Editor's Comments

Many interesting letters arrive at the Editor's desk. Some plead for less technical articles; others ask for more rigorous technical material. We will continue to provide a balanced diet in each issue.

Some have asked how the peer review process works. At the editor's discretion, manuscripts are sent to qualified readers who critique the paper. Names involved are kept confidential, a standard practice in peer review. The author is then notified whether the manuscript can be published in its present form, and reviewer comments are shared. The acceptance rate for manuscripts in the first reading is about 50%. Both authors and peer reviewers are to be thanked for their efforts to maintain the quality of the *CRSQ*.

Other letters from readers ask Creation-Science questions which yet need to be addressed in journal articles. People are looking for answers in all areas, from mountain building to Mars to mutations! Keep writing letters, and keep supporting the Society. The stronger we are, the better job we can do.

This issue begins a series of study articles on the constants of nature and their possible variation. Dr. Emmett Williams is overseeing this project, along with Dr. Eugene Chaffin. Initial response from writers and readers has shown that this area desperately needs to be addressed. Dr. Williams' article begins the constants mini-symposium with an overview of the subject. Watch it develop in future issues!

Don DeYoung, Editor

MINISYMPOSIUM ON VARIABLE CONSTANTS—I

SUMMARY OF THE SYMPOSIUM ON VARIABLE "CONSTANTS"*

EUGENE F. CHAFFIN**

In order to try to answer some important questions that seem to be puzzling creationists, Don DeYoung, Emmett Williams, and I organized a symposium on variable "constants." Variable "constants" is of course a contradiction in terms, but we use this terminology since physics may be incorrect in labelling some items as "constants." Emmett Williams provided an introductory article summarizing the *Creation Research Society Quarterly (CRSQ)* literature on the subject that has appeared to date. For readers who may not be familiar with the physics and mathematics of radioactive decay he gives an introductory discussion. He then covers Gentry's work on radioactive halos, along with thoughts on variable decay constants by Morton, DeYoung, Akridge, Chaffin, and others. The Setterfield emphasis on variable speed of light has been lurking in the background since the early 1980's, and some of the ideas that foreshadowed this, in articles by Harris and others, are reviewed.

Robert Herrmann is interested in nonstandard analysis and its application to mathematical philosophy. Nonstandard analysis starts with a rigorous treatment of infinitesimals more similar to Isaac Newton's original intuitive ideas than to the "modern" definition of limits, derivatives, etc. using epsilons and deltas (Jerome Keisler 1985, *Elementary calculus: an infinitesimal approach.* Second edition. Wadsworth) The article illustrates how the logic behind the nonstandard theory of infinitesimal changes can be used to support the idea of variable "constants," as well as to probe the limits of human model building. Readers may find the Bastin-Prokhovnik model of gravity to be instructive.

Donald DeYoung discusses the relations between the constants of physics including the gravitational constant, G, and points out the experiments and observations that so far have not given much evidence for G variation. The thrust of my paper is twofold. The first part presents an example of a theory which allows not only the constants, but the form of physical law to vary. The specific theory presented leads to an explanation of the redshifts in the light from distant galaxies. The second part points out some incomplete analyses of the Oklo natural reactor data which have been used to place unnecessary limits on the variation of the Coulomb force relative to the nuclear force.

Glenn Morton gives a comparison of the variable G, variable permittivity, variable permeability (speed of light), and related theories which are currently being considered by creationists. He discusses various problems that creationist theories need to explain and how the candidates fare in these respects. John Byl discusses objections, both on scientific as well as theological grounds, to the apparently bizarre idea of variable constants. None of the objections is found to be very compelling. Various models need investigation, since the unbeliever tends to set his own terms for acceptability, believers want to find God's answers, and multiple theories leave more opportunities to arrive at the truth.

Cam de Pierre uses a pragmatic approach to the decay of the speed of light idea, postulating an exponential form for this decay and investigating the numerical consequences. John Baumgardner cites evidence such as the differing characters of ocean floor sediments and the changing patterns of magnetic reversal data to support his contention that the fundamental constants of physics must have changed to allow continental drift to occur within the young Earth time frame.

Robert Brown discusses radiohalo evidence. Through noting that radiohalo diameters produced by a given nuclide were at least approximately the same throughout the ages, he suggests the severe constraints this places on the types of models that should be acceptable. Robert Gentry, who is the most accomplished experimental expert in the study of radiohalos, and

*Editor's Note: This series begins in this issue of *CRSQ* and continues in future Quarterlies.

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the world authority in this area, offers his own view of whether the experimental evidence, and in particular the Geiger-Nuttal law, speaks in favor of variable decay rates. His article is a response to Brown's article in many respects, which I requested in order to clarify the issues involved. Alan Montgomery discusses the recent redshift and mass treatment in Barry Setterfield's privately distributed, unpublished "Atomic constants, light and time" manuscript of 90 pages. He finds contradictions in Setterfield's approach that may be difficult to handle.

MINISYMPOSIUM ON VARIABLE CONSTANTS—II

VARIABLES OR CONSTANTS? AN INTRODUCTION

EMMETT L. WILLIAMS*

Received 9 September 1989; Revised 28 September 1989

Abstract

The creationist literature, particularly from CRSQ, *is reviewed concerning proposals that the radioactive decay constant, permittivity of free space, or the speed of light changed with time. Questions involving extrapolation, predictability, symmetry and conservation are explored.*

Introduction

As one reads the *Creation Research Society Quarterly (CRSQ)* over the last 25 years occasional themes arise to the effect that certain quantities which are deemed to be constants in modern scientific theory actually could have varied since creation. Therefore at a recent CRS Board of Directors meeting, I discussed with Don DeYoung and Gene Chaffin the possibility of having a minisymposium in the Quarterly presenting the various views on whether radioactive decay constants, the speed of light and the permittivity of free space have changed with time.

Many scientists were invited to participate and several responded affirmatively. It is hoped that their contributions will be of interest and that the implications of "variable constants" will be explored. After reading over the various papers, if you have any thoughts to contribute, I urge you to write a letter to the editor on this topic.

It is my purpose to review some literature on the subject, mainly from *CRSQ*, and offer a few comments as an introduction to the minisymposium.

Radioactive Decay Law

It is assumed that the decay of a particular radioactive nucleus is a matter of chance since such factors as pressure, temperature and chemical surroundings are not supposed to affect the rate of transformation (Goble and Baker, 1971, p. 319). Also the probability of decay is assumed to be the same for all nuclei of the same species. For instance, the probability of decay of all U^{235} nuclei is the same regardless of external environment. Allow this probability of decay to be p. With the above assumptions, the only factor that affects the decay of a particular nucleus is time (t). If the length of time that a nucleus is "observed" is Δt, then

$$p \propto \Delta t \text{ or}$$
$$p = \lambda \Delta t \quad (1)$$

where λ is called the disintegration constant which is assumed to be characteristic of the decaying nuclei.

Conversely the probability (p_l) of the "observed" nucleus not decaying in the time interval Δt is

$$p_l = 1 - \lambda \Delta t. \quad (2)$$

Thus, the probability of (p_n) of the nucleus not decaying in the time interval $n\Delta t$ is

$$p_n = (1 - \lambda \Delta t)^n. \quad (3)$$

The total "observation" time (t) for n intervals is

$$t = n\Delta t \quad (4)$$

and equation 3 becomes

$$p_n = \left(1 - \lambda \frac{t}{n}\right)^n.$$

Let $\Delta t \to 0$ and $n \to \infty$; thus

$$p_t = \lim_{n \to \infty} (1 - \lambda t/n)^n$$

or

$$p_t = e^{-\lambda t} \quad (5)$$

becomes the probability of a nucleus surviving for a time t without decay. Multiply p_t by the number of original nuclei (N_0) and

$$N = N_o e^{-\lambda t} \quad (6)$$

where N is the number of undecayed nuclei at any time t. Equation 6 is referred to as the law of radioactive decay (Goble and Baker, 1971, p. 320).

Employing a different approach, the change in the number of nuclei because of decay can be written as follows

$$dN = -\lambda N dt \quad (7)$$

where N is the number of nuclei at any moment and dN is the number transforming in a time interval dt. The negative sign indicates that the number of nuclei remaining is decreasing. Equation 7 can be rewritten as

$$dN/dt = -\lambda N \quad (8)$$

where dN/dt is referred to as the activity of a decaying sample.

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The half-life, $T_{1/2}$ (the time for one-half of the nuclei to decay) of a radioactive species can be derived as follows. Using equation 6, allow $N = N_0/2$ and $t = T_{1/2}$

then $N_o/2 = N_o e^{-\lambda T_{1/2}}$

and $\ln 1/2 = -\lambda T_{1/2}$ or

$$T_{1/2} = 0.693/\lambda. \quad (9)$$

The half-life is considered one of the chief characteristics of any type of radioactive nucleus (Goble and Baker, 1971, p. 321).

Commentary by Creationists

Gentry (1968, pp. 83-85)* in an early *CRSQ* suggested that the radioactive decay constant λ may have varied over geological time. He carefully outined the possibility that so-called fractures or blasting halos might be the result of a period where radioactive decay was greater than is observed today. In other words he asked, was there a time when $\lambda\Delta t$ did not represent the probability of a single radioactive nucleus decaying within the interval Δt? Gentry (1968, p. 85) states:

> The isotropization of the host minerals would have occurred very rapidly due to an anomalous decay rate, and hence fracturing of the outer mineral would be expected.

DeYoung (1976, pp. 38-41) in a study sponsored by the Research Committee of the Society examined the possibility of variable nuclear half-lives. He noted that a variety of experimentors succeeded in changing nuclear decay rates several percent by various techniques (DeYoung, 1976, p. 39). The various effects are summarized as follows:

Chemical Effects

Bonding and valence effects
Stress in molecular layers

Physical Effects

Applied electric and magnetic fields
Applied pressure
Magnetic and electric ordering transitions
Superconducting transition
Temperature extremes

DeYoung (1976, pp. 39, 40) claimed that radioactivity should be influenced by incident cosmic radiation. He suggested that the wide differences in ages shown by lunar samples (which were supposed to be the same "age" as the Earth) could have been caused by cosmic ray or solar wind particles not opposed by a strong magnetic field as is present on the Earth. This excellent article contains many instances of possible variable radioactive decay rates and should be studied carefully and updated by a young-earth creationist. DeYoung (1976, p. 39), as if to caution creationists not to swing wildly to a view of a continual drifting of the magnitude of physical constants, notes that the Creator has established a stable physical universe (Psalm 89:2). Thus the ambivalence of a thoughtful creationist on the subject of this minisymposium can be seen in this treatise.

*This issue of *CRSQ* [5(2)] has several excellent articles on radioactive dating and the young Earth: Brown, 1968, pp. 65-68, 87; Cook, 1968, pp. 69-77; Whitelaw, 1968, pp. 78-83.

In discussing Gentry's work on radiohalos, Talbott (1977, p. 103) claims the reader's attention with one of three startling statements: "Current physical laws may not have governed the past." He (p. 104) continues:

> Whereas radiohalos have been thought to afford the strongest evidence for unchanging radioactive decay rates throughout geological time (and these rates enable scientists to determine rock ages), in actuality the overall evidence from halos requires us to question the entire radioactive dating procedure: something appears to have disrupted the radioactive clocks in the past.

Talbott (1977, p. 106) predicted that a storm would fall on Gentry because of his creationist interpretation of radiohalos. See Gentry (1986) for a verification of this prophecy.

Chaffin, in a series of two articles (1982, pp. 32-35; 1985, pp. 10-16) on the Oklo natural uranium reactor, attempted to interpret the known data within a young Earth framework. He carefully explained his postulates and assumptions, honestly offering alternates to his interpretations. Chaffin, in his first article (1982, p. 33), mentioned that decay constants may have been variable (based on Gentry's pleochroic halo work). In the later study (1985, p. 15), he suggested that the decay constant λ of various radioisotopes rose to a large value at sometime in the past, possibly at the Flood, then decreased exponentially to its current "stable" value. Chaffin claimed that if this increase in λ did occur, it would cause increased production of nuclei of mass numbers above 140 (particularly increased production of neodymium isotopes) which would offer another young Earth possibility for the Oklo data. This interpretation involves a variation of k_0 in Coulomb's law,

$$F = \frac{k_o q_1 q_2}{r^2} \quad (10)$$

where F is the electrical force (attraction or repulsion) between two charges, q_1 and q_2 separated by a distance r. The constant, k_0 is referred to as the electrostatic constant. For an interesting discussion of Coulomb's law, see Lobkowicz and Melissinos (1975, pp. 142-48).

In an article review, Chaffin (1986, pp. 118-20) discussed some of Hermann Weyl's work. (Chaffin referred to him as the ultimate relativist.) In a section headed "Time Variation of Constants" (1986, p. 118), Chaffin started with Newton's second law for a central force, modifying the equation so that it is scale covariant to allow for Weyl's postulate of "relativity of magnitude." A term, β, is introduced such that constants can vary with time (a scale transformation). "In the context of such a theory, β would be a slowly varying function of time" (Chaffin, 1986, p. 119). He offered a similar suggestion in his 1985 Oklo reactor paper; a transient episodal variation in β could have occurred at the time of the Flood.

Morton, *et al.* (1983, pp. 63-65) warned that any proposed model involving radical changes in radioactive decay rates would be faced with the possible release of sufficient quantities of heat to vaporize the Earth.* This letter to the editor demonstrates that creationists are concerned over both sides of an issue and realize the necessity of constructing models that maintain a stable environment for man as promised by the Creator. However, keep in mind that God has caused changes in the natural world as a result of man's sin and violence-prone tendencies, i.e. at the Fall and the Flood.

Radioactive Decay—Perspectives

The so-called radioactive decay law is actually a rate equation and belongs in the realm of kinetics. For instance see Walas (1959, pp. 44-46) for chemical reaction rate equations of the same form as equation 8. Thus the decay constant λ is based on an observed rate of change in a particular situation. Often in the science of kinetics a wide gulf exists between theoretical calculations and the actual rate of change. Many circumstances can cause variations in the rate of reaction and the same may be true of radioactive decay.

Therefore creationists who suggest that the kinetics of today may not have been the same as that of a past era are not tampering with natural law in the sense of the uniformity of nature. A physical law may govern two different situations (one occurring at time t_1 and the other at t_2 where $t_2 > t_1$) but the rate at which its ultimate effects are observed can vary. No principle of nature is being altered, only the rate of the change involved. However caution must be observed so as not to violate good science and good sense.

Creationists assume that during the Flood and its aftereffects, the rates of sedimentation, erosion, etc. were accelerated. Likewise the rapid hardening of sedimentary layers envisioned during and after the Flood seem to have no modern analogy. Did this acceleration (increase in the rates of formation and/or rates of destruction) of certain natural processes (in an unnatural event) spill over into the rates of radioactive decay?

Considering the standard model for the formation of the universe, Weinberg, (1977, pp. 102-05) in a very readable popularization, claimed that nucleosynthesis began at 900 million degrees Kelvin (13% neutrons, 87% protons) and was complete in the interval from three to 35 minutes after the big bang, leaving helium and hydrogen! Later in the evolution of the universe, heavier elements would be formed in stars. See Wilt (1983, pp. 60-72) for a discussion of nucleosynthesis. The point is that the standard model has many amazing features that cannot be duplicated by present-day science. Thus in considering Gentry's proposal (1986) that the time between nucleosynthesis and crystallization of certain Precambrian rocks was quite short,* is some creationist speculation in order?

During creation, could not nucleosynthesis through the heavier elements followed by some radioactive decay** sequences have occurred within a brief period of time with fantastic energy release and removal during the formation of the Earth? Absolutely wild speculation, I confess. Nucleosynthesis in this framework is viewed as a process*** coupled with high available energy content overseen by intelligent design and purposiveness. The standard model speculation as well as the Biblical account of creation belong in the area of miracles. One is a naturalistic miracle, the other a supernatural one.

Some creationists may object to the speculation that some radioactive isotopes could have decayed during the creation week. They consider that when God overlooked His finished creation, He pronounced it "very good" (Genesis 1:31) this would preclude radioactive decay. Peterson (1982, p. 226) feels that radioactivity developed at the Fall and that the decay rates were higher then than at the present.

Permittivity of Free Space (ϵ_0)

It has been proposed that the permittivity of free space (ε_0) was changed miraculously by God during or after the Flood (Morton, 1982, pp. 227-32; 1983, pp. 219-24; 1987, pp. 53-58). The proponent of this view believes that an expanding Earth after the Flood would account for many features of the present-day Earth. The mechanism proposed to accomplish this expansion is by an increase in ε_0, the size of all atoms would increase, but different minerals would expand at different rates to cause the changes envisioned! Weaknesses in the expanding Earth hypothesis were explored in a question and answer exchange in the orogeny minisymposium (Waisgerber *et al.*, 1987, pp. 58-61).

Considering the relationship between the speed of light (c), permittivity of free space (ε_0) and the permeability of free space (μ_0):

$$c^2 = \frac{1}{\epsilon_0 \mu_0}. \tag{11}$$

If ε_0 were 1676 times smaller than its present value (Morton, 1983, p. 222) and μ_0 remained constant, then:

$$c^2 = \frac{1}{\mu_0 \frac{\epsilon_0}{1676}}.$$

Since $\mu_0 = 4\pi \times 10^{-7} \frac{\text{N-sec}^2}{\text{coul}^2}$ and $\varepsilon_0 = 8.85 \times 10^{-12} \frac{\text{coul}^2}{\text{Nm}^2}$ presently then

$$c = 122.7 \times 10^8 \text{ m/sec before the Flood.}$$

Then the speed of light before the Flood would have been approximately 41 times greater than it is today. Morton (1982, pp. 229-30) also relates his changing permittivity argument to radioactive decay constants claiming that a lower ε_0 would imply greater decay constants in the past.

The ε_0 constant appears in many of Maxwell's equations dealing with electromagnetic fields. When one is faced with either a changing ε_0, μ_0 (Morton, 1982, p. 23l)* or c then it is necessary to deal with differences in electromagnetic field intensities as well as energies

*Humphreys (1989c) suggests that since heat conduction is a slow process, most of the heat released by radioactive decay would still be present inside the Earth. Very rapid radioactive decay followed by only a few thousand years of heat release would not appreciably change the temperature distribution in the Earth Anderson (1981).

**Neilson (1977, p. 181) suggested that some radioactive decay could have occurred during creation week.

*For a recent exchange concerning aspects of this model, see Gentry (1989) and Wise (1989).

***I believe that creation occurred in six literal days by direct acts of God. The term process can be employed for anything physically occurring during a day of creation in an attempt to formulate a "scientific" model. The procedure is hazardous, fraught with extreme difficulty and prone to human error and ignorance.

*Morton implied that μ_0 could vary but he did not pursue the issue.

and effects of such fields when extrapolating into the past and comparing the past with the present. Examples of equations involving the constants ε_0 and μ_0 are as follows:

$$\mathbf{D} = \epsilon_0 \mathbf{E} \text{ in free space} \tag{12}$$

where **D** is the electric displacement vector and **E** is the electric intensity of the electrical field. Where matter is present ε is used in place of ε_0 such that:

$$\epsilon = k_e \epsilon_o \tag{13}$$

with k_e being the dielectric coefficient of the material. Thus:

$$\mathbf{D} = \epsilon \mathbf{E} \text{ in a linear medium.}$$

Likewise

$$\mathbf{B} = \mu_0 \mathbf{H} \text{ in free space} \tag{14}$$

where **B** is the magnetic induction and **H** is the intensity of the magnetic field. Where matter is present μ is used in place of μ_0 such that:

$$\mu = k_\mu \mu_o \tag{15}$$

with k_μ being the relative permeability. Thus,

$$\mathbf{B} = \mu \mathbf{H} \text{ in a linear medium.}$$

Interested readers wishing to delve into this topic could profit by employing a very readable textbook on the subject (Barnes, 1977) which includes some of the author's work on the decay of the Earth's magnetic field as well as his approaches to the unification of physics.

Other creationists have developed models that utilize electromagnetic equations involving ϵ_o, μ_o and c. Barnes'[a] and Humphreys'[b] concepts of the Earth's decaying magnetic field and Barnes'[c] and Lucas'[d] efforts to obtain equations for the unification of physics are examples.

Assume that ε_0, μ_0 and c do vary with time and suppose a person wishes to extrapolate back in time to determine magnetic or electric field strengths, etc., what magnitude of ε_0, μ_0, or c should he use? How can he be sure he is using a correct value? Will the predictions obtained from such a procedure be worth the effort?

Speed of Light

When one speaks on the topic of creationism and the subject of a young universe is introduced, when the session is opened for questions from the audience, someone often will pose the following problem. "If the universe is young, how is it that we can see stars that are millions of light years away from us?" Of course the assumption is the light was generated when the star formed and had to travel vast distances to be seen millions of years later on the Earth. Generally creationist replies-for the past 25 years can be categorized into dissertations on the speed of light or a possible smaller sized universe (Moon and Spencer, 1953; Akridge, 1984, pp. 18-22; Byle, 1988, pp. 138-40). I will discuss the speed of light reasoning only.

One solution is that when God created the light-bearing objects (stars—Genesis 1:14), He created the light reaching all points in the physical universe. Akridge (1979) in a very interesting paper, developed a theoretical framework for such a possibility. He proposed that when electrical charges were created, it was accomplished by having mature or fully-developed electromagnetic fields associated with the charges. He claimed that the demands of conservation of energy were fulfilled as well as having light visible in all points of the universe as soon as it was created.

> Order in the universe would not be threatened if the mature electromagnetic fields were created at the same time their charge sources were created. With the complete field present at the instant of creation, there are no expanding Coulomb regions causing discontinuities in the motion of other charges. Rather the field from each charge extends outward to all other charges at creation and therefore acts on them in a continuous manner after the creation event.
>
> The paradox of light from the distant stars is no longer a paradox. Light is an electromagnetic disturbance. Creation of the charges in the star would be accompanied by the creation of the mature electromagnetic field of the charges in the star. Unlike the evolutionary field, this mature electromagnetic field would extend throughout the entire universe at the instant of creation. Thus, the light from the distant stars would be created enroute from those stars at the instant of creation. Therefore, when one observes the light from a star one billion light-years away, he does not observe the light that actually left the star one billion years ago. Rather, he observes the light that was created enroute only a few thousand years ago. As strange as this concept may seem, it is required for an orderly universe in which energy is conserved. (Akridge, 1979, pp. 70-71).

Another solution is that the speed of light was infinite when the stars were created and decreased immediately or some time later to its present value. Harris (1978) proposed that the velocity of light was infinite at creation and it became constant, c, at the Fall. He speculated that at the Fall a boundary layer or bubble expanded away from the Earth into space at a velocity v where $v < c$. Outside the boundary $c = \infty$ and inside c was constant.

It may be instructive to graphically represent some of the possibilities of a decreasing speed of light without considering the expanding bubble concept. The Akridge model is visualized in Figure 1. Immediately at the creation of the stars ($t = 1$), light with a velocity c is seen throughout the universe. It could be argued that actually the speed of light was infinite at $t = 1$,

[a](Barnes, 1971, pp. 24-29; 1972, pp. 47-50; 1973, pp. 222-30; 1975, pp. 11-13; 1983a; 1984a, pp. 109-13; 1986a, pp. 30-33; 1989, pp. 170-71).
[b](Humphreys, 1983, pp. 89-91; 1984, pp. 140-49; 1986, p. 115; 1988a, pp. 130-37).
[c](Barnes, 1980, pp. 42-47; 1983b, pp. 208-12; 1983c; 1984b, pp. 56-62; 1985, pp. 186-89; 1986b; Barnes and Upham, 1976, pp. 194-97; Barnes, Pemper and Armstrong, 1977, pp. 38-46; Barnes and Ramirez, 1982, pp. 198-200, 235; Barnes, Slusher and Akridge. 1982, pp. 113-16; Pemper and Barnes, 1978, pp. 210-20).
[d](Lucas, 1987, pp. 127-32).

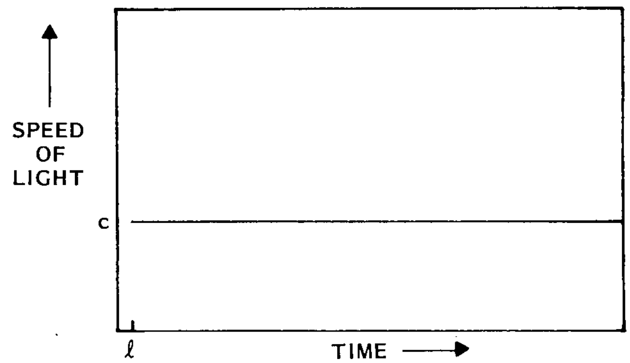

Figure 1. Akridge (1979) model for the speed of light. At t = 1, light is created and is seen everywhere in the universe with a speed, c. Drawing by Joe Whitaker.

immediately dropping to c as noted in Figure 2. Other possible models could be suggested to the effect that the decrease in the speed of light was not instantaneous but an exponential decay from some higher speed to its present value (Figure 3). Since the creation model of science contains two known supernatural acts that affected the physical world; the Fall and the Flood, some creationists may prefer to postulate changes in the speed of light developing at these two events (Figure 4). Different models could be suggested other than the ones I have offered, however I have listed these three to illustrate the point.

Many creationists believe that the speed of light has decreased from some higher value. However the so-called proof that such a decrease has occurred is open to argument (Aardsma, 1988, pp. 36-40; 1989a, pp. 208-209; 1989b, p. 30; Akridge, 1983, pp. 65-66; Bowden, 1989a, pp. 207-208; 1989b, pp. 32-33; Brown, 1988, pp. 91-95; 1989, p. 32; Holt, 1988, pp. 84-88; 1989, p. 68; Humphreys, 1988b, pp. 84-88; 1989a, pp. 30-32; 1989b, p. 33; Morton, *et al.*, 1983, pp. 63-65; Setterfield, 1983, pp. 66-68; 1984, pp. 210-11; 1989, pp. 190-97; Steidl, 1982, pp. 128-31). The concept of a decreasing speed of light is very attractive to creationists as is the hypothesis of decreasing radioactive decay rates, for they offer possibilities for young Earth interpretations.

Assume that the speed of light has decreased. What value does a scientist use if he wishes to extrapolate to a past date and make some calculations? Considering equation 11, if one desires to extrapolate some electromagnetic field calculations into the past, he is faced

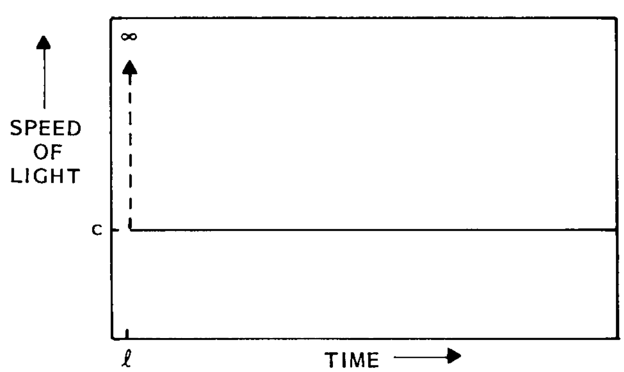

Figure 2. Speed of light is infinite at t = 1, instantaneously decreasing to c. Drawing by Joe Whitaker.

with a dilemma. If c has changed, it affects the magnitude of ε_0 and/or μ_0. Which is the correct value at a given past date?

Consequences of Variable "Constants"

It is necessary to discuss the startling consequences resulting from the assumption that a constant such as c or ε_0 can vary with time. Morton has not pursued very deeply his hypothesis of changing ε_0. However Setterfield has delved into his model to outline the adjustments that must be made by science to accommodate a changing c, thus I will use his work as an example.

Akridge (1983, pp. 65-66) pointed out that a changing speed of light construct violated the principle of energy conservation. Setterfield in his reply (1983, p. 88), stated that he needed more time to study Akridge's comments and toyed with the idea of either abandoning or restricting the principle of conservation of energy:

> Also, if it is admitted that things which have been supposed to be constant, such as the velocity of light, actually have varied, it may be that it is necessary to look a little more carefully at the various principles of conservation. Presumably conservation of energy did not apply right at the beginning of creation; maybe some thought is in order as to when it did begin to apply.

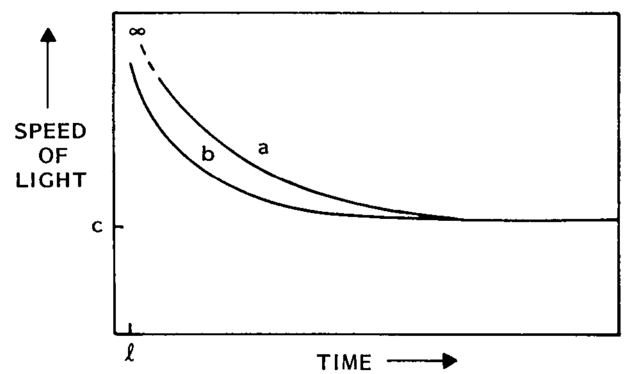

Figure 3. Possible models for a decrease in the speed of light with time. Drawing by Joe Whitaker.
a. Speed of light is infinite at t = 1, decreasing to a value of c.
b. Speed of light greater than c at t = 1 decreasing to a value of c.

By 1985 (pp. 210-11) Setterfield had tinkered with his model, deciding to maintain energy conservation. He developed a table (1985, p. 210) that reappeared in the Norman and Setterfield report (1987, p. 28, Table 12) to explain the adjustments that the principles of physics would have to make to accommodate a changing speed of light. Setterfield (1985, p. 210) claimed that Akridge's criticism:

> . . . resulted from a misunderstanding. The whole basis of the velocity of light (c) decay research has been to uphold the energy conservation laws . . . he is incorrect when he states that magnetic permeability would need to be constant for the magnetic energy to be conserved.

Setterfield then explained however that other constants in physics also would have to vary.

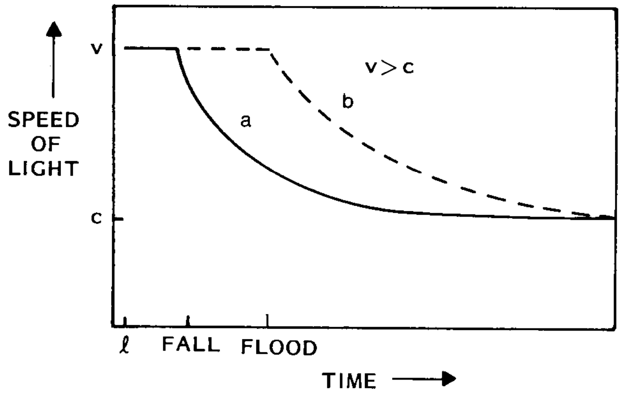

Figure 4. Possible models for a decrease in the speed of light with time in conjunction with the Fall or the Flood. Drawing by Joe Whitaker.
a. Speed of light begins to lessen at the Fall.
b. Speed of light begins to lessen at the Flood.

In 1983 Setterfield was perilously close to a collision with the symmetry concepts of physics, particularly the symmetry of time. Consider the following comments by Ford (1963, pp. 104-05):

> Symmetry of time is an obvious extension of spatial symmetry; the fact that nature's laws appear to remain unchanged as time passes is a fundamental symmetry of nature . . . The laws of nature are the same, so far as we know at all points in space and for all time . . . The chain of connection we have been discussing is: Symmetry → invariance → conservation.

However as Ford (pp. 104-05) notes:

> It might seem hard to visualize any science at all if natural law changed from place to place and time to time, but, in fact, quantitative science would be perfectly possible without the homogeneity of space-time. Imagine yourself, for example, on a merry-go-round that speeded up and slowed down according to a regular schedule. If you carried out experiments to deduce the laws of mechanics and had no way of knowing that you were on a rotating system, you would conclude that falling balls were governed by laws which varied with time and with position (distance from central axis), but you would be quite able to work out the laws in detail and predict accurately the results of future experiments, provided you knew where and when the experiment was to be carried out. Thanks to the actual homogeneity of space and time, the results of future experiments can in fact be predicted without any knowledge of the where or when.

In justice to Setterfield, he wisely chose to embrace the symmetry of time concept and thus maintain conservation of energy in his model. However Holt (1988, pp. 84-88) has questioned the conservation of rotational kinetic energy in relation to the consistency of pulsar signals within the framework of the changing speed of light model. Possibly Setterfield must adjust his concepts again?

To preserve conservation of energy with a changing c, several other physical constants must also vary. Some of these are listed with the particular pages from the Norman and Setterfield report (1987).

Permeability of free space	$\mu_o \propto 1/c^2$	p. 28	(16)
Atomic rest mass	$m \propto 1/c^2$	p. 31	(17)
Planck's constant	$h \propto 1/c$	p. 33	(18)
Gyromagnetic ratio	$\gamma \propto c$	p. 39	(19)
Radioactive decay constant	$\lambda \propto c$	p. 56	(20)
Thermal conductivity of a substance	$\kappa \propto c$	p. 57	(21)

If one accepts the thesis that a statistical "trend"* of the decreasing speed of light has been demonstrated, then one must abandon the constancy of the quantities illustrated in the proportionality relations 16-21. Next the problem of so many varying quantities must be faced. As one extrapolates into the past, all of the now-varying "constants" (with time) must change in *synchronization* with each other so that energy has been conserved at all times. Rather than being satisfied with proportionality relationships, exact curves for each quantity variation with time must be derived from the available data and extrapolated into the past. Any lack of synchronization of increase or decrease of these proposed variables (once constants) will violate conservation of energy principles. The quantities must increase or decrease with time in a regular manner together!

Then if all of these vastly complex changes can be arranged into a synchronized, regularly-varying network, Setterfield has only changed one set of constants for another set. All of the proportionality relationships (16-21) must be placed in equation form employing proportionality constants for it is "the constants that make the equations work." Then it would be advantageous to find physical meanings for the new constants. For instance the inverse product of ε_0 and μ_0 yields the speed of light squared in equation 11.

According to Norman and Setterfield, the decrease in the speed of light has stopped. If future measurements of the constants listed in relationships 16-21 "continue to increase or decrease," not in conjunction with speed of light, the symmetry of time principle will be violated. Of course *ad hoc* hypotheses can be developed to save the model but these will not be very satisfying except to those who wish to believe in the decreasing speed of light concept. I admire Setterfield for going into considerable depth with his model but he still has only investigated the tip of the iceberg. If he is correct the principles of present-day physics will have to be modified greatly.

Correlation of Proposed Models

Morton has proposed an increasing ε_0 in his model and the stipulation that μ_0 could vary whereas Setterfield has opted for a varying μ_0 with ε_0 as a constant. The two models are opposed to each other in this circumstance. Thus either Morton or Setterfield is correct or both are wrong.

Barnes, Humphreys and Lucas have developed models employing electromagnetic concepts assuming that μ_0 and ε_0 are constant (thus c is constant also). These models in their present forms cannot mesh with

*A statistical trend in a set of data is often in the eye of the beholder. One person can utilize a specific statistical method and "prove" that a trend exists, whereas another person can employ a different statistical tool and "prove" that no trend exists.

the ones proposed by Morton and Setterfield. Consider the models of the decreasing strength of the Earth's magnetic field (Barnes, 1971; 1972; 1973; 1975; 1984a; 1986a; 1989; Humphreys, 1983; 1988a) and the model of the decreasing strength of the planetary magnetic fields (Humphreys, 1984; 1986). Using these models, if extrapolation into the past is desired, how can one be sure that the calculated field and pole strengths are not a result of μ_0 varying rather than the interpretation offered by Barnes of greater field strength in the past? As hazardous as extrapolation is, not knowing what can and cannot vary, renders the exercise even more dangerous.

Also if the speed of light has ended its descent according to Norman and Setterfield, any possibility of verifying the change in speed of light model by future measurements is zero. But the models of the Earth's and other planets' magnetic fields can be checked with future measurements. Humphreys has obtained close agreement with his model from the recently-obtained Uranus data.

Conclusions

The variation of radioactive decay rates appears to be a substantial possibility. Other factors besides the speed of light may have greater effects on decay rates. This area offers possibilities for future creationist research. If the models offered by Morton and Setterfield are accepted, then major, if not total, restructuring of physical science theory would be necessary. Considerably more work is necessary and more evidence should be offered to demonstrate the feasibility of any decreasing speed of light model. Present physical science theory may be in need of repair but serious consideration should be given by everyone interested in science before such a leap into a new framework is contemplated.

Reflections

Lest someone think that creationists are merely tilting windmills and anti-creationists have their feet on solid ground, I offer the following quote by Jaki (1989, pp. 16-17).

> Whereas few physicists are willing to consider the possibility of fluctuating values for the speed of light, most physicists have been for some time entertaining something far more daring, if not outright foolhardy. With a few exceptions, they have been wallowing for the past two generations in an elementary philosophical fallacy while taking it for good science. For it is an elementary fallacy, a patent non-sequitur, to claim that a physical interaction that cannot be measured exactly, cannot take place exactly. It is a flouting of plain logic to rush from a purely operational situation, the inability to measure certain interactions exactly, to a situation where interactions do not take place exactly. The latter inexactitude refers not to the quantitative aspects of things, but to the ontological reality of those very things.
>
> If this elementary fallacy is ignored, one ushers in a world view in which all things, all processes, all perceptions are seen as resting on nothing, even if in place of the word "nothing" one uses the scientifically respectable word chance though it ultimately stands for nothing. One is in the presence here of the most radical flippancy conceivable; its object is no longer this or that fact, or situation, or custom, or belief, but the very ground of reality of existence.
>
> It would be tempting to blame physicists for the emergence of this frightening prospect within which no coherence can be claimed by anything. For even if the prospect is merely a possibility, it would give priceless support to those who on other grounds have already claimed that there are no objective, let alone absolute truths and norms. The support is priceless because it is provided by that very enterprise, science, which commands the highest premium in modern culture. It is in this light that one should appraise the countless declarations of physicists that causality, which is the very clue to ontological coherence in a world of change, has been shown by quantum mechanics to have no basic validity. The same holds true of presentations, again by countless physicists, of the theory of relativity as a proof that everything is relative.
>
> The real culprits are not physicists or scientists in general, but the philosophers. They should have been the ones to shout their heads off, a task for which they had, however, incapacitated themselves. Prior to the advent of relativity and quantum theory, the world of philosophy had only heads but no external and coherent things, that is, the kind of world which is called universe. For no external things forming an objective world but only minds thinking unto themselves were allowed to exist by Neo-Kantianism which ruled supreme in circles that still professed themselves to be philosophical. Philosophers with a sense for the real decided to appear as empiricist interpreters of science which was taken for an economical correlation of sense data and not for knowledge of objective reality.

Is it possible that the only constant in this world is the Creator Himself?

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