ice; the ice particle need not touch any supercooled droplets to grow larger at the expense of the droplets. Between -10 and -15°C the vapor pressure difference between ice and supercooled liquid is greatest. This may be partly responsible for the -15° peak in the ice crystal growth rate that is coincident with dendritic growth.

The understanding of vapor pressure is also needed for investigations of a possible pre-Flood vapor canopy (Dillow, 1983). In their numerical model of a vapor canopy, Dillow and Baumgardner arrived at canopy temperatures that were colder than the condensation temperatures for the given pressure profiles. The curve in Figure 6a shows the threshold temperature-pressure relation where the partial pressure of water vapor is used instead of the total atmospheric pressure. If the canopy were pure vapor, then the curve of Figure 6a would be exactly the lower temperature limit for the total atmospheric pressure at each altitude. Therefore their hypothesized canopy could not have existed by natural processes. Even so, their postulated total water content of the canopy (think "stratosphere" for those not familiar with the canopy theory) was only twice the water content of a saturated canopy. For a first attempt, that is encouraging; it could have been off by a factor of a thousand. Refinements of their model would be encouraged.

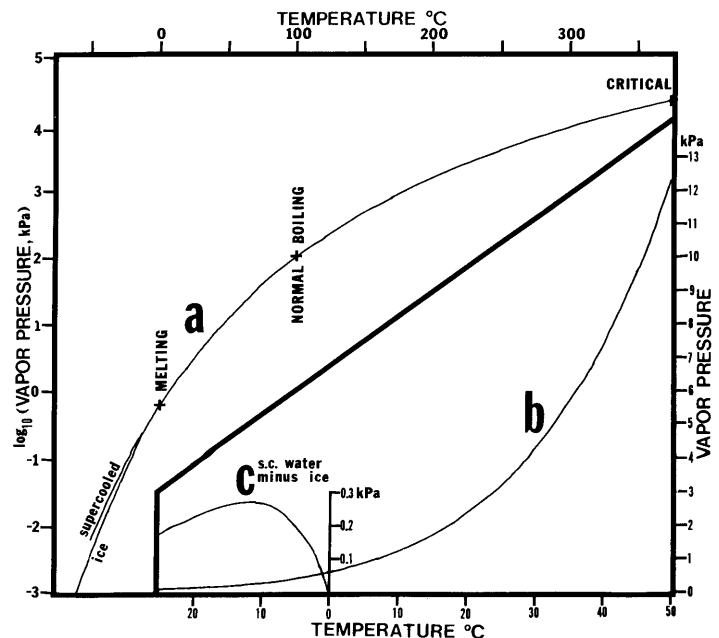


Figure 6. The equilibrium pressure of water vapor over water and ice surfaces. Curve (a) gives the entire temperature and pressure range for liquid water using the scales at the left and top. Curve (b) enlarges that portion of the range more appropriate to environmental temperatures using the scales at the right and bottom. Curve (c) shows the difference between the vapor pressures over supercooled water and over ice using the scales at the bottom and lower center.

This description of vapor pressure has been too brief to give full understanding of the concept. It has also digressed into other subjects not specifically related to cavitation. The purpose has been to show how vapor pressure is related to many other processes of interest. Creationist subjects that can involve water vapor pressure include cloud and precipitation physics for producing the pre-Flood mists, the rains of the Flood, the snows of any ice age after the Flood, and current weather phenomena; the structure of any vapor canopy whose collapse contributed to the Flood; the cavitation assist (the subject of this paper) to erosion processes during and after the Flood; the physics of superheated waters for hydrothermal deposit and dissolving of minerals; and the role of steam in the pressures of volcanism.

The Mechanism of Cavitation

As mentioned above, the difference between boiling and cavitation is that boiling involves the vaporization of water by the addition of heat to water; cavitation is the vaporization of water as a result of the decrease of pressure in the water. The pressure at any point within a fluid is the sum of static and dynamic pressures. Static pressure is generally from the weight of all of the fluid above that point, including the atmosphere. Dynamic pressure is the additional contribution, positive or negative, that results from the movement of the fluid. Positive dynamic pressure is similar to the pressure of the wind or of water flow against a stationary object. Negative dynamic pressure occurs, for example, in the air above the curved wing surface of an aircraft causing it to fly.

The cavities produced by pressure decrease need not be of pure water vapor; other gases may be present. Gaseous cavitation occurs when cold water is warmed, forcing dissolved air to come out of solution and form bubbles. Gaseous cavitation is also observable when the pressure is reduced by opening a container of a carbonated beverage and bubbles of mostly carbon dioxide are formed. Similarly, the reduction of pressure as a diver rises from deep water causes the formation of bubbles of nitrogen gas in his blood, leading to the bends. All of these are examples of cavitation.

Cavitation is the mechanism by which ultrasonic cleaners operate. The sound waves not only cause the pulsation of the boundaries of bubbles (if any) injected into the water, but may so reduce pressures at the water interface with a solid object that bubbles of pure water vapor rapidly form and collapse. The rapid fluctuation of bubble surfaces touching the object provides the forces to flush the contaminating substances away from that surface.

On several occasions this author has flown in an unpressurized aircraft to altitudes above 20,000 feet (6 km) where the atmospheric pressures were 30 to 40 kPa. (All crew members and passengers were breathing through oxygen masks.) By creating a strong sucking action inside my closed mouth I could feel the saliva bubble as cavitation was produced by the reduced pressure. The sucking created a pressure in my mouth less than the 6.3 kPa vapor pressure of water at 37°C. Apparently my mouth is not strong enough to initiate cavitation against atmospheric pressures in excess of 40 kPa at lower elevations.

The concept of sucking is perhaps helpful for understanding the initiation of cavitation in water. Ship propellers are subject to damage by cavitation. While the screw action creates increased pressures on the aft side of the propeller, where it pushes against the water, a decreased pressure occurs on the fore side of the propeller. That pressure decrease, for hard-working propellers, can be sufficient to vaporize water. The propellers then become severely pitted and lose efficiency.

Dynamic pressure decreases also occur in water valves, pumps, and gates that regulate the flow of high speed water. Figure 7 illustrates the cavitation damage done to a steel valve surface 25 cm in diameter. The irregular pitting and sharp edges are indicative of cavitation rather than ordinary erosion, which would have produced striations and smooth bumps. Concrete and rock do not have as much strength as steel to resist the damage of cavitation.

Part of Bureau of Reclamation's studies of the cavitation processes were conducted in a vacuum chamber with scale models. By greatly reducing the atmospheric pressure on the model, cavitation could be achieved with low flow velocities. Figure 8 shows the bubbles produced by an obstruction. The damage occurred downstream (right) where the bubbles fade away.

Damage from Cavitation

The bubble formation itself does not create the damage of cavitation. It is the downstream collapse of those bubbles, where pressures are restored in excess of the vapor pressure, that can subject solid surfaces to shock waves and water jet impacts. Falvey (1990) summarizes two methods that may be involved. Bubbles that collapse within the water send out shock waves. As these shock waves encounter another bubble, they subject it to a pressure increase that is likely to cause the collapse of that bubble as well. The newly collapsed bubble adds its energy to the shock wave. In this manner the bubbles collapse in phase and together create a shock wave of large amplitude. The mechanism is similar to the operation of a laser, in which the emission of light from individual atoms is triggered by the passage of the light wave front past the atom. When the shock wave produced by the

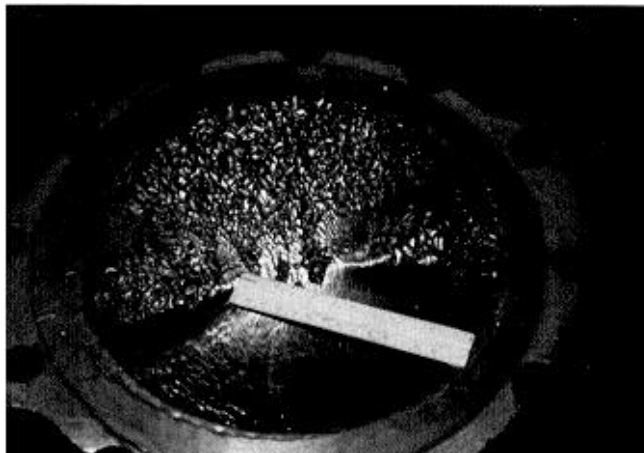


Figure 7. Cavitation pitting in the steel surface of a valve. A 15 cm (6 in) ruler provides a scale.

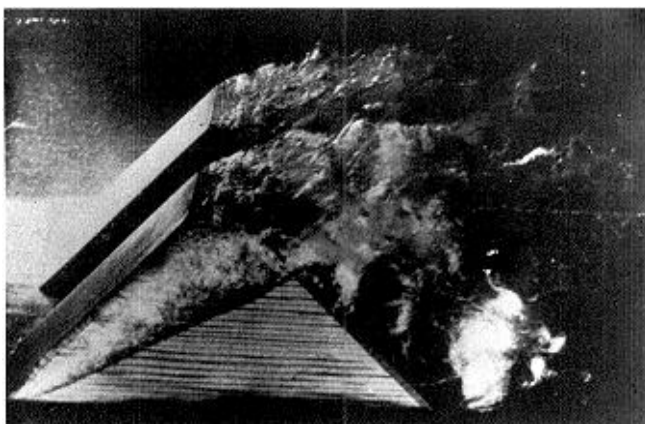


Figure 8. The turbulence and vortices downstream of an obstruction cause the production of cavitation bubbles in this scale model. The greatest surface damage occurred where the bubbles vanished. (Photograph by Bureau of Reclamation)

collapsing bubbles reaches a solid surface, even if there are no bubbles there, they strike the surface with a considerable force. The present theory suggests that the magnitude of the pressures that are generated can exceed 200 times ambient pressure.

The other mechanism for damage is for bubbles in contact with a solid surface when they collapse. The contact gives the bubbles a slight to major asymmetry. The dynamics and wave mechanics of the collapse cause a water jet to be initiated on the bubble surface opposite the solid surface. Naude and Ellis (1961) examined the process. They showed high speed motion picture frames of such a collapse, but the photographic technique can only show a dimpled bubble surface and not the jet itself. Their jets pitted aluminum with a yield strength in excess of 300 MPa, or 3000 times normal atmospheric pressure.

The bubble collapse dynamics, at slower speeds for an air bubble in sea water at the upper air-water surface has been illustrated in Woodcock *et al.* (1953) by a series of photographs, one of which is copied in Figure 9. The water surrounding the bubble parts first at the solid surface. Surface tension and wave mechanics then cause a rapid flow of water around the inner surface of the bubble to converge at the point of the bubble farthest from the solid surface. The convergence causes a mound and then a jet of water to rebound from that convergence point towards the interface surface. In this figure the jet fragments at its tip into several water droplets. In the collapse of a cavitation bubble at a solid surface, the jet strikes the solid at high speed. That speed is considered to be near sonic (>1400 m/s) speeds. The summary in Falvey (1990) suggests that additional laboratory and theoretical work is still needed for both mechanisms of proposed damage initiation.

Falvey (1990) gives some preliminary indications of the relative strengths of some materials in terms of the amount of time to achieve the same amount of damage from cavitation. Reinterpreting those approximate values to a relative scale gives concrete—1, polymer concrete—42, aluminum or copper—80, plain carbon steel—286, stainless steel—2000. In this review some values for granite, sandstone, shale, and limestone would have been desired, but the concrete

value might approximate that for limestone. There is an obvious need for laboratory calibrations for various rocks.

Indicators of Cavitation

In order to anticipate possible cavitation damage to man-made structures while still in the design phase, it is helpful to have some predictive capability based on known physical principles. Once structures are built, it is additionally helpful to have some guidelines for recognizing cavitation-initiated damage while it is still small in extent. Some of the descriptive equations given in Falvey (1990) and important to an understanding of cavitation in practical water flow conditions are given in Appendix I.

There are three numbers among the equations that are used to describe several aspects of the cavitation process: the cavitation index, the cavitation damage potential, and the damage index. It is challenging for those who do not use the terms regularly to distinguish between them. Their definition equations are repeated in Appendix I.

The cavitation index has as its numerator the difference between the ambient water pressure and the vapor pressure of water at its particular temperature. Water will vaporize into bubbles to prevent this difference from becoming negative. Therefore shallow water (small static pressure) is more likely to produce cavitation than deep water. Hot water is also easier to cavitate because of its higher vapor pressure. The denominator is the ambient kinetic energy of the water and therefore is proportional to the square of the water velocity. Low ambient water pressures and high water speeds make the cavitation index a small number, approaching zero. The smaller the index, the easier it is for some bump in the water channel to create a local eddy that results in the vaporization of

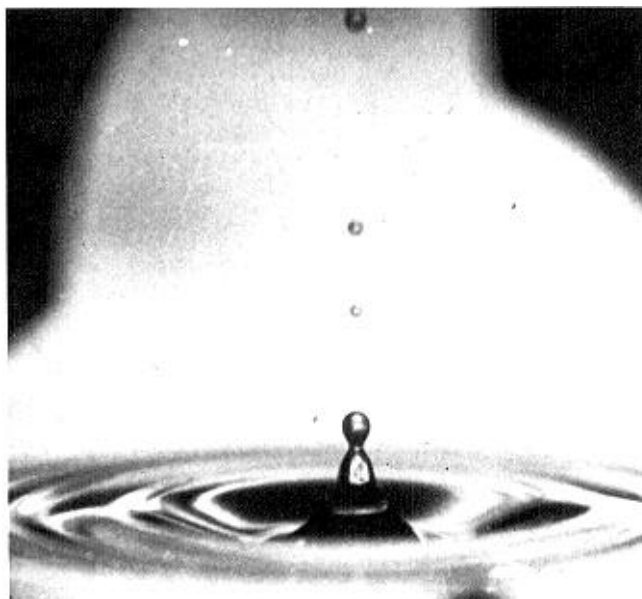


Figure 9. A water jet reduced by the asymmetric collapse of a 1.0 mm diameter air bubble at an air-sea water interface. The photo from Woodcock *et al.* (1953) was taken by C. F. Kientzler with an exposure time of 30 microseconds. The smallest droplet diameter was 0.09 mm. A similar jet may strike a surface in contact with a collapsing cavitation bubble.

water into cavitation bubbles. The cavitation index is therefore an estimate of how easy it is for cavitation to be initiated.

The second number is the damage potential. It addresses the question, given that cavitation is likely to occur at a location, of how strong the damaging forces will be. Falvey 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. Using the flow conditions for the threshold of cavitation as a reference, the damage potential number is defined, as in Appendix I, by comparing actual flow values with the reference values. The damage potential was crudely calibrated in the monograph by comparing actual damage at several dams with the theoretical damage potential numbers. Values of damage potential for "incipient," "major," and "catastrophic" damage are given as 500, 1000, and 2000, respectively. The damage at Glen Canyon Dam was considered to be "catastrophic." It is the behavior of the damage potential that will be examined in a subsequent article.

The third number includes a time factor to estimate the degree of damage. If a flow produces a high but brief damage potential, there will not be as much destruction as if the condition was sustained. Furthermore, cavitation damage appears to be somewhat self-limiting. Surface damage will produce a roughening that will slow the water and increase the boundary layer thickness, increasing the cavitation index and lessening the damage potential. Cavitation damage also makes the solid surface recede from where the bubbles were collapsing, thus reducing the shock pressures at the surface. Large excavations of the solid surface, as illustrated in Figure 3, fill with calmer water and shield the surface from the stronger flows. It is then that ordinary erosion replaces cavitation as the damage mechanism.

To express both the time factor and the self-limiting nature of cavitation, Falvey defines the damage index. It multiplies the damage potential by the logarithm of elapsed time at the particular flow condition. Some of the terms are cumulative to account for the effects of previous flow conditions. Using the same three threshold names, values of the damage index are crudely calibrated at 5000, 10,000, and 20,000 for incipient, major and catastrophic cavitation damage, respectively.

The equations for the growth and collapse of bubbles of various air contents are not presented here. As with boiling, nuclei are needed for bubble initiation. These can be microscopic air bubbles. The collapse equations indicate that the radius of the bubbles decreases rapidly, which contributes to the generation of shock waves. The pressure intensity of an example, as estimated for a distance of about two initial bubble radii from the collapse center, is about 200 times the ambient pressure of the region. The shock wave propagates at the speed of sound in water (about 1400 m/s). The addition of air bubbles into the water lowers the speed of sound in the surrounding water to at or below the speed of sound in air (about 340 m/s). This effect significantly decreases the shock pressure intensities at the solid surface.

Falvey summarizes theoretical cavitation characteristics for a variety of general flat and curved pro-

files of water channels. A variety of surface irregularities, both into the flow and away from it, and of several geometrical shapes were investigated. Concrete structures do not remain smooth, even if so constructed. There may be displacements along joints as slight settling occurs. Water seeping through cracks in the concrete can rapidly create calcite deposits similar to stalagmites during periods in which the structures are not in use. Many observations and experiments relating to such deposits are summarized by Gish (1989). Normal erosion, dissolution, and freeze-thaw damage can change the surface texture of the concrete. While bumps in a smooth surface are likely origin; for cavitation, it was found that uniform roughness could create a thicker boundary layer and decrease the damage from cavitation.

Cavitation damage can be recognized by its texture, locational symmetry, and origin. Part of the damage is caused by a pressure wave that travels at the speed of sound in water, typically 10 to 40 times the flow velocity. Other damage may be caused by minute water jets aimed directly at the solid surface. Therefore the damage appears to be formed by a source that is perpendicular to the surface. Cavitation damage in metal is pitted irregularly rather than striated (Figure 7). Damage to concrete consists of loss of the matrix, including shapes which look like crevices and worm holes, and a polishing of the aggregate. Perhaps a water hammer phenomenon also occurs in some of the holes. Erosion of concrete, however, by sand-laden water, polishes both the aggregate and the matrix. Freeze-thaw damage breaks both the aggregate and the matrix. Cavitation damage always occurs downstream from its cause and never propagates upstream. Surface irregularities that cause cavitation are left intact and can be inspected upstream of the damaged area.

A bump (it can also be an offset into or away from the water stream) creates a flow disturbance that results in a dynamic pressure decrease sufficient to create cavitation bubbles, as illustrated in Figure 10. These bubbles collapse downstream and damage the nearby surface. Prolonged damage produces another flow disturbance, more bubbles, and more damage. The surface downstream of a bump can thereby develop a chain of craters. That was the form of the damage upstream of the largest hole in the Glen Canyon Dam left spillway, as illustrated in Figure 11. This series of holes was about 3 m deep and 6 m wide. They made a series of small waterfalls at the time the scene was recorded.

Sometimes the flow geometry creates longitudinal vortices, with reduced central pressure (like tornadoes and aircraft wing-tip vortices in air, and like gurgling whirlpool drainages in water). Longitudinal motion in the form of a pair of counterrotating vortices is produced by water flowing in a circular tube that is itself smoothly bending, like where the Glen Canyon spillway tubes change from steep descent to nearly horizontal flow and also in the flip bucket at the end of the horizontal section. In cross section, water initially, descends in the center and rises at the edges. This is partly the cause of the U-shaped cross section of the water being thrown into the air by the left flip bucket in Figure 12. The same shape of vortices can be seen,

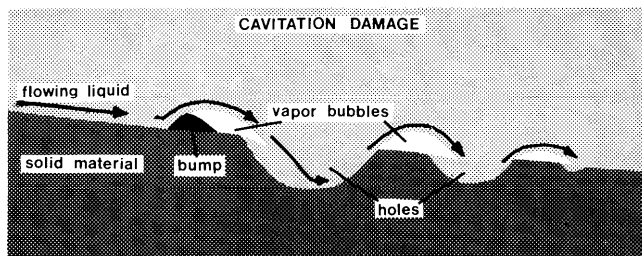


Figure 10. Cavitation damage can occur to a solid surface by the formation and collapse of vapor bubbles downstream of a bump. Large holes can cause more downstream cavitation and damage.

though vertically inverted, in a steam or smoke plume emitted by a smokestack into windy air. Cavitation damage created by such longitudinal vortices will not have exact origins, like surface bumps, to identify them.

Once a hole is started by cavitation, the flow of water begins to be diverted into the hole. High velocity water will impinge on the downstream end of the hole, creating higher pressure there compared to the ambient pressures. The high pressure water typically finds minute cracks and forces them to enlarge. The destructive process then changes from cavitation to normal erosion as large chunks of material are ripped out of the surface of the water channel. Whereas pitting from cavitation tends to be at random locations, erosion tends to be more organized and striated.

Surface roughness, however, is of considerable practical interest. Falvey mentions that very smooth concrete surfaces can be made with rugosities of 0.015 mm by pouring the concrete into special steel forms. Rugosities of 1.5 mm would represent the other extreme for rough plywood forms and misaligned construction joints. Such an increase in rugosity by a factor of 100 reduces the damage potential by a factor of 3.2 in one example. While isolated irregularities initiate cavitation, uniform irregularities reduce it. Natural channels will have large roughnesses and therefore less potential for cavitation damage.



Figure 11. The first cavitation-induced holes in the left spillway were a series in which each one triggered the formation of the next. They were about 3 meters deep and 6 meters wide. (From Bureau of Reclamation video)

Falvey presents an entire chapter on the design of aerators for the purpose of introducing air bubbles into water flows. The air bubbles reduce the sonic velocity in the mixture. It has been found that cavitation damage varies inversely with air content of the water at mole concentrations between 8 and 20×10^{-6} . At about 0.07 moles of air per mole of water, cavitation damage is completely eliminated. The Bureau of Reclamation's solution at the Glen Canyon Dam was to create an air slot part way down the spillway tunnel. It can be seen in Figure 13 as the dark ring at the top of the view. A man can be seen standing beside a small stream of water in the tunnel and beside dripping water from the ceiling of the tube. He is standing near the former location of the holes of Figure 11. After construction of the air slot the spillway was tested at water flows greatly exceeding those which caused the catastrophic damage of 1983. There were no traces of any damage after these tests. So the solution of creating an air slot was highly successful and will prevent any more damage from cavitation in the future.



Figure 12. A view downstream at the Glen Canyon Dam showing water flowing from the four by-pass tubes (foreground) and the left spillway tunnel (background). The circular cross section of the spillway tunnel and the circular vertical curvature at the water exit cause a U-shaped profile to the water, as revealed by the shading in the water plume. (From Bureau of Reclamation video)

This effect of air bubbles is of vital importance in dealing with natural water channels. Any channel irregular enough (boulders, ledges, sharp turns) to create "white water" by its turbulence is unlikely to be damaging its channel bed by cavitation. There is too much air mixed into the water. It is the high speed clear turbulent flow that is damaging.

Discussion and Conclusions

The process of cavitation is generally familiar to our experiences but rarely recognized. Engineers are more likely to recognize its presence, especially when they must design equipment to avoid damage from cavitation. The physics of cavitation involves numerous phenomena with which we can relate in our common experiences, the most important of which is the physics of water vapor. As considered in this paper, cavitation is the creation of water vapor bubbles within liquid water by the reduction of pressure



Figure 13. The air slot constructed in the left spillway tunnel of the Glen Canyon Dam is seen as the dark ring at the top of the view. By reducing the speed of sound in the water and somewhat by providing a cushion of air bubbles the new slot now prevents cavitation damage in the spillway by greatly reducing the speed of sound in the water. (From Bureau of Reclamation video)

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 monograph findings have been summarized above; the software simulations are being left for a subsequent article. Variables of particular importance during the process of cavitation are the head of water (energy available from elevation changes), water depth and speed (affecting the static and dynamic pressures), water temperature (affecting the vapor pressure), surface roughness, material strength, and especially air bubble content.

The thesis of Paiva (1988) also addressed the process of cavitation in catastrophic flows. It is mostly a theoretical work paralleling parts of the Falvey monograph. He discussed several related phenomena that appear to be worthy of further investigation. Among them is mentioned the possibility that the pressure fluctuations during bubble collapse might achieve a frequency that resonates with the natural frequency of the bedrock. If that happens, then the rock would disintegrate rapidly. But Falvey suggests that typical cavitation frequencies are greater than 10 kHz and that rock frequencies are less than a few Hz. It would be useful to establish these frequencies more precisely.

Paul M. MacKinney has been wondering if the cavitation damage in 1983 at the Glen Canyon Dam created detectable seismic vibrations. Falvey (private communication) mentions that the Army Corps of Engineers tried to detect cavitation seismically at the Hoover Dam in 1983. Their measurements located the tunnel, but the communication did not mention the magnitude of the vibrations.

Hot water cavitates more readily than cold water, so large water flows heated by volcanic activity are

candidates for destruction of the landscape by cavitation processes. One might investigate if the process of hot water cavitation could have caused the rapid breaching of the Vulcan's Throne lava flow that temporarily plugged the Grand Canyon in the geologically-recent past.

None of the present theoretical work addresses what happens if the vapor bubbles coalesce into large bubbles. It would seem reasonable that forces of collapse would operate over a greater distance (bubble radius) and release a greater energy. Perhaps it might result in greater surface damage.

The boulders shown in Figure 4 are similar in size and texture to those found in the conglomerate at the bottom of the Tapeats sandstone in the Grand Canyon. This is the first layer above the Great Unconformity, and the boulders of the conglomerate appear to have been formed from the underlying rock species. Yet the Great Unconformity is widespread flat surface. From where did the boulders come? To move them in from elsewhere would have required large, widespread flows of water approaching the conditions (the computer simulations indicated about 40 m/s speeds) that created and moved the boulders at Glen Canyon Dam. Those conditions were also conducive to the processes of cavitation.

There is much opportunity for further research into numerous phenomena related to the process of cavitation. But even with the present knowledge and actual experience it appears that the rapid destruction of rock by the process of cavitation can greatly assist the process of normal erosion in removing rock from water channels during truly catastrophic flows of water. Thousands or millions of years are not necessarily needed for the carving of some valleys and canyons if the process of cavitation becomes involved.

Acknowledgments

The author first became sensitized to the possible role of cavitation in catastrophic floods while attending the First International Conference on Creationism (Holroyd, 1987). While Austin (1986) briefly mentioned cavitation in an article about erosion at Mt. St. Helens, one of the other conference attendees, Paul M. MacKinney, was championing the process and possible effects of cavitation during the Flood in the private conversations during breaks and mealtimes and in a short presentation one afternoon. It is therefore in response to the interest of Mr. MacKinney that this present introductory study was initiated.

The contents of this article have been greatly improved through discussions with many people. The greatest help came from the engineers of the Bureau of Reclamation, who also provided draft copies of the Falvey monograph beginning in mid-1988. The comments of Paul M. MacKinney, Steve Austin, and Duncan C. Blanchard have been helpful. Dr. Blanchard provided Figure 9 and a copy of the Naude and Ellis article showing the actual collapse of cavitation bubbles at a solid surface.

Parts of this study were funded by interest from the contributions to the Creation Research Society Laboratory Fund (1306 Fairview Road, Clarks Summit, PA 18411). Image processing software for the microcomputer system was made available by MicroImages, Inc., 201 N. 8th, Suite 15, Lincoln, NE 68508-1347.

Appendix I. Equations of Cavitation

Some of the equations given in Falvey (1990) important to an understanding of cavitation in practical water flow conditions are reviewed. The monograph can be examined for the rest. Steady state water flow can be described by the Bernoulli equation in the form,

$$v_o^2/2 + P_o + Z_o g = v^2/2 + P + Z g \quad (1)$$

where ρ = density of water

v = flow velocity

P = absolute pressure

Z = elevation

g = gravitation acceleration constant,

and the subscript o refers to an upstream flow location. The equation can be rearranged to a dimensionless form that introduces the pressure coefficient or Euler number, C_p :

$$C_p = 1 - (v/v_o)^2 \\ = [(P + Z g) - (P_o + Z_o g)] / (\rho v_o^2 / 2) \quad (2)$$

When the pressure is reduced by turbulence or vortices to the vapor pressure, P_v , of the water, then the onset of cavitation is reached. This threshold is represented by the cavitation index, σ :

$$\sigma = -C_p \text{ at } p = p_v \quad (3)$$

The vaporization of water will prevent the pressure from lowering below P_v . For negligible elevation difference between the reference and sample locations, this can simplify to:

$$\sigma = (P_o - P_v) / (\rho v_o^2 / 2) \quad (4)$$

This cavitation index is mostly a function of the ambient pressure and the flow velocity. For the perturbation caused by an abrupt obstruction extended into the flow, $\sigma = 1.8$ is the threshold for the first bubbles. The computer model of the left tube of the Glen Canyon Dam gave $\sigma = 0.1$ near the points of severe damage under high flow and smooth surface conditions. Cavitation is more intense as σ decreases towards zero as either the ambient pressure is decreased or the velocity is increased.

The Falvey monograph indicates that cavitation damage is inversely proportional to the cavitation index and approximately proportional to the sixth power of the velocity. He introduced the term, D_p , damage potential, as

$$D_p \propto [1/\sigma - 1/\sigma_r] [v/v_r]^6 \quad (5)$$

where σ_r is the cavitation index and v_r is a reference velocity for the initiation of damage. He gives some approximate damage potential thresholds for incipient, major, and catastrophic damage as $D_p = 500, 1000$, and 2000, respectively.

As damage actually occurs, the surface is eroded away. Water flow is diverted somewhat into the resulting cavity. Large surface cavities may cushion the flow of water into them. But ultimately the surface recedes away from the location at which cavitation bubbles are collapsing. For steady flow the amount of further damage that can be done by cavitation lessens with time. To express this relation Falvey also introduces the term D_i , damage index, as

$$D_i = D_p \ln(t - t_o) \quad (6)$$

where t is the time and t_o is a constant of integration set to -1 for the start of operation of a structure. For later times and differing flows,

$$t_o = t_c - \exp(D_i/D_p) \quad (7)$$

where t_c is the cumulative time of operation of the structure, D_i is the damage index at the end of the previous discharge, and D_p is the damage potential for the next discharge. Therefore the damage index combines both the intensity of the flow (damage potential) and the passage of time. For the same three damage categories, incipient, major, and catastrophic, $D_i = 5000, 10000$, and 20000, respectively.

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QUOTE

Since Sartre also argues that man's goal is to become God, self-psychology often can be interpreted as a commercialized American packaging of much of European existentialism.

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INDEX TO VOLUME 26 OF THE CREATION RESEARCH SOCIETY QUARTERLY

A

- A Demonstration of the Mixing Model to Account for Rb-Sr Isochrons by Larry S. Helmick and Donald P. Baumann, 20
 A Mathematical Illustration of the Law of Symmetric Variation by Colin Brown, 18
 Anderson, Kevin L.
 Prebiotic Formation of the First Cell, 55
 Anthropology, Bone Munching and Science by Emmett L. Williams, 136

B

- Bitterroot, by Willis E. Keithley, 53
 Brown, Colin
 A Mathematical Illustration of the Law of Symmetric Variation, 18
 Notochord and the Acorn Worm, 99
 The Origin of the Snake, 55
 Brown, R. H.
 Speed of Light Statistics, 142

C

- Chaffin, Eugene F.
 Summary of the Symposium on Variable "Constants," 121
 Changing Constants and Gravitation by Don B. DeYoung, 130
 Critical Thoughts and Conjectures Concerning the Doppler Effect and the Concept of an Expanding Universe—Part II by Vincent A. Ettari, 102
 Crofut, Bill and Raymond M. Seaman
 Evolutionism: Primordial Airs, 100
 Evolutionsim: Punctuational Gradualibria?, 131

D

- DeYoung, Don B.
 Changing Constants and Gravitation, 130
 DeYoung, Don B. and David E. Rush
 Is the Sun an Age Indicator?, 49

E

- Ettari, Vincent A.
 Critical Thoughts and Conjectures Concerning the Doppler Effect and the Concept of an Expanding Universe—Part II, 102
 Evolutionism: Primordial Airs by Bill Crofut and Raymond M. Seaman, 100
 Evolutionism: Punctuational Gradualibria? by Bill Crofut and Raymond M. Seaman, 131

G

- Gish, Duane T.
 More Creationist Research (14 years) —Part II: Biological Research, 5

H

- Harris, David M.
 Noctilucent Clouds, 137
 Helmick, Larry S. and Donald P. Baumann
 A Demonstration of the Mixing Model to Account for Rb-Sr Isochrons, 20
 Honeyman, James
 Origin of Mountains, 133

- Humphreys, D. Russell
 New Evidence for Rapid Reversals of the Earth's Magnetic Field, 132

I

- Is the Sun an Age Indicator? by Don B. DeYoung and David E. Rush, 49

K

- Kaufmann, David A.
 Minutes of the 1989 Creation Research Society Board of Directors Meeting, 101
 Keithley, Willis E.
 Bitterroot, 53
 Lucifer on the Loose, 131
 Key Word Index to Volume 25 by Glen W. Wolfrom, 61
 Kofahl, Robert E.
 The Hierarchy of Conceptual Levels for Scientific Thought and Research, 12

L

- Light and Communication (Bertman), 99
 Lucifer on the Loose by Willis E. Keithley, 131

M

- Man and His "Ancestors" by Emmett L. Williams, 54
 Minutes of the 1989 Creation Research Society Board of Directors Meeting by David A. Kaufmann, 101
 Montgomery, Alan
 Statistical Analysis of C and Related Atomic Constants, 138
 More Creationist Research (14 years) —Part II: Biological Research by Duane T. Gish, 5
 Myers, Ellen
 The Impact of Modern Theories of Evolution Upon Western Intellectual Thought, 150

N

- New Evidence for Rapid Reversals of the Earth's Magnetic Field by D. Russell Humphreys, 132
 Noctilucent Clouds by David M. Harris, 137
 Notochord and the Acorn Worm by Colin Brown, 99

O

- Oard, Michael J.
 Small Comets May Mean a Young Solar System, 14
 Origin of Bedded Salt Deposits (Nutting) by Emmett L. Williams, 15
 Origin of Mountains by James Honeyman, 133

P

- Parks, William S.
 The Role of Meteorites in a Creationist Cosmology, 144
 Prebiotic Formation of the First Cell by Kevin L. Anderson, 55

R

- Rosnau, Paul O., Jeremy Auldaney, George F. Howe and William Waisgerber
 Are Human and Mammal Tracks Found Together

with the Tracks of Dinosaurs in the Kayenta of Arizona? Part I: a History of Research and Site Description, 41
 Part H: A Field Study of Quasihuman, Quasimammalian and Dinosaur Ichnofossils Near Tuba City, 77

S

Science vs. Humanity (Roche), 55
 Scientific Liberalism vs. Myth (Roche), 16
 Small Comets May Mean a Young Solar System by Michael J. Oard, 14
 Speed of Light Statistics by R. N. Brown, 142
 Statistical Analysis of C and Related Atomic Constants by Alan Montgomery, 138
 Summary of the Symposium on Variable "Constants" by Eugene F. Chaffin, 121

T

The Computer—Questions and Answers (Bertman), 113
 The Hierarchy of Conceptual Levels for Scientific Thought and Research by Robert E. Kofahl, 12
 The Impact of Modern Theories of Evolution Upon Western Intellectual Thought by Ellen Myers, 150
 The Origin of the Snake by Colin Brown, 54
 The Revolt Against God (Reilly), 54
 The Role of Meteorites in a Creationist Cosmology by William S. Parks, 144

V

Variable Constants, Minisymposium—I, II, III, 121, 122, 130
 Variables or Constants? An Introduction by Emmett L. Williams, 122

W

Williams, Emmett L.
 Anthropology, Bone Munching and Science, 136
 Man and His "Ancestors," 54
 Origin of Bedded Salt Deposits (Nutting), 15
 Variables or Constants? An Introduction, 122
 Wolfom, Glen W.
 Key Word Index to Volume 25, 61

ARTICLE AND BOOK REVIEWS

A Critique of Howard J. Van Till's The Fourth Day reviewed by Don B. DeYoung, 64
 Anti-Evolution, An Annotated Bibliography reviewed by Clifford L. Lillo, 25
 Astronomy and the Bible reviewed by Emmett L. Williams, 64
 Biology Through the Eyes of Faith reviewed by Don B. DeYoung, 110
 Creationist Research (1964-1988) reviewed by Clifford L. Lillo, 147
 Galileo, Science and the Church reviewed by Clifford L. Lillo, 63
 Land Mammals and the Great American Interchange reviewed by G. Richard Culp, 24
 Quasars, Redshifts and Controversies reviewed by Allen W. Jang, 146
 Remarkable Record of Job reviewed by Clifford L. Lillo, 109

Science and Earth History reviewed by Wilbert H. Rusch, Sr., 147
 Addendum by Emmett L. Williams, 148
 Time's Arrow, Time's Cycle reviewed by Michael J. Oard, 26
 The Case for Creation reviewed by Dudley J. Benton, 63
 The Illustrated Origins Answer Book reviewed by Dudley J. Benton, 149
 The Necessity of Creationism in Public Education reviewed by Clifford L. Lillo, 25
 The World that Perished reviewed by Don B. DeYoung, 110

LETTERS TO THE EDITOR

Australian Publications by Andrew Snelling, 33
 CRSQ Article Reprint by Emmett L. Williams, 67
 Definition of Science by Richard W. Ikenberry, 111
 "Disastrous" Situation by Neil F. Walter, 29
 Earth Magnetism by Chris Chui, 65
 Genesis and Genetics by Vernon A. Raaflaub, 152
 Genetic Variability by Raymond Bray, 67
 Granite Intrusions by Paul A. Garner, 152
 Inadequate Defense of C-Decay Hypothesis by D. Russell Humphreys, 30
 Models for Canyon Formation by Emmett L. Williams and George F. Howe, 29
 Modern Science and the Existence of God by Emmett L. Williams, 34
 More Thoughts on Relativity by Dudley J. Benton, 152
 New Geology Texts by Hansruedi Stutz, 112
 On Patten's Response to Northrup by J. Michael Fischer, 29
 Reflections on Origins by Ross S. Olson, 68
 Rejoinder to Setterfield by R. H. Brown, 32
 Relativity Thoughts by Dudley J. Benton, 34
 Reply to Bowden by D. Russell Humphreys, 33
 Reply to Garner by Robert V. Gentry, 153
 Response to Setterfield by Gerald E. Aardsma, 30
 "The Descent of Man" by Emmett L. Williams, 111
 The Gene-Theme Model and Origin of Man by Colin Brown, 65
 The Norman-Setterfield Model: An Inaccurate Description of Reality by Roy D. Holt, 68
 The Speed of Light—Corrected Roemer Values by Malcolm Bowden, 33

QUOTE

Leaving the institution of kingship aside, young sociologist Jean-Pierre Dupuy from the Ecole Polytechnique presents (in *Ordres et desordres*, Paris, 1982) a complementary thesis. Modern society's crisis should be explained by the fact that it recognizes no reference-system beyond and above itself, so that the citizen acknowledges no transcendental source of authority or ordering principle. Everybody being equal like gas molecules in a container, the constant agitation appears to be the only "law," motivating each molecule to rise to the top. This is what classical authors used to call "anarchy," the end-product of democracy's inherent logic.

Molnar, T. 1987. Crisis. *Modern Age* 31:215.

PANORAMA OF SCIENCE

Evolutionism:

A View Through Rose-Colored Blinders*

"Organs of Extreme Perfection" is the title of one chapter in Darwin's *Origin of Species*. Biblical creationists have, at least since the time of William Paley (1743-1805), acknowledged the evidence for the existence of our transcendent Creator God from the empirical facts of Design with purpose.

The eye would seem to be about as complex an organ as could be used for an example of Design. Yet, one contemporary evolutionist "visionary" seemingly has been able to write off the eye as of little consequence in the context of the creation/evolutionism debate. He inveighed against what he termed, "... a spate of more or less silly books by fundamentalist crackpots . . .," the purpose of which was to expose the inadequacies of Darwinism.

There is nothing original in the objections deployed by these books, just the old favorites ("The eye is too complicated to have evolved by blind 'chance,' " and the rest) that Darwin himself raised and demolished (Dawkins, 1985, p. 683).

Demolished is a bold term to be certain. Yet, the eye is no less complicated today than it was in 1859. Furthermore, the 'great demolisher' fully recognized this fact.

To suppose that the eye with all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I freely confess, absurd in the highest degree (Darwin, 1902, p. 170).

Demolished then, would seem to be more the product of wishful thinking than a factual accomplishment. At least one evolutionist has demonstrated a willingness to face the evidence honestly, a rare trait in the evolutionists with whom we are familiar. He has put the problem (for evolutionists) in the context of the supposed evolutionary synthesis.

Even something as complex as the eye has appeared several times; for example, in the squid,

***Editor's Note:** Readers interested in articles and notes on vision from a creationist perspective may consult the following selected bibliography from the Quarterly.

Armstrong, H. 1968. Insect eyes and teleology. *CRSQ* 4:135; 1968. Unique insect lenses. *CRSQ* 5:115-116, 119; 1969. The eye, colour and evolution. *CRSQ* 6:138, 140; 1970. Eyes and ears and physics. *CRSQ* 6:190, 195; 1970. Vision, physiology and teleology. *CRSQ* 7:124; 1971. Binocular vision in frogs. *CRSQ* 8:197, 206; 1972. Lens of sight. 9:71-72, 75; 1974. Ultra-Violet features matched for bees and flowers. *CRSQ* 11:162, 169; 1976. Optical design in creation. *CRSQ* 13:66, 70; 1978. The eyes have it once again. *CRSQ* 15:69, 72; Duffett, G. H. 1984. The adult common frog *Rana Temporaria* L: a linkological evaluation. *CRSQ* 20:209-10; Hamilton, H. S. 1985. The retina of the eye—an evolutionary road block. *CRSQ* 22:59-64; 1986. The jumping spider's wondrous eyes. *CRSQ* 23:63-64; 1987. The snakes's spectacular spectacle. *CRSQ* 23:177-78; 1987. Convergent evolution—do the octopus and human eyes qualify? *CRSQ* 24:82-85; 1987. The watchmaker surfaces again. *CRSQ* 24:144-45; 1988. The eye of the air—breathing vertebrate: did it emerge from the sea? *CRSQ* 25:117-20; Shute, E. V. 1970. Puzzling similarities. *CRSQ* 7:150-51; Smith, E. N. 1985. To see or not to see. *CRSQ* 21:198.

the vertebrates, and the arthropods. It's bad enough accounting for the origin of such things once, but the thought of producing them several times according to the modern synthetic theory makes my head swim (Salisbury, 1971, p. 338).

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Evolutionism:

Bones and Stones of Contention

A tremendous amount of time and effort has been expended in seeking and collecting fossils. This fact was most ably noted by a ranking U.S. geologist. "There are about 250,000 different species of fossil plants and animals known. These have been named and described and specimens have been deposited in museums throughout the world," (Raup, 1979, p. 22). A world renowned French biologist provided the justification for such extensive activity.

Naturalists must remember that the process of evolution is revealed only through fossil forms. A knowledge of paleontology is, therefore, a prerequisite; only paleontology can provide them with the evidence and reveal its course or mechanisms (Grasse', 1977, p. 4).

It is understandable, then, that creationists have also considered the fossil record important in the context of the creation/evolutionism debate. Yet, anthropologist Vincent Sarich (1987, p. 41) has very soundly denied the importance of this empirical evidence. "No matter what the creationists may pretend, the fossil record is not, and never has been, our major source of information about evolutionary relationships." No matter what the evolutionists may pretend, Grasse' is not, and never has been, a creationist. It would seem, then, that he must also stand guilty of the charge of 'pretender.' Nor did he stand alone. An earlier published biologist, also of world renown, wrote in much the same respect over three decades ago.

Evolution, if it has occurred, can in a rather loose sense be called a historical process; and therefore to show that it has occurred historical evidence is required . . . The only evidence available is that provided by the fossils (Thompson, 1967, p. 14).

Thompson's use of the conjunction, "if," with regard to the "occurrence" of evolution is most interesting. An evolutionist geologist of unquestioned credentials wrote from a position closer to the real problem.

. . . the paleontologist can provide knowledge that cannot be provided by biological principles alone. But he cannot provide us with evolution.

We can leave the fossil record free of a *theory of evolution*. An evolutionist, however, cannot leave the fossil record free of the *evolutionary hypothesis* (Kitts, 1974, p. 466).

Sarich's adamant position with regard to the fossil record seems quite understandable in light of the last quote. It would seem to be a simple case of evolutionist sour grapes.

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"You Are What You Eat"

This old adage takes on a literal rendering in the insect world according to a report in *Science*. Erick Greene (1989) of the Princeton University Biology Department reported a previously undescribed case of developmental polymorphism in the caterpillar of the moth *Nemoria arizonaria*, which as the name implies, occurs in the desert Southwest. The adult moth appears twice each year, the first cohort in late winter or early spring, and the second appearing in late summer. In the spring the caterpillars feed on the staminate flowers (catkins) of oak trees. The summer caterpillars, which hatch long after the catkin flowers have fallen, feed on the leaves of the oak trees.

Amazingly, while the caterpillars of the two broods appear identical when they hatch, they develop differently. The spring caterpillars (catkin morphs) develop into virtually identical mimics of the catkins on which they feed. They are yellow in color with many papillae, a rugose texture, large dorsolateral projections, and two rows of stamen-like reddish-brown dots along the dorsal midline. In contrast, the summer brood (twig morphs) are mimics of oak twigs, being greenish-grey in color, less rugose, and having smaller dorsolateral projections. The two forms also differ in morphology of the head and jaws, each being suited to feeding on the soft pollen grains of the catkins (catkin morphs), or on the tougher oak leaves (twig morphs). Furthermore, there is a behavioral difference: twig morphs placed on catkins move onto twigs or leaves, while catkin morphs, placed on leaves or twigs, move onto catkins.

Greene experimentally determined that the developmental responses are not dependent upon environmental temperature or photoperiod, but rather upon diet. In the laboratory, all caterpillars fed catkins developed into the catkin morph, while all those fed leaves developed into the twig morph. It was also demonstrated that the tannin content of the diet is associated with the morphological development. Most caterpillars fed a catkin diet supplemented with either

leaves (which are high in tannins) or tannins developed into twig morphs.

The mechanism responsible for the effect of dietary tannins on morphology is not known, although it is speculated that tannins may interact with receptors which in turn alter hormones which may influence the regulation of developmental genes. Rather than attributing this phenomenon to intelligent design, the author asks "What has led to the evolution of this striking developmental polymorphism?" His explanation deals largely with selection pressures and population genetics rather than how such a remarkable case of "dual identity" in a single species could arise by the random, purposeless processes of chance evolution.

Interestingly, until recently, the summer adults were considered to be different species (*N. aemularia*) from the spring adults. Greene cites other reports of developmental polymorphism, particularly among arthropods, which are induced by environmental conditions, and suspects that there may be more instances of diet-induced developmental polymorphism than is currently appreciated. One cannot help but wonder if any fossil forms attributed to different species may actually be cases of developmental polymorphism. Such variations in form may include, in addition to color and texture, wings or no-wings, sexual or asexual forms, and different social caste systems.

Reference

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Jonathan Edwards—Scientist

Many creationists have heard of the preaching of Jonathan Edwards, particularly his famous sermon, "Sinners in the Hands of an Angry God." But few, including this writer, are aware that Edwards had scientific ability and actually wrote some scientific treatises. The following quote is taken from *Faith and Freedom: The Christian Roots of American Liberty* by Benjamin Hart.

Jonathan Edwards was the son of Timothy Edwards, a Harvard graduate and pastor of the parish of East Windsor, Connecticut. Jonathan's mother was Esther Stoddard, the second child of Reverend Solomon Stoddard. Esther lived until she was 98, and so was able to see the spiritual earthquake her brilliant son would help bring about in the history of America. The incidents that have made Jonathan Edwards such a legend began at a very young age. He was 11 or 12 when he wrote his famous 1,000-word essay on flying spiders in which he discussed a basis for their classification and presented a theory of equilibrium explaining their ability to navigate in the air. He also hypothesized that their webs were spun from a liquid substance. At age 12, he wrote an essay on colors, in which it was clear that he had studied Newton's *Opticks*. But his primary interest from the start was God. As a child he fasted frequently and often went on long solitary walks in the forest where he prayed and meditated on the Almighty. His interest in

science was merely a means to apprehend more profound eternal truths.

In those days, science had not yet turned against Christianity. Isaac Newton (1642-1727), one of the greatest scientific minds in the history of the West, spent much of his time trying to elucidate biblical prophecy. For him, science was an inquiry into the laws of God. Faith and knowledge, he believed, illuminate each other so profoundly that their relationship cannot be overemphasized. Theological references are scattered throughout Newton's works, and he wrote many tracts that were strictly devotional. Wherever one looks there is order and beauty in the universe, and this he thought was a cogent proof of God's existence and love for man. From a very early age, this was Jonathan Edwards' view as well. For him, the study of insects, animals, and plants was a way to obtain a glimpse of God's infinite creative powers. At age 13, Edwards entered Yale College. There he continued his study of Newton, and wrote his "Notes on Natural Science." There was little doubt that Edwards could have become one of America's greatest scientists if he had chosen that path. But he chose instead to follow his family heritage, and became a minister of the Gospel (Hart, 1988, pp. 210-11).

Reference

Hart, Benjamin. 1988. *Faith and freedom: the Christian roots of American liberty*. Lewis and Stanley. P.O. Box 790609. Dallas, TX 75379-0609.

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Evolutionism: A Charge Looks Back

There is no question that Genesis 1:1 is dogmatic. "In the beginning God created heaven and earth" is a very simple, factual statement, but one that cannot be subjected to test. By Divine Fiat, that is, by simple command, at the volition of Almighty God, there now exists the physical universe where, prior to God's command, there had been nothing. That is a concept which is difficult to comprehend under the best of circumstances, but impossible to accept without faith. A statement of faith is also impossible to disprove or falsify. A leading U.S. evolutionist adamantly took Biblical creationists to task for maintaining such a posture:

"Scientific creationism" is a self-contradictory, nonsense phrase precisely because it cannot be falsified. I can envision observations and experiments that would disprove any evolutionary theory I know . . . Unbeatable systems are dogma, not science (Gould, 1981, p. 35).

Yet, Gould has leveled an accusation that also fits those who hold the tenets of evolutionism. A pair of biologists, from the Universities of Sydney and Stanford respectively, have found the same criticism with evolutionism:

Our theory of evolution has become, as [Karl R.] Popper described, one which cannot be refuted by any possible observations. Every conceivable observation can be fitted into it. It is

thus "outside of empirical science" but not necessarily false. No one can think of ways in which to test it. Ideas either without basis or based on a few laboratory experiments carried out in extremely simplified systems have attained currency far beyond their validity. They have become part of an evolutionary dogma accepted by most of us as part of our training (Birch and Ehrlich, 1967, p. 352).

The Birch-Ehrlich testimony would seem to be unambiguous. However, an evolutionist philosophy professor, apparently assuming the role of apologist, attempted to downplay the impact of the quote:

The creationists did *not* cite the very next sentence: "The cure seems to us not to be a discarding of the modern synthesis of evolutionary theory, but more skepticism about many of its tenets" (Hutcheson, 1986, p. 6).

Had "... the very next sentence" been cited, it might have provided a temporary measure of solace to a wishful thinker. However, it would have changed nothing that was written in the preceding six sentences. "Ancient" history would have been made no more testable as a result. The fact that "every conceivable observation . . ." could be placed within the evolutionist paradigm would have remained unaffected. No amount of citation, then or now, will make fact of logical fallacy. It should come as no surprise that Birch and Ehrlich would not advocate "... discarding the modern synthesis . . ." They, as is the case with many other evolutionists, have a vested interest in the modern synthesis. Yet, the supporters of this evolutionary concept may be clinging to a tenuous thread:

I have my doubts about one point in the concept [of] . . . Neodarwinism . . . The problem is the origin of variability . . . The modern theory emphasizes the importance of genetic recombination but ultimately rests upon mutations as the source of the variability acted upon by natural selection. This is where I run into problems . . . Could random changes in the nucleotide sequences of DNA (mutations) provide . . . (new) genes and ultimately the enzymes? At the moment I doubt it (Salisbury, 1971, p. 335).

Salisbury's perplexity was apparently limited to synthetic "theory." He hesitated not in the slightest to declare his acceptance of the evolutionary "story" and the "mechanism" of natural selection. Still, his doubts would have to put him at odds with a vast majority of his peers. As earlier noted, there is at least one instance in which Gould's charge of dogmatism leveled against creationist is valid. Yet, nearly four decades ago, a well known, if not well accepted, geneticist wrote with a dogmatic zealotry which rivaled that of any creationists: "Evolution of the animal and plant world is considered by all those entitled to judgment to be a fact for which no further proof is needed" (Goldschmidt, 1952, p. 84). Goldschmidt wrote boldly to say the least. He might have served himself better had he exercised a measure of restraint. A later botanist, in a refreshing display of honesty, removed one entire biological kingdom from the Goldschmidt "judgment":

Much evidence can be adduced in favor of the theory of evolution—from biology, biogeography and paleontology, but I still think that to the unprejudiced, the fossil record of plants is in favor of special creation (Corner, 1961, p. 97).

A more recently published ecologist quite effectively destroyed the illusion of proof in evolution “science”:

Neither the hypothesis of continental drift nor that of evolution was **proved** true before it won acceptance. In fact, no scientific hypothesis is ever proved true. Rather, it is tested continually with more and more data, and as the data continue to conform with the idea, and fail to disprove it, the community of scientists comes to have more and more confidence in its validity (Futuyma, 1983, p. 67).

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BOOK REVIEWS

Of Pandas and People: The Central Question of Biological Origins by Percival Davis and Dean H. Kenyon. 1989. Haughton Publishing Company. Dallas, TX. 166 pages. Hardback, \$17.95. 1989. Paperback, \$13.95

Reviewed by Trevor J. Major*

Of Pandas and People is an attempt to produce, not a complete textbook, but a work which would supplement any origins curriculum while remaining within the bounds of the U.S. Supreme Court ruling in the recent ***Edwards v. Aguillard*** case.

The book begins with an “Overview” of biogenesis, genetics and evolution, speciation, fossils, homology, and biochemistry. In fairly general terms, the authors show the failure of evolutionary theories to explain the existence and form of life by purely naturalistic means. They propose instead that intelligent causes are required to explain life, although they leave the specifics of this cause to religion and philosophy. However, the Overview is only a summary of the case. The remainder of the book comprises six “Excursion Chapters” which elaborate on the Overview topics for those with more time or interest. For instance, the “Homology” overview mentions the differences and similarities between the giant and lesser panda. The corresponding excursion chapter then provides additional information on historical background, anatomical descriptions, and other factual details.

Two facets of this book shine forth. First, the text is a comprehensive summary of anti-evolutionary arguments. As expected, it covers many of the evidences against evolution used by creationists. But it draws just as much, if not more, from the work of evolutionary skeptics and dissidents such as Michael Denton and Soren Lovtrup. Second, the book is very well-presented. While some of the original artwork is a little sketchy, photographs are reproduced with great clarity. Captions are instructive and relevant, and text is well organized with good breaks, key-word emphasis, and pronunciation guides.

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Along with these commendable features, the book has two possible short-comings. First, although intended for high school classrooms, the reading-level may be described as “mature.” The Excursion Chapters will certainly demand concentration from young teenage readers. Second, and this is a minor but frustrating point, references to footnote numbers within the body of the text are entirely absent from the book. This was a production error which, according to Henry Skrabanek of Haughton Publishing, may be corrected in a forthcoming teacher’s guide.

On one hand, teachers and parents violently opposed to non-evolutionary views will be offended by ***Pandas***, not because the book is derisive, but because it undermines their world-view by establishing a case for intelligent design. On the other hand, “strict” creationists may question the value of a book which fails to: (a) attribute design in nature to the God of the Bible; and (b), critique the evolutionary geological timeframe. Nonetheless, ***Of Pandas and People*** is an important contribution to biology education and to the creation/evolution debate. No other text is more suited to the science classrooms of both public and private schools. At the very least, parents should have a copy at home for the sake of their teenagers’ education. Finally, all those interested in the origins issue will find ***Pandas*** a valuable addition to their library.

From Eternity to Eternity, by Albert Sippert. 1989. Sippert Publishing Company, P.O. Box 1913, 330 Wheeler Avenue, N. Mankato, MN 56002. 419 pages. \$12.95.

Reviewed by Clifford L. Lillo*

The cover of this book describes it as:

A Treatise on the Origin and Destiny of All Things
From the Evolution Point of View
From the Creation Point of View
(Written in the Language of the Average Person).

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However, the reader will have difficulty in finding anything written by the author from an evolutionary point of view.

In the Preface the author says the book is written "For evolutionists who are looking in vain for answers in their search for the origin of the universe, earth and mankind" (p. 3). In Chapter III, the author states:

When one compares the evolution of man from animal apedom with the historical fact of civilization suddenly appearing all at once all over the world . . . there is just no correlation. The facts of archeology disprove the guesses and assumptions of the evolutionists (p. 39).

Another of the author's anti-evolutionary statements appears in a section titled "The Interlude":

I shall cover first, the turmoil that the evolutionists have caused by promulgating through public institutions, their unproven ideas of the origin of the universe, of the earth, and of mankind, as though they were proven facts . . . (p. 124)

In a section called, "Hoaxes and Frauds of Evolution" Sippert reveals the chicanery of Eugene Dubois regarding Java Man and then states, "This is one of many frauds concocted by evolutionists to bolster their preconceived notions of evolution" (p. 130). Because the strong beliefs of the author against evolution are so manifest in his writing, the words on the cover of the book regarding an evolutionary point of view are invalid.

Creationists will find much to like in this book but may not agree with Sippert on some points. For example, the author says, ". . . it is however very possible that the Creator who created all other materials found in the earth also created much or most of the coal found today" (p. 93). Another example relates to the ice age. Sippert quotes from *The Flood*, by Alfred Rehwinkel, against glacial theory saying,

Ice on a level surface, is a dead, immobile mass which can be piled up to a considerable height, like so much rock or so many bales of hay, without causing the slightest movement . . . The pressure of thousands of feet of ice would be so enormous and the friction of the molecules of ice so great that thousands of feet of ice would cause the bottom to melt at a rate more rapid than it could accumulate on the top (p. 101).

Since Sippert does not take issue with Rehwinkel, he leaves the impression that he agrees with him, yet many creationists believe an ice age did occur and that glaciers did once cover much of the northern hemisphere. Further, Sippert says,

Creationism should not be taught [in public schools], not only because it is a violation of the First Amendment of our Bill of Rights, but for many other reasons. Teaching creation in public schools would only harm Christianity (p. 355, 356).

Since the book is written "in the language of the average person" it may be preferred by many non-scientist Christians while scientists would prefer more highly technical material on creationism.

The Life and Death of Charles Darwin, by L. R. Croft. 1989. Elmwood Books, Lancashire, England. 138 pages. \$12.00

Reviewed by John W. Klotz*

Croft has provided a well researched and carefully documented account of the life of Charles Darwin; yet this reviewer cannot accept his final conclusion that Darwin died a Christian. After a first chapter in which the author presents the essential biographical facts about Darwin, he zeros in on the "Origin" and the development of Darwin's theory of evolution. He reaches the same conclusion that Dr. Rusch reached in an article published elsewhere (Rusch, 1989) that Darwin came to the stage of history at a time when people were anxious to throw off the authority of their God. They were optimists and wanted to be the masters of their fate and the captains of their souls.

Croft devotes one chapter to the question of priority and takes the position that Darwin was obsessed with the desire to be given full credit for developing the theory of evolution by natural selection. Croft documents his claim that serious consideration should be given to the evidence that much of the theory was first developed by Alfred Russel Wallace. He also believes that Patrick Matthew, a commercial fruit grower and plant hybridizer, outlined the essentials of the theory in a book published already in 1831, and he also suggests that Edward Blyth has some claim on being the originator of the theory because he wrote several articles on evolution and natural selection already in the 1830s. Croft's evidence is overwhelming.

Another topic that receives considerable attention is Darwin's illness. Croft explores the various explanations for his illness and reaches the conclusion that Darwin probably was a schizophrenic. This reviewer is not ready to go as far as the author does, but he agrees that his general ill health was due to tensions developing as a result of conflicts over his theory, conflicts not only with churchmen, but also with fellow scientists, his fellow countrymen and even with his wife.

In the last chapter, Croft presents the evidence for a return to Christianity by Darwin in his last months. He makes much of the account of Lady Hope who reported that when she visited with Darwin she was asked to address a meeting and speak of "Christ Jesus and His salvation." This report was first published around 1916 in the *Boston Watchman Examiner* and has been reproduced later in a number of places. That Darwin ever met Lady Hope has been categorically denied by Darwin's daughter, and Croft examines the evidence of her denial that Darwin never met Lady Hope, that he never recanted any of his scientific views, that there was no summer house at Down, where Lady Hope is supposed to have spoken, and that no servants or villagers sang hymns to Darwin. The author then examines each of these denials and reaches the conclusion that because some of them can be demonstrated to be untrue, the Lady Hope story is credible. He also claims that after Darwin's death his family went through all his papers

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and carefully removed any evidences of Darwin's returning to Christianity.*

This reviewer remains skeptical. He believes there is good reason for doubting the return of Darwin to the Christian faith and believing that the stories of his return are based on wishful thinking. He finds it hard to believe that all references to any confession of faith in Darwin's last writings would have been removed by his family, though he concedes that because it is a very emotional subject this could have been the case. Rather, he thinks that the life of Darwin is an example of how those who deny Creation soon go on to deny Christ.

Two other areas of minor disagreement are mentioned. This reviewer believes that Darwin's high

*Editor's Note: It is suggested that the reader consult *Did Charles Darwin Become a Christian?* (Creation Research Society Books).

regard for his father was a much greater factor in his life than the author believes it to be. Darwin wanted to demonstrate to his father that he could be a success in spite of his early failures. He had a high regard for his father. This also played a part in his abandonment of the Christian faith, for his father was an outspoken critic of Christian theology.

This reviewer also feels that much of the tension in Darwin's life came from the fact that his wife Emma, whom he dearly loved, could not accept his theory of evolution, but rather remained a strong creationist. Still, this book is a worthwhile library addition and this reviewer recommends it highly.

Reference

Rusch, W. H. 1989. A jealous God. *Affirm* 13:6-7.

LETTERS TO THE EDITOR

Definition of Science

"The Hierarchy of Conceptual Levels for Scientific Thought and Research" by Robert Kofahl (1989, pp. 12-14) contains some remarkable statements. Dr. Kofahl asserts immediately that we must accept a philosophically neutral definition of science. This is difficult since there are only two possibilities for choice: Creation or Evolution. All mankind must choose one or the other. To quote Kofahl, "Each person's philosophical view of the world, either consciously or unconsciously, influences every thing he thinks or does" (1989, p. 12). How then can science or the scientist be neutral? It is impossible to think "blank" as it were! Kofahl would require the creationist to leave God in the church to be neutral in the real world. It is startling to have a believing creationist tell us there is no place in the working world of science for the Creator of the laboratory and all that is in it—especially the personal created mind of the scientist.

Let us see how we are led into a position of support for our evolutionary opponents. As an example, let us take another quotation from Kofahl's article. "Scientific hypotheses may reference only elements of the empirical world and, therefore, may not reference any supernatural entity, activity or influence" (1989, p.12). If this is true, where does it leave the *Creation Research Society Quarterly*? Most scientists publishing in the *Quarterly* assume as part of their hypotheses that "God created" or, at the very least, an outside influence created and injected information into the empirical system. This rational information cannot be "chance" by definition. We find that this position regarding either DNA or photosynthesis cannot be admitted as a scientific hypothesis by Kofahl's prior neutral definition. Since God is rational and intelligent, He must be barred from all explanations such as those of DNA, the nitrogen cycle, etc. We are left with an irrational, chance-driven universe.

According to Kofahl, an hypothesis with a spiritual or intelligent aspect is not allowed. The evolutionist has won the battle without a shot because he has the only other alternative.

Reference

Kofahl, Robert E. 1989. **The hierarchy of conceptual levels for scientific thought and research.** *Creation Research Society Quarterly* 26:12-14.

Lawrence and Felicia McGhee
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Portland, OR 97233

Reply to McGhee

Lawrence McGhee in his criticism of my article misunderstands and distorts almost everything which I said. In the first place, I have never said that science is philosophically neutral. Rather, I have said that "a correct definition of science is philosophically neutral at least to the extent that it has nothing to say about what a scientist believes or disbelieves." (Kofahl, 1986, p. 112). I also made it quite clear that the scientific enterprise has profound philosophical implications, but that what these implications are is a matter of dispute among philosophers of different persuasions (Kofahl, 1986, p. 114).

In his first paragraph my critic plainly reveals his lack of understanding of how science is defined when he implies that the task of defining science must take into account the creation/evolution debate. Supposedly, then, believers in creation and evolution must have different definitions of science. This a gross error. In the task of defining science no account must be taken of any particular scientific hypothesis, theory or law. In other words, the defining of science comes in logical order before any observations are made or hypotheses are framed.

Neither did I say that a scientist's world view may not "influence" his hypotheses. The hierarchy of conceptual levels which I propose has three upper layers in which I expressly allow for as much content of the supernatural as any particular scientist wishes to incorporate therein. Surely, if his philosophical world view, his episteme, and his conceptual framework for some field of inquiry all incorporate elements of the supernatural, a scientist's hypotheses will be *influenced* by concepts or principles of the supernatural.

However, my point is that nobody's scientific hypotheses may **contain** or **reference** supernatural entities, influences or activities. Need I explain again why this is so?

No, functioning under a correct, philosophically neutral definition of science, we are not kicking the Creator out of the empirical world. Rather, we are recognizing that science is a human enterprise which functions through the use of our natural senses and material instruments which are incapable of observing, measuring, controlling, or reproducing the supernatural. Therefore, the supernatural may not be included or referenced in a scientific hypothesis, but the content of the hypothesis may certainly be influenced by supernatural considerations.

My critic seems to charge me with holding that "no supernatural entity, activity or influence is possible . . ." Will he kindly show where I have said this? I never have. I simply assert that supernatural entities, activities and influences are not subject to controlled, repeatable scientific observation and therefore may not be included in any scientific hypothesis. On the other hand, new knowledge resulting from scientific research flowing from a hypothesis framed with a conceptual framework which encompasses supernatural concepts may provide circumstantial evidence in support of the reality of those supernatural concepts.

The McGhees say that, if the correct philosophically neutral definition of science is consistently followed, then divine intelligence as the source of such phenomena as photosynthesis, the information content of DNA, etc., (1) "cannot be admitted as a scientific hypothesis" and (2) must be "barred from all explanations." The consequence, they assert, is that "[we] are left with an irrational, chance-driven universe."

Their assertion (1) quoted above is certainly correct, for the proposition that divine intelligence is the source of the machinery of photosynthesis or of the information in DNA cannot be falsified by any possible empirical test, nor can it be proved true by any empirical evidence. Therefore, that proposition cannot be part of a bonafide scientific hypothesis. We Christians, by faith, believe the proposition to be true, nevertheless. On the other hand, at the purely human level of science and apart from the true knowledge Christians have received by divine revelation in the Scriptures, it is entirely possible that secular science may one day demonstrate naturalistic processes which can bring a photosynthetic apparatus into being and incorporate the requisite bioinformation into DNA. But as long as secular science fails in the quest, belief that such features of nature are products of divine intelligence is not barred by science, and anyone can hold this belief without being in the slightest degree "unscientific." We Christians are confident that the secular failure will continue to the end of the age, but this confidence is grounded first of all in our faith in what God has told us in the Scriptures.

The McGhees' assertion (2) is not correct. Our acceptance of the philosophically neutral definition of science does not bar God from **all** explanations, but only from **scientific** explanations. We accept by faith the proposition that divine special creation is the correct explanation of the origin of basic biodesigns and of the corresponding genetic information stored

in DNA. We believe this is the correct explanation, but it is not a scientific explanation. A scientific explanation of how God brought biodesigns and stored genetic information into being is not possible, for the divine work to accomplish these things supervened all natural law. Scientific explanations can encompass only those aspects of natural phenomena which are explainable within the compass of natural law.

No, the evolutionists have not "won the battle without a shot" until they actually demonstrate empirically the reality of their naturalistic alternative. And Christians can continue with their participation in science with confidence, guided and motivated in their research questions, hypotheses and goals by truth revealed in Scripture. But to preserve this freedom, indeed, to regain it, we must struggle to reestablish the neutral definition of science.

Reference

Kofahl, Robert. 1986. **Correctly redefining distorted science: a most essential task.** *Creation Research Society Quarterly* 23:112-14.

Robert E. Kofahl
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San Diego, CA 92123.

International Conference on Creationism

The Creation Science Fellowship, Inc. is again sponsoring the INTERNATIONAL CONFERENCE ON CREATIONISM (ICC), to be held July 30-August 4, 1990 in Pittsburgh, PA. This Conference will follow the high standards set in 1986 at the first ICC, and is expected to surpass it in size and scope. With more than 60 authors and 80 papers to be presented, the 1990 ICC will again form a landmark in the history of modern creationism featuring many of the leading creationists from around the world, including:

Dr. Gerry Aardsma, Dr. Steven Austin, Rev. Paul Bartz, Dr. John Baumgardner, Dr. Richard Bliss, Dr. Robert Brown, Dr. Donald Chittick, Dr. M. E. Clark, Dr. Donald DeYoung, Mr. Apostolos Frangos (Greece), Mr. Randy Hedtke, Dr. Edmond Holroyd, Mr. Roy Holt, Dr. D. Russell Humphreys, Dr. Lane Lester, Dr. Charles Lucas, Mr. Robert Melnick, Mr. Mats Molen (Sweden), Mrs. Ellen Myers, Mr. Michael Oard, Dr. Joachim Scheven (West Germany), Dr. Harold Slusher, Dr. William Stillman, Mr. Ian Taylor (Canada), Mr. David Tyler (England), Dr. Larry Vardiman, Dr. Gregg Wilkerson, Dr. Kurt Wise, Mr. John Woodmorappe and many more.

The Conference will be divided into three tracks:

1) **Technical Symposium:** This track is geared to high level presentations of "state-of-the-art" creationism concerning the Age of the Earth. The Symposium represents some of the most recent research in creation science and all Symposium papers contain reviews, rebuttals, and author responses. The Technical Symposium spans the entire Conference running Monday through Saturday.

2) **General Creation Track:** This track is designed to provide intermediate level, as well as entry level presentations of the creation model of origins. It is intended for the individual who wishes to deepen his/her understanding of the creation model or for those who are just beginning a study of creationism. Also, included in the General Track are lectures on

the educational and legal issues of the creation/evolution controversy and are designed for the educator and/or lawyer interested in the origins debate. The General Track runs from Wednesday through Saturday.

3) *Evening Sessions*: The 1990 ICC will be complemented by an outstanding team of evening lecturers, including: Dr. Henry M. Morris, offering the keynote address, Dr. D. James Kennedy, Mr. David Maines, Dr. Duane Gish, offering the closing address.

Also, included in the Evening Sessions will be a forum devoted to the theme of the Technical Symposium, *The Age of the Earth*. This Forum will provide an exciting platform for the presentation of arguments and rebuttals from both sides of the age issue. Representing the "young-earth" position will be Dr. Steven Austin, of the Institute for Creation Research, and representing the "old-earth" position will be Dr. Gregg Wilkerson, of the Bureau of Land Management. Each of the Forum participants will present for inclusion into the Conference Proceedings a position paper for their respective points of view. Attending the 1990 ICC means that you will meet many of the top creation scientists from around the world and have a rare opportunity to take part in a history making event.

For more information write to: International Conference on Creationism, P.O. Box 17578, Pittsburgh, PA 15235, or call the conference hotline at, (412) 341-4908 or (412) 824-3930. The ICC also has a Bulletin Board Service (BBS) at (412) 243-0675.

Robert E. Walsh, Chairman
Creation Science Fellowship

Ellesmere Island: Evidence for Catastrophism?

A recent article in *National Geographic* has a paragraph relevant to the creation model of science (Mech, 1988, p. 757):

Could the frosty face of Ellesmere once have been a warm primeval swamp? At one of four fossil forests so far discovered, Dr. Jack McMillan of the Geological Survey of Canada works near a fallen down redwood. Not petrified, a little coal-like but still woody, the tree and others nearby probably date from between 40 million and 65 million years ago. Other evidence reveals that during the Eocene large lizards and constrictor snakes, tortoises, alligators, tapirs, and flying lemurs—now found only in Southeast Asia—lived in Ellesmere forests. What could explain such a radically different climate? The causes remain a mystery.

The entirety of Ellesmere Island is north of the 75th parallel. Continental drift must be rejected as inadequate to explain the enigma of Ellesmere Island. There is simply not enough time to transport the Island from a tropical zone to its present location. Surely something catastrophic occurred to preserve Ellesmere in its present state! This Canadian island warrants consideration as a possible location for creationist research in the future.

Reference

Mech, L. David. 1988. Ellesmere Island: life in the high artic. *National Geographic* 173:750-67.

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QUOTE

Duhem's discovery was simply that Galileo, whose discoveries marked him as the founder of the modern science of mechanics, had a number of predecessors who had anticipated his great discoveries, the earliest of whom worked at the University of Paris in the fourteenth century. There was, in fact, a rich vein of scientific work which had been done in the Middle Ages and which Duhem was the first to discover and reveal in a series of detailed and comprehensive studies, including multi-volume works on the scientific legacy of Leonardo da Vinci and the history of cosmological theories from ancient to modern times. No longer, then, could modern disciples of the Enlightenment and the Renaissance plausibly claim that modern science stood in opposition to all that the medieval Church had stood for, for priests such as Jean Buridan and Nicholas Oresme (later Bishop of Lisieux) had provided the scientific spadework on which the scientific "revolution" had been built.

Duhem argued forcefully that there was a "continuity" between medieval science and modern science. The discoveries of the predecessors of Galileo and of the characteristic of continuity in the development of science had more than historiographical implications; it had religious, cultural, and even political implications, implications of which Duhem was very aware. It was Duhem's vocation to have made this important discovery, the final implications of which are just now being drawn out.

Caiazza, John C. 1988. Book review of *Uneasy Genius: The Life and Work of Pierre Duhem*. *Modern Age* 32:155-56.

QUOTE

Robert Frost wittily calls scientism to task:

Sarcastic Science, she would like to know,
In her complacent ministry of fear,
How we propose to get away from here
When she has made things so we have to go
Or be wiped out. Will she be asked to show
Us how by rocket we may hope to steer
To some star off there, say, a half light-year
Through temperature of absolute zero?
Why wait for Science to supply the how
When any amateur can tell it now?
The way to get away should be the same
As fifty million years ago we came—
If any one remembers how that was.
I have a theory, but it hardly does.

Reist, Jr., John S. 1986. The existentialist challenge to Christian values: sheer freedom or shaped faith? in Burke, Thomas J. (editor). *The Christian Vision: Man and Morality*. The Hillsdale College Press. Hillsdale, ML pp. 62, 63.

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HELP US ESTABLISH THE CREATION MODEL OF SCIENCE

QUOTE

Historically, the broad intellectual foundations of the ideologies of Locke, Rousseau, and Paine have a common source in the battle between the "Ancients" and the "Moderns." All three writers are moderns. They reject and despise the authority of the past, the prudential wisdom derived from historical experience and tradition, and the continuity in laws, manners, religion, and culture of the generations of Europeans over many centuries. Rousseau's admiration of Sparta and the Roman Republic provides him with abstract models of government, but are hardly a tradition. Paine refines upon the rejection of the past and asserts as a principle the impropriety of allowing one generation to legislate for its successors. Despite their rejection of the historical past, all three writers have an evolutionary conception of society, which in Paine becomes an explicit theory of social progress. In religion all three rejected the orthodoxy of Christianity. Locke retained nominal membership in the Church of England, while tending toward deism, and Rousseau fluctuated between Calvinism and Roman Catholicism, before he became a pantheist. Paine was most vehement in his radical deism, asserting the superiority of "natural reason" and "nature" over the "prejudice" and "superstition" of institutional Christianity and scriptural revelation.

Stanlis, Peter J. 1987. Ideology and the revolutionary spirit. *Modern Age* 31:154.

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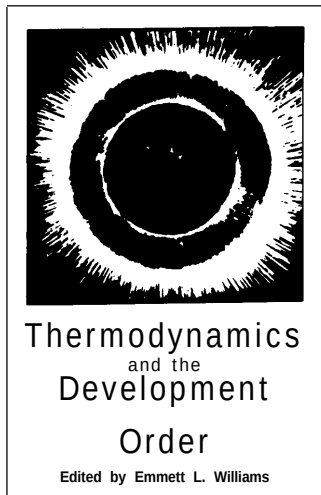
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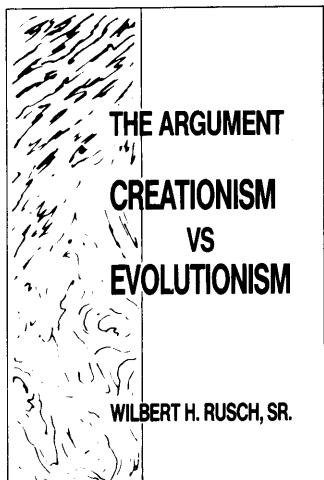
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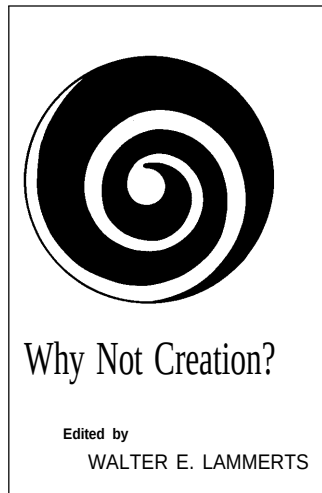


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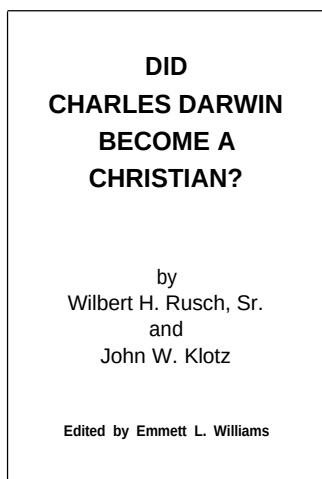


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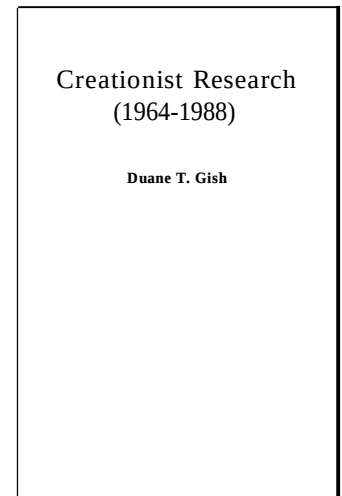
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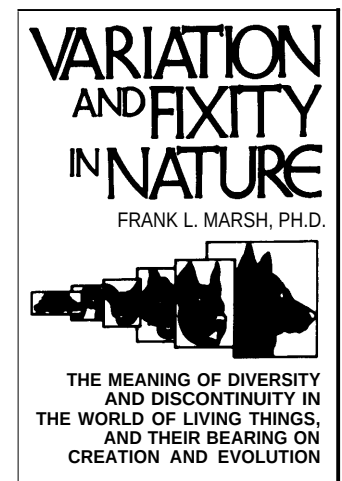
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