

Creation Research Society Quarterly

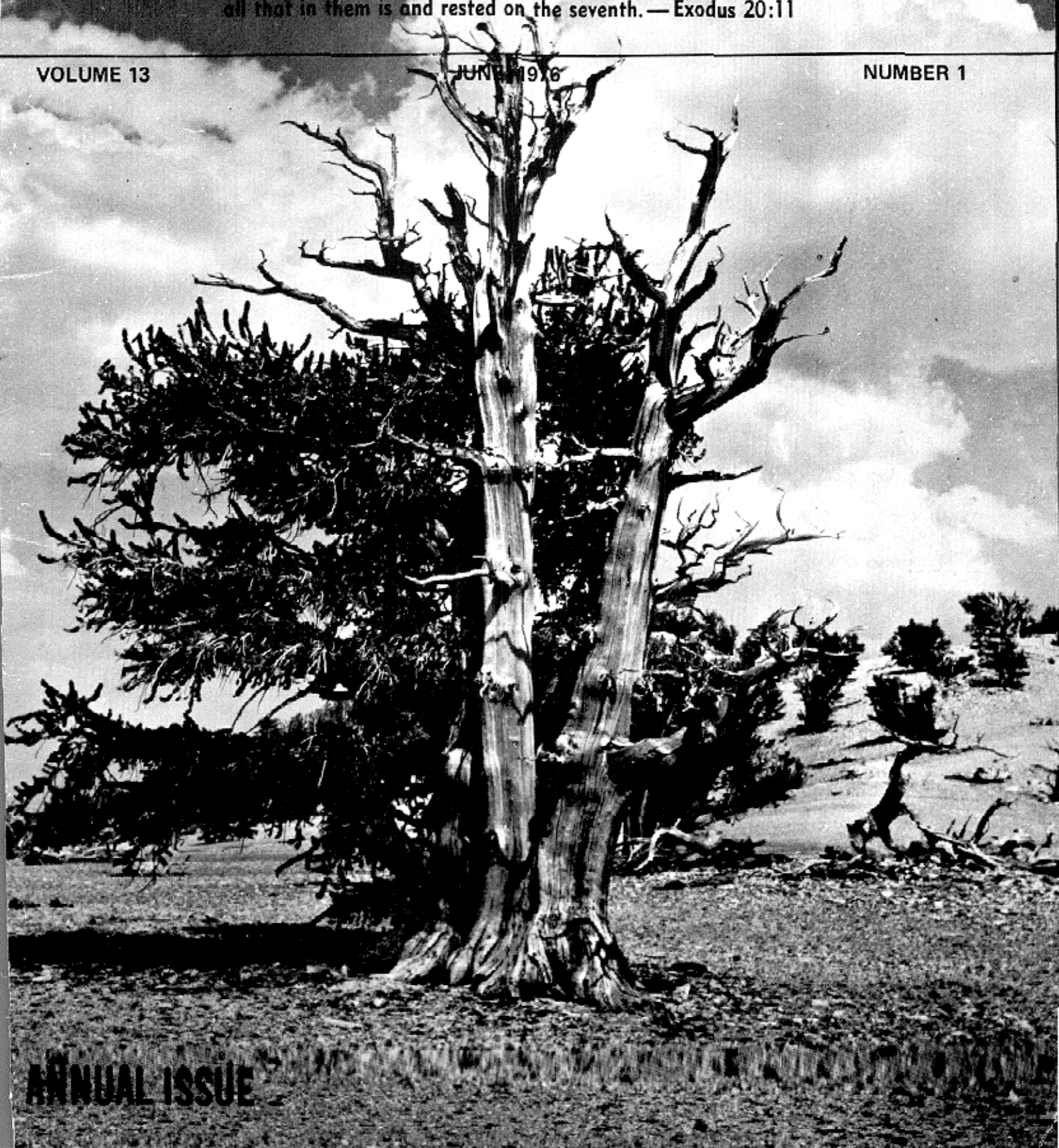
Haec credimus:

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

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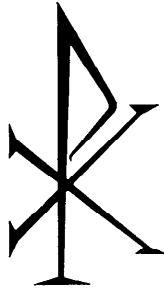
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TARDINESS REGRETTED

Mailing of this issue has been delayed greatly due to many editorial "slowdowns" and production problems. Your understanding is requested as all editing is accomplished on a voluntary basis.
— Managing Editor.

COVER ILLUSTRATION

One topic that needs attention by creationists in 1976 is that of tree rings. Researchers are attempting to use the rings of very old trees, such as the bristlecone pines, to establish dates in chronology, and also to check on the behavior of carbon 14, used to determine ages of archaeological samples.

While the use of the tree rings shows much promise, there are still many questions to be answered. So there is no need, on the strength of information supposed to be obtained from the tree rings, to give up any dates or durations which are soundly based on Biblical information.

The picture on the front cover shows typical bristlecone pines, in California. This picture was supplied by the Forest Service of the United States Department of Agriculture, Washington, D. C.; and taken by Don K. Porter.

More about the tree rings will be found in an article by Dr. Herbert C. Sorensen, elsewhere in this issue of the *Quarterly*.

TABLE OF CONTENTS

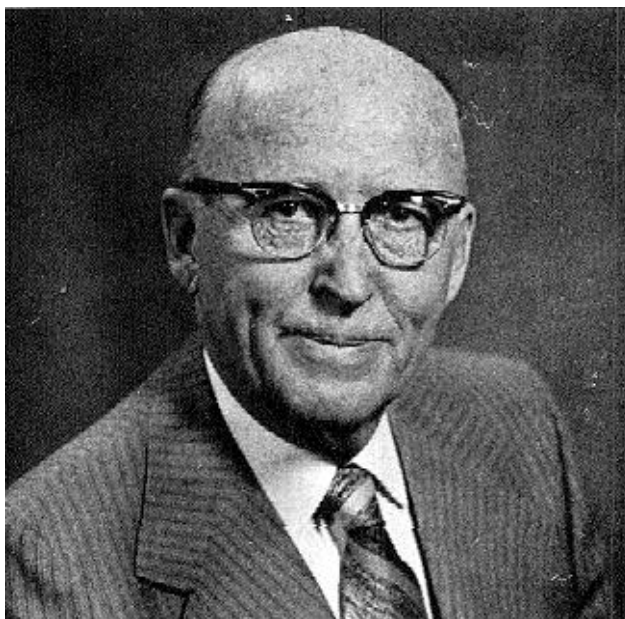
	Page
Dedication to Frank Lewis Marsh	3
Bristlecone Pines and Tree-Ring Dating: A Critique Herbert C. Sorensen	5
A Critique of Velikovsky's Catastrophic Theory of the Solar System. J. C. Keister	6
Nitting or Knitting Willis E. Keithley	13
Amino Acid Racemization in Marine Sediments Larry S. Helmick	14
A Most Urgent Job for Creationists in 1976 T. Robert Ingram	23
Problems in the Glacial Theory Douglas E. Cox	25
A Creation Model for Natural Processes Emmett L. Williams	34
What about the Zonation Theory? Clifford L. Burdick	37
The Precision of Nuclear Decay Rates Don B. DeYoung	38
The Principle of Anarchy Howard Byington Holroyd	42
The Reign of Law William J. Tinkle	44
On Methods of Teaching Origins: A Progress Report John N. Moore	46
Some Mathematical Considerations on Radiocarbon Dating, I James N. Hanson	50
Evolutionary Contradictions and Geological Facts R. W. Morrell	56
Sinking Continents James R. Honeyman	58
Descriptions of Past Populations Edmond W. Holroyd, III	63
Response to Comments by E. W. Holroyd David J. Rodabaugh	65
Panarama of Science	66
Book Reviews (4)	71
Letters to the Editor (3)	73

ANOTHER LOCATION OF THE *QUARTERLY*

An addition can be made to the list of repositories of the *Creation Research Society Quarterly*, announced in the September 1975 issue.

The Library of Grace Theological Seminary, Winona Lake, Indiana 46590, holds all volumes of the *Quarterly*. Original copies cannot be circulated, but inter-library loan services are available.

Hopefully, other persons or educational institutions that have the *Quarterly* complete or nearly so, and are willing to make it available will make that information available so that it can be announced.



FRANK LEWIS MARSH

We take great pleasure in dedicating this Annual Issue of the *Creation Research Society Quarterly* to Dr. Frank Lewis Marsh, general biologist, educator, author, and one of the 10 founding members of the Creation Research Society.

Dr. Marsh was present at the first organizational meetings in 1963 at Asbury College in Kentucky and at the home of Dr. John J. Grebe in Midland, Michigan. He was a member of the Board of Directors of the Creation Research Society from 1963-1968. He was one of the contributing writers of the Creation Research Society Textbook Committee which produced the secondary level biology textbook, *BIOLOGY: A Search for Order in Complexity*; and he has contributed seven articles to the *Creation Research Society Quarterly*. He was elected unanimously a Fellow member at the 1976 annual meeting of the Board of Directors.

Dr. Frank Lewis Marsh was born on a grain and stock farm near Aledo, in Mercer County, Illinois, October 18, 1899. He received the B. A. and B. S. degrees from Emmanuel Missionary College (now Andrews University), Berrien Springs, Michigan. The M. S. degree in zoology (animal ecology major) was conferred upon him by Northwestern University in 1935, and the Ph.D. degree in botany (plant ecology major) by the University of Nebraska in 1940.

The title of Dr. Marsh's master's thesis was "A Regional Study of *Samia Cecropia* and Nine Associated Primary Parasites and Hyperparasites." In this study a food chain was

discovered which was unique in that it (1) consisted of five links (instead of the usual three or four), (2) the members of the food chain were all insects, and (3) a new chalcid wasp was discovered, later named *Cirrospilus inimicus* by Gahan. Dr. Marsh summarized his work in *Ecology*, Vol. 18, No. 1, January, 1937, pages 106-112, entitled, "Ecological Observations upon the Enemies of *Cecropia*, with Particular Reference to Its Hymenopterous Parasites."

His doctor's problem was in plant ecology under J. E. Weaver (world authority on plant roots) on the prairie near Lincoln, Nebraska, and his thesis was titled, "Water Content and Osmotic Pressure of Certain Prairie Plants in Relation to Environment." This study was published as *University Studies*, Vol. XL, No. 3, June, 1940; U of Nebraska publication. 44 pages.

Dr. Marsh has been mainly a teacher of biology (five years at the secondary level, and 38 years at college and graduate levels). His first position was that of instructor in science and mathematics at Hinsdale Academy, Hinsdale, Illinois. Then he was a graduate-student laboratory teacher of zoology at Northwestern University. Next he taught biology at Union College, Lincoln, Nebraska for 15 years. At Union College he served as assistant professor, associate professor, then as professor, while heading the biology department there.

The remainder of his active teaching in biology was at Andrews University, where he headed the biology department for eight years, served as senior research worker in the Geoscience Research Institute for six years, then returned to the biology department as professor until retirement. During the same period he taught classes in science and reli-

FORMATION OF STUDENT CHAPTERS OF THE CREATION RESEARCH SOCIETY

At the 1976 annual meeting of the Board of Directors of the Creation Research Society, it was decided to initiate a policy of having Student Chapters at universities or schools. Student groups wishing to apply for Student Chapter status should submit such requests to Dr. Harold Slusher, Chairman, Student Chapter Committee, Creation Research Society, Department of Physics, The University of Texas at El Paso, El Paso, Texas 79968.

NOTE ON REDUCED PRICE FOR C. R. S. MEMBERS

Creation Research Society members are strongly encouraged to purchase copies of the geoscience anthology, *Speak to the Earth*, at a new low price of \$6.00 for *members only*. Such orders should be mailed directly to the Presbyterian and Reformed Publishing Company, Box 185, Nutley, N. J.

gion in the Seventh-day Adventist Theological Seminary, first in Washington, D. C., then on the Andrews campus.

In other activities, while at Union College Marsh was director of and teacher in the Rocky Mountain Biology Station, Chambers Lake, Colorado the summers of 1948 and 1949; chairman of the biology section of the SDA Quadrennial Conference of Science and Math Teachers, (1944, 1948, 1952, and 1956); and lecturer on creationism in England, Denmark, and Germany during the summer of 1957.

Perhaps Dr. Marsh is most widely known in scientific circles through his writings on insect parasitism and hyperparasitism; insect food-chain interrelationships; and insect life cycles. His articles have appeared in *Annals of the Entomological Society of America*; *Canadian Entomologist*; *Ecology*; *Journal of the New York Entomological Society*; *Psyche*; and *Botanical Gazette*. His basic interest has been the search for limits of variation in the plant and animal kingdoms.

More than 125 philosophical articles by Dr. Marsh on

creationism have appeared in religious journals and he has authored eight creationist books. Several of his books have been published in foreign language editions.

Dr. Marsh is listed in American Men and Women of Science, and after 40 years as an active member of Sigma Xi, is now "an Emeritus Member of Chapter-at-Large" of that society. At Andrews University where he has taught for the last 21 years he is now Professor of Biology, Emeritus. In the Andrews University Alumni Association he was the honored alumnus of 1960, and was cited to the alumni Hall of Fame in 1973.

Dr. Marsh is married to Alice Ruth Garrett (Doctor of Science and Registered Dietitian), who has headed the Home Economics Dept at Andrews for the last 22 years. The Marshes have been married for 49 years. The former Life Sciences building on the Andrews campus has been officially named Marsh Hall in honor of Frank and Alice Marsh. They have a married son and daughter and one grandson.

— The Editors

CREATION RESEARCH SOCIETY

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 creationism, with a current membership of about 500 voting members (with graduate degrees in science) and over 1600 non-voting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and is now recognized as probably 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.

Membership Voting membership is limited to scientists having at least an earned graduate degree in a natural or applied science. Dues are \$10.00 (Foreign, \$11.00 U. S.) per year and may be sent to Wilbert H. Rusch, Sr., Membership Secretary, 2717 Cranbrook Road, Ann Arbor, Michigan 48104. Sustaining membership for those who do not meet the criteria for voting membership, and yet who subscribe to the statement of belief, is available at \$10.00 (Foreign, 11.00 U. S.) per year and includes subscription to the Annual Issue and Quarterlies. All others interested in receiving copies of these publications may do so at the rate of the subscription price for all issues for one year: \$13.00 (Foreign, \$14.00 U. S.).

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. Subsequently a Revised Edition (1974), a Teachers' Guide and both Teachers' and Students' Laboratory Manuals have been published by Zondervan Publishing House. 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 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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BRISTLECONE PINES AND TREE-RING DATING: A CRITIQUE

HERBERT C. SORENSEN*

While the notion of telling the age of trees by counting rings is an old one, the method has recently come into much prominence through application to the old bristlecone pines in the south-west. Some have claimed, for instance, that the results would serve to settle problems in chronology, and to provide an independent calibration for attempts to find ages from carbon 14. While the method certainly has much promise, the author shows that, at the present, there are very pertinent questions which have not been answered. Thus it would be premature, at the least, to say that results supposed to be obtained from tree rings have to be accepted, particularly if they should conflict with Biblical evidence.

Introduction

The curious ways in which ideas become a part of scientific dogma have been discussed frequently. What I want to note here is that the actual introduction is usually by one or a few persons and usually involves a very narrow deductive idea. Intuitive reasoning by the introducers or others rapidly increases the broadness of the idea, i.e., expands the usefulness of the idea. The usefulness of the idea ultimately determines acceptance or rejection.

Scientific pragmatism demands acceptance of a broadly useful idea even if there are known weaknesses in its origin. In this sense much of what I have to say is irrelevant to the validity of tree-ring dating. That is, irrelevant to scientific chronologists who find dendrochronology of the bristlecone pines very useful in buttressing other chronological theories (radiocarbon, etc.). However, a serious examination of the foundations of the bristlecone pine chronology is justified for those who are curious, critical or confused.

For centuries the rings of trees have been counted as an indication of age.¹ Although this first basic principle of dendrochronology is valid, certain difficulties are known. For example, if several wet and dry seasons alternate in a single year, several rings may become apparent. On the other hand, very dry years may result in missing rings or partial rings (not completely encircling the tree).

There are cases known where as many as 30 percent of the rings are extra rings and other cases where as many as 10 percent of the rings are missing. However, inaccurate counting of rings is not the major problem in dendrochronology.²

Obviously a 9,000 year chronology is not established by counting the rings of a single tree. Rather a composite of many trees is formed and the count is based on the composite. Formation of the composite is then the critical problem in dendrochronology. The composite is possible because the *pattern of ring widths* may be distinctive (a signature). If the same distinctive pattern is found in two specimens it is presumed that the similar sections grew simultaneously.

If one of the specimens has rings older than the common pattern and the other has rings younger than the common pattern, combining the two specimens by overlapping the common pattern results in a composite specimen longer than either of the single specimens. Adding a third specimen may allow further extension of the composite.³ The bristlecone pine chronology was developed by this method and includes very old dead wood samples, as well as living trees.⁴

Validity of cross matching signatures has been well established in specific applications. It has *not* been established in the bristlecone pine chronology. Major difficulties of

the bristlecone pine chronology will be discussed in order of significance:

1. **Cross matching is subjective** and largely depends on visual inspection and comparison; with statistical analysis after a cross match has been identified. The whole thing depends on the judgement of a highly skilled, trained but fallible investigator.

The magnitude of this problem can be assessed by considering the difficulty of matching a specimen with several hundred rings against a composite of several thousand rings. So great is the difficulty in finding cross matches that the wood is *first* radiocarbon dated to determine its approximate location in the chronology.⁵

I have these facts in writing from the original investigators who cite the bristlecone pines dates as being in excellent agreement with radiocarbon dates.^{6,7} Of course they agree. Since the bristlecone pine dates are at least partially determined by radiocarbon dates it is essentially a case of circular reasoning.

A colleague and I, under the auspices of the Geoscience Research Institute, have attempted to circumvent the subjectiveness of cross dating by developing a method for systematically searching for cross matches by computer. Our results have been encouraging and have shown the feasibility of eliminating the subjective element.

2. **The rings width patterns in the bristlecone pines are not sufficiently distinctive.** The rings are extremely thin (as many as 100 per cm) with a high percentage missing. (See reference 4). The most distinctive rings are the thinnest and these are of course the ones most likely to be missing. If the very thin rings are removed from any specimen the result is a non-distinctive pattern termed *complacent*. Complacent specimens are unsuitable for cross matching.

In the case of pine alpha, one of the more famous members of the bristlecone pine chronology, if the nine missing rings are left out the result is a complacent specimen.⁸ In fact, nearly half of the components of the bristlecone pine chronology are insensitive and relatively complacent, even with "missing" rings included.⁹

3. **The entire chronology is the work of one laboratory, the director of which has refused to allow critical study of the raw data.** It is a fortunate scientist who finds his work of such interest to a colleague that much time and effort is spent in critical appraisal of the work. Because of the far-reaching implications of the bristlecone pine chronology to radiocarbon dating, archaeology, climatology, etc., it is essential that every facet be critically appraised.

I have dedicated a substantial amount of time to such an endeavor but have been considerably hampered by the lack of available data. Refusal by the original investigators to make such data available seems inexplicable. Surely the cause of science cannot suffer by focusing opposing viewpoints on raw data.

Questions

In conclusion, the bristlecone pine chronology is flawed through lack of adequate documentation. Answers to the

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following five questions would substantially clarify the issue:

- a. How can a chronology be constructed with a high percentage of complacent specimens?
- b. How can specimens with up to 10 percent of their rings missing be cross matched under any circumstances?
- c. How can this chronology be used to "calibrate" radiocarbon dating when radiocarbon dating is used in construction of the chronology?
- d. If a ring is missing how can it be found, especially when a high percentage of rings are missing?
- e. Why is only the final chronology published, with refusal to release the data upon which it is based?

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A CRITIQUE AND MODIFICATION OF VELIKOVSKY'S CATASTROPHIC THEORY OF THE SOLAR SYSTEM

J. C. KEISTER*

Velikovsky's catastrophic theory of the Solar System is briefly reviewed. One of the most serious physical problems of his theory (i.e., that of determining a mechanism for disposing of tremendous orbital energies) is discussed. Specifically, gravitational interaction, electrical interaction and magnetic interaction are each considered, and found to be inadequate to dispose of the required amount of orbital energy.

A modification to Velikovsky's theory is then proposed, which would permit gravitational interaction (electrical and magnetic interactions are still far too weak) to dispose of a far less amount of orbital energy, and still fulfill the appearance of what Velikovsky's theory proposes.

Some theological aspects of Velikovsky's theory are discussed and it is pointed out that whenever the theory and Scripture truly disagree, the theory obviously must be modified. Analyses of such a theory are worthwhile means for developing analytical tools for handling other catastrophic theories.

Background

Velikovsky's theory of the Solar System (which is discussed in his book *Worlds in Collision*) centers around the catastrophes related to the Exodus, the Battle of Jericho, the battle at Beth-Horon, and the siege of Jerusalem by Sennacherib. A brief summary of the theory (described more extensively in *Penseé*)¹ is as follows:

1. Some time before 1500 B. C., Venus was expelled from Jupiter.

2. Venus passed close to the Earth during the time of the Exodus. When Venus first approached the Earth, the fine red dust in its cometary tail gave a bloody hue to the land and sea, which Velikovsky used to "explain" water being turned into blood as the first of the plagues in Egypt. Velikovsky uses other similar phenomena to "explain" the other plagues and happenings of the Exodus.

3. Venus then retreated from the Earth and completed an orbit. About forty years later, when Joshua attacked Jericho, or a little later, at the battle of Beth-Horon, Venus approached again. Great stones were cast on the Earth and the Sun stood still as was recorded in Joshua 10:11. According to Velikovsky, men worshipped Venus to a far greater extent thereafter than they did before these catastrophes took place. For centuries, there was the menace to these people of the close passage of Venus to the Earth.

4. Venus then took an irregular path, and had a near-collision with Mars in the days of Uzziah, king of Jerusalem. Prophecies in Amos are then quoted by Velikovsky as predictions of dire consequences from the close passage of Mars. The first passage of Mars is associated datewise with the founding of Rome in 747 or 753 B. C. A new calendar

was formed. Mars and Venus then competed for the allegiance of men. Prophets (Joel, for example) spoke of evil consequences to come.

5. In or about 687 B. C., Mars made a close pass to Earth, and a giant thunderbolt charred the bodies of the army of Sennacherib. The Sun retreated several degrees due to the change in the rotation in the Earth.

6. Finally, after many passes of Venus and Mars, and of Mars and Earth, Venus emerged a tame planet as Velikovsky asserts is the meaning of Isaiah 14:12-17.

A brief summary: Venus was expelled from Jupiter about 1500 B. C. Venus had near-collisions with the Earth and continued to make near-passes until about the 8th century B. C. when it nearly collided with Mars. A period of time lapsed when encounters of the Earth and Mars and of Venus and Mars were observed. Mars then had its final encounter with Venus, stabilizing the orbit of Venus.

Because of the success of predictions based on Velikovsky's theory, (which are outlined in detail in *Penseé*)² this theory warrants a serious examination from the physical, historical and Biblical viewpoints. In the present article the physical problems associated with the planetary orbital energy changes are examined. Examination of the physics of the expulsion of Venus from Jupiter (the largest and most severe energy problem) is being considered by the author in a separate study.

The orbital energy problem is basically one of disposing of enough kinetic energy to bring Venus down from its expulsion orbit to its present orbit. In the three sections that follow, the mechanisms of gravitation, electrostatic interaction, and magnetic interaction are respectively considered as means for permitting the various planets (i.e., Mars, Earth and Jupiter) to dispose of the required amount of kinetic energy for Venus.

*J. C. Keister, Ph.D., teaches at Covenant College, Lookout Mountain, Tennessee 37350.

Gravitational Attraction

The gravitational interactions between Venus and Mars, Venus and Earth, and Venus and Jupiter are all considered as means for extracting orbital energy from Venus. In view of the fact that Venus interacted with Mars last, and also because the Venus-Mars interaction is the most *inefficient* for extracting energy, we shall consider the maximum amount of energy that can be extracted by Earth and Jupiter first, and then determine whether Mars could in fact extract the rest of Venus's orbital energy.

First, an estimate is needed of the total amount of energy that needs to be extracted. Assuming that Venus' initial orbit has a seven year period,³ it can be shown (see Appendix I) that the major elliptical length of the orbit of Venus is $1.40 R_j$, where R_j is the distance of Jupiter to the Sun.

The final orbit of Venus is only $1/7.2$ of the distance from the Sun at which Jupiter is.⁴ The major axis of Venus' final orbit is the diameter of the very nearly circular orbit Venus travels today, which is $(2/7.2) R_j$. The energy E that must be lost by Venus is given by:

$$E = GMM_s(7.2/2R_j - 1/1.40R_j) = 2.9GMM_s/R_j \quad (1)$$

where M is the mass of Venus, M_s that of the Sun, and G is the universal constant of gravitation.

Now, Jupiter could in principle change the orbit of Venus into a *very* elongated ellipse, so that one tip extends to the Sun, while the other tip extends to Jupiter's orbit. The major diameter in this case would be simply R_j , and the energy of this orbit $GMM_s(1/R_j)$. The difference in energy per encounter between this elongated orbit assumed to have been established in one encounter and the original orbit is:

$$\Delta E_j = GMM_s(1/R_j - 1/1.40R_j) = 0.29GMM_s/R_j \quad (2)$$

which is equal to only 10% of the total change of energy, E . Therefore, Jupiter can extract at most 10% of the required total energy loss, E .

Consider next the amount of energy which the Earth could extract from Venus. In principle, the Earth could extract a great deal of energy from Venus, but this would mean that the Earth would have to have been much closer to the Sun than it now is. Now, the radiant energy per unit area impinging on any object is inversely proportional to the square of the distance of that object from the radiant energy source.

So, if the Earth were at a distance of $2^{1/2}R_e$ (where R_e is the present Earth orbit distance from the Sun), it would receive *twice* the radiant energy it is now receiving from the Sun. Furthermore, it would seem *highly* unlikely that the Earth's orbit could be changed so drastically and yet have it end up so nearly circular today. Also, the effect of having *twice* the sunlight on the Earth (if we assumed a gray or black body radiation loss) would be to raise the absolute temperature T in accordance with the T^4 rule.

The Earth's average equivalent radiation temperature is of the order of 270°K , and if the energy received from the Sun is doubled, then T^4 is also doubled (assuming internal core heat loss is relatively negligible). This would produce a temperature of $2^{1/4} \times 270 \approx 1.19 \times 170 = 320^\circ\text{K}$ which corresponds to an average Earth temperature of 120°F (which is *way* too hot!).

Even if the Earth core energy loss were, say, half the average heat loss (which would then put the Earth's average radiation temperature at about 75°F), the sun's radiant energy would produce extraordinarily high temperatures for living purposes.⁵ Be that as it may, we will suppose that

the Earth was originally at a distance of $2^{1/2}R_e$ even though recognizing that it is *unlikely* the Earth could have been in that close to the Sun and have absorbed so much of Venus's orbital energy. So a *maximum* energy the Earth could absorb would be (the Δ again indicating the change per encounter):

$$\Delta E_e = GM_s M_e (2^{1/2}/2R_e - 1/2R_e) \quad (3)$$

where M_e is the mass of the Earth, and R_e is the distance of the Earth from the Sun.

Since $M_e = 1.25M$, and $R_e = R_j/5.2$, about, this comes to be about $1.35GMM_s/R_j$ which is around 50% of the total energy loss required.

Therefore, Earth and Jupiter together can dispose of *at most* 60% of the total orbital energy loss of Venus. Interactions between Venus and Mars *must* dispose of the other 40%.

Optimum conditions of interactions between Venus and Mars are now assumed, whereby the planets come within Roche's distance from each other, so as to promote the maximum exchange of energy. A formula is derived for the maximum deflection angle corresponding to this "brush pass" in Appendix II. This deflection angle then is used to derive the optimum orbit intersection angle between Venus and Mars which will maximize the energy exchange between the two planets.

The calculation for the optimum orbit intersection angle is performed in Appendix III. The results show that at *most* less than 5% of the total orbital energy loss can be affected with each near-collision of Venus with Mars.

Therefore, it would take over 8 such optimum near-collisions between Venus and Mars to dispose of the required 40% of the total orbital energy loss. Such a situation would be *most* unlikely. Furthermore, Velikovsky's theory requires substantial energy losses with only *two* such major passes. Therefore, the mechanisms of electrostatics and magnetism are next investigated to see if these might somehow enable Mars to extract enough orbital energy from Venus.

Electrostatic Interaction

The problem here is to determine whether electrical charges could have been built up on Venus and Mars to such an extent that the electrostatic force would dominate the gravitational attraction. If so, then some sort of repulsion between the two planets might have permitted a billiard-ball type of interaction, and the planets would not need actually to have touched.

Since the charge would be associated with material on the surface of the planets, the electrical forces would tend to lift that material off the planets. The criterion used here to set an upper limit on the electric field near the surface will be this: that the electrical force on material at the surface should be no greater than the force necessary to break the material. For if it were greater, material would break loose and fly off (the electrical force would be much greater than that of gravity). Since the material would carry charge with it, the planet would be discharged rather rapidly.

The breaking strength of granite, limestone, and other common rocks is somewhat less than 100,000 p.s.i. Suppose, then, that the electrical force were of this magnitude, which, in other units, is 6.9×10^9 dynes/cm². Moreover, this force is given by the product of the strength of the electric field and the surface density of charge, in units of charge per square cm. (the c.g.s. electrostatic system of electrical units is being used here.)

Now, if there is a charge Q on a sphere of radius r , the field at the surface is of magnitude Q/r^2 , and the surface density of charge is $Q/4\pi r^2$. Thus the criterion comes to be

$$\frac{Q^2}{4\pi r^2} = 6 \cdot 9 \times 10^9 \quad (4)$$

Now for Venus, $r = 6.31 \times 10^8$ cm, and for Mars 3.42×10^8 . The Q 's calculated by the above formula are Q_m (Mars' charge) $= 3.44 \times 10^{22}$ esu. The electrostatic force between these two charges is given by the product divided by the square of the separation. Thus the force between Mars and Venus at any separation (i.e., distance between centers) would be, in dynes, 4.03×10^{45} divided by the square of the separation. (This assumes that the charge remains uniformly distributed. Actually, when the planets were very close the electrostatic force would be somewhat less, because charge would be partly repelled to the most distant parts of the planets.)

The gravitational force would be given by the product of the masses, about 4.80×10^{27} gms for Venus and 6.40×10^{26} for Mars, and the universal constant of gravitation, 6.67×10^{-8} , divided by the square of the separation. So the gravitational force would be about 2.05×10^{47} divided by the square of the separation.

So the electrostatic force, even according to the extreme assumptions made here, would be only about one fiftieth of the force of gravitation. Thus the electrostatic force could have little effect on the orbits.

Magnetic Interaction

The possibility that magnetic forces between the planets might have been effective in re-arranging their orbits will be discussed at greater length in Appendix IV. It is enough to note here that it turns out that the magnetic forces are no more able to accomplish what is asked of them than the electrostatic ones are.

Modifications to Velikovsky's Theory

In view of the above, it appears as though there is no known mechanism, gravitational, electrical, and magnetic forces having been ruled out, that would be sufficient to dispose of the excess orbital energy of Venus. Therefore, it seems very doubtful that Venus could have done what Velikovsky's theory insists that it must have done to effect the catastrophic events specified.

Nevertheless, it is possible to modify the theory such that everything *appears* in a manner suggestive of the theory, without actually having Venus be the "actor". Specifically, suppose that *Mars* was the actor, all the time.⁶ Consider the following scenerio, matched to Velikovsky's original theory:

Velikovsky's Theory

1. Venus comes from Jupiter, and looks like a comet.
2. Venus has near-collision with the Earth.
3. Venus has a near-collision with Mars, (which is approximately located at Venus' present orbit) and sends Mars out into an eccentric orbit.
4. Mars has a near-collision with the Earth.

Modified Theory

1. Mars comes from Jupiter, (or appears to) and looks like a comet.
2. Mars has near-collision with the Earth.
3. Mars has a near-collision with Venus, (which is located at the same orbit as it is at present), and then continues its way in a modified orbit. Mars has collisions with asteroids, loses most of its tail and picks up two trebants and looks like a different planet. In fact it looks like Mars at present.
4. Mars has a near-collision with the Earth.

- | | |
|---|--|
| 5. Mars has final near-collision with Venus. | 5. Mars has final near-collision with Venus. |
| 6. No explanation for how Mars gets to its present orbit. | 6. Mars has a collision (perhaps several) with more asteroids, and then settles into its final, present orbit. |

Mars as the Actor

A relatively simple calculation reveals that Mars would need to lose only 1/20 the energy which Venus would need to lose. This means that, in principle, Mars could lose up to all the required energy in a single near collision with, say, Venus or Earth. Therefore, one of the biggest problems of Velikovsky's theory, that of excess orbital energy, would be disposed of. And there is more: the final orbit of Mars is somewhat eccentric, whereas the orbit of Venus is very nearly circular. It seems unlikely that Venus, starting from a very eccentric orbit, would eventually have a very nearly circular one.

Furthermore, why would Venus not have picked up a trebant or two while orbiting near Jupiter and the asteroids? Apparently Mars did pick up trebants; and Mars has less capture ability than Venus, being much lighter.

Obviously, there may be difficulties with the new model. For instance, how does one dispose of the tail of a comet? It must have been disposed of; Mars today has little atmosphere. This is indeed a difficult problem, although possibly a close pass by the Sun (assuming a very eccentric orbit for Mars) could have blown most of the atmosphere away. Nevertheless, a problem of this sort is (energetically speaking) far easier to solve than the orbital energy problem that Venus poses.

Conclusions

1. I do not mean to deny the possibility of catastrophic planetary interaction; but the only way that the basic thrust of Velikovsky's theory can be maintained is by changing the notion that *Venus* was the main actor. Modification of his theory so that *Mars* is the chief actor will at least permit the theory to be feasible from the energy standpoint.⁷

2. Acceptance of Velikovsky's theory (or a modified version), does *not* mean rejecting scripture, *provided*: (a) all parts of his theory which go contrary to scripture are modified to be consistent with scripture, and (b) we recognize that God governs *all* of the universe, and that so-called "natural" events are every bit as much God's doing as the miraculous events. Therefore, to "explain" some event that took place by "natural" means does not in any way leave God out of the picture.

3. Thinking and speculating along the lines of possible catastrophes, may lead to lines of thought which correspond to the actual historical chain of events which took place. Whatever else has happened, Velikovsky has introduced a mode of thinking (interdisciplinary in nature) which may be invaluable in attempting to understand the universe around us. If Velikovsky is, say, only 20-30% correct in his theory, he will have performed far better than many steady state, uniformitarian type astronomers.

4. It should not be assumed that the Creation Research Society, or individual members of the Society, or even the author, necessarily believe that the events outlined in this modified theory actually happened. The point being made is that some such modification is necessary if the theory is to be even a plausible one.

Acknowledgements

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Appendix I

Calculation of the Major Axis of Expulsion Orbit of Venus

By ordinary mechanics,⁸ the Period T of the planet around the Sun is given by

$$T = \frac{2\pi a^{3/2}}{(GM_s)^{1/2}} \quad (5)$$

Equation 5 is an approximation, good only if the planet mass is negligible compared to the Sun.

Here a is a semi-major axis (i.e., half the tip-to-tip dimension) of the orbit; the other symbols have been defined already.

Now as given in e.g. the Handbook of Chemistry and Physics, $M = 4.8 \times 10^{27}$, and $M_s = 1.97 \times 10^{33}$ gm. Also, Equation 5 may be put into a form to give the semi-major axis directly:

$$a = \left(\frac{T}{2\pi}\right)^{2/3} (GM_s)^{-1/3} \quad (6)$$

When the proposed seven year orbit (in appropriate units) is put in for T , along with the other numbers, the result is $a = 5.43 \times 10^{13}$ cm. Hence the length of the orbit is 1.09×10^{14} cm. That number is about $1.40R_j$, since $R_j = 7.78 \times 10^{13}$ cm.

Appendix II

The Maximum Angle of Deflection for Encounter of Venus with Mars

The purpose is to develop a formula relating the maximum scattering angle θ to $r_{\min}$ (the distance of closest approach from Mars to the center of mass). Consider Figure 1, in which b is what is called the impact parameter, and θ the angle of scattering relative to the center-of-mass coordinate system. Locations of Mars, the center of mass between Mars and Venus, and Venus are represented, respectively by M , C and V . Incidentally, while that system is picked here, later the scattering problem will have to be related to a co-ordinate system in which the Sun is at rest.

Suppose that Mars has an initial velocity V_{mo} relative to the center of mass, the impact parameter being b , as mentioned. Then the angular momentum of Mars is mbV_{mo} . The total energy of Mars, relative to the center of mass, is $(m/2)(V_{mo})^2$. By conservation of energy and of momentum, one can write

$$\frac{m}{2} V_m^2 - \frac{GMm}{r} \tau^2 = \frac{m}{2} V_{mo}^2 \quad (7)$$

Here m and M are the masses and subscript indices of Mars and Venus, respectively, V_m and V_M are velocities relative to the center of mass, V is the velocity of the center of mass, subscript zero indicates initial values, r is the distance from Mars to the center of mass, and $\tau = M/(M+m)$.

When V_m is expressed in polar coordinates, the dot here, as elsewhere, indicating differentiation with respect to time, one gets

$$\frac{m}{2} [\dot{r}^2 + r^2 \omega^2] - \frac{GMm}{r} \tau^2 = \frac{m}{2} V_{mo}^2 \quad (8)$$

Where ω indicates the angular velocity of Mars around the center of mass. The angular momentum of Mars, relative to the center of mass, is

$$m\omega r^2 = mbV_{mo} \quad (9)$$

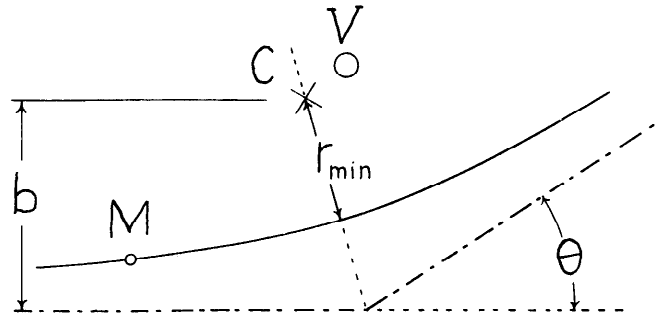


Figure 1. The path of Mars as (according to the proposal investigated here) it passed close to Venus. The path is a hyperbola; it is enough to find the angle between the asymptotes, the straight lines which the hyperbola approaches. M indicates Mars, V Venus; and C is the center of mass of the system. b is the impact parameter, the perpendicular distance from the asymptote of the original orbit to the center of mass. $r_{\min}$ is the minimum distance from the center, and θ the angle through which the planet is deflected.

Consequently, Equation 8 can be written as

$$\dot{r}^2 + \frac{b^2 V_{mo}^2}{r^2} - \frac{2GM}{r} \tau^2 = V_{mo}^2 \quad (10)$$

Since when $r = r_{\min}$, $\dot{r}^2 = 0$, it follows that

$$V_{mo}^2 r_{\min}^2 + 2GM \tau^2 - b^2 V_{mo}^2 = 0 \quad (11)$$

This is solved for $r_{\min}$ to give

$$r_{\min} = [-2GM \tau^2 \pm (4G^2 M^2 \tau^4 + 4b^2 V_{mo}^4)^{1/2}] / 2V_{mo} \quad (12)$$

The negative root cannot apply, so the solution is

$$r_{\min} = [(4G^2 M^2 \tau^4 + 4b^2 V_{mo}^4)^{1/2} - 2GM \tau^2] / 2V_{mo} \quad (13)$$

Now, the relation between b and θ , the scattering angle, must be determined. The relationship is established by considering the change in momentum from the initial to the final state, with the help of reference 9. The result, when corrected for center-of-mass coordinates, is

$$b = \frac{GM \tau^2 \cot(\theta/2)}{V_{mo}^2} \quad (14)$$

Now substitute Equation 14 into Equation 13 to obtain

$$r_{\min} = \frac{GM \tau^2}{V_{mo}^2} \left(\csc \frac{\theta}{2} - 1 \right) \quad (15)$$

Now the distance between the centers of the two planets must be at least $2.5r_v$, corresponding to Roche's limit from Venus, r_v being the radius of Venus. Therefore, since $r_{\min} = \tau \times$ (distance between centers of planets), one obtains

$$r_{\min} > 2 \cdot 5 \pi r_v \quad (16)$$

By use of Equation 15, Equation 16 becomes

$$\csc \frac{\theta}{2} > 1 + \frac{2 \cdot 5 m V_{mo}^2}{(GM \tau^2 / r_v)} \quad (17)$$

Since M is about $7m$, τ is about $7/8$. Also, $(m/2)(V_{mo})^2$ can be related to a fraction f of the potential energy, as follows:

$$\frac{m}{2} V_{mo}^2 = \frac{f GM_s m}{R_v} \quad (18)$$

Here M_s is the mass of the Sun, and R_v is the distance of the Sun from Venus today (hence, according to Velikovsky's theory, the former distance of Mars from the Sun). Thus Equation 17 can be re-written

$$\csc \frac{\theta}{2} > 1 + \frac{40f}{7} \frac{M_s}{M} \frac{r_v}{R_v} \quad (19)$$

Now in the Handbook of Chemistry and Physics $M_s/M = 329390/0.8073 = 4.03 \times 10^5$; and $r_v/R_v = 3785/67,000,000 = 5.66 \times 10^{-5}$. Therefore,

$$\csc \frac{\theta}{2} > 1 + 131f \quad (20)$$

So a formula relating the maximum deflection angle to the fractional energy in the center-of-mass system has been derived. In Appendix III, this formula is used to help derive a maximum of energy which can be extracted from Venus in a given near-collision with Mars.

Appendix III

Calculation of the Maximum Possible Loss of Energy per Near-Collision Between Venus and Mars

The thrust of the calculation here is to determine the optimum orbit intersection angle between Mars and Venus, which will transfer a maximum amount of energy between Venus and Mars, following a near-collision between the two planets. This calculation is concerned with motions of Venus and Mars relative to the Sun, as well as to the center of mass between Venus and Mars. The relationships of all these velocities are illustrated in Figure 2.

Where V_m is the velocity of Mars relative to the Sun, V_{mo} is the velocity of Mars relative to the center of mass - (Venus & Mars), V_v is the velocity of Venus relative to the Sun before interaction, V'_v is the velocity of Venus relative to the Sun after intersection, V_{vo} is the velocity of Venus relative to the center of mass - (Venus & Mars), and V is the velocity of the center of mass of Venus & Mars. Also, γ is the orbit intersection angle between Venus and Mars, and θ is the deflection angle (see Appendix II).

Now, for small velocity changes (and they are small) the change in magnitude from V_v to V'_v is approximately as shown in Figure 2. Thus the change is approximately $2V_{vo} \sin(\theta/2) \cos(\pi/2 - \theta/2 - \beta)$. Or

$$\Delta V_v \approx 2V_{vo} \sin \frac{\theta}{2} \sin(\frac{\theta}{2} + \beta) \quad (21)$$

The change in energy of Venus is therefore given by

$$\Delta E_v = \frac{1}{2}M[4V_v V_{vo} \sin \frac{\theta}{2} \sin(\frac{\theta}{2} + \beta) - 4V_{vo}^2 \sin^2 \frac{\theta}{2} \sin^2(\frac{\theta}{2} + \beta)] \quad (22)$$

The second term is quite small compared with the first, so

$$\Delta E_v \approx 2MV_v V_{vo} \sin \frac{\theta}{2} \sin(\frac{\theta}{2} + \beta) \quad (23)$$

Since the mass ratio of Venus to Mars is 7:1 it follows that $V_{mo} = 7V_{vo}$; and so $V_o = V_{mo} + V_{vo} = 8V_{vo}$. Therefore, by the law of sines

$$\Delta E_v \approx \frac{1}{4}MV_v V_m \frac{\sin \gamma}{\sin \beta} \sin \frac{\theta}{2} \sin(\frac{\theta}{2} + \beta) \quad (24)$$

Again, this is per encounter. Now it is necessary to consider getting the expressions involving $\theta/2$ and β in terms of γ . Recall from Appendix II that $\csc(\theta/2) = 1 + 131f$, (for the maximum angle of deflection). Therefore $\sin(\theta/2) = 1/(1 + 131f)$. Note that f is the ratio of $(m/2) V_{mo}^2$ to the potential energy of Mars at the distance of Venus from the sun. This potential energy is twice the kinetic energy $(m/2) V_m^2$ at the same distance from the Sun, for a circular orbit. Therefore

$$f = \frac{1}{2} \frac{(m/2)V_{mo}^2}{(m/2)V_m^2} = \frac{V_{mo}^2}{2V_m^2} \quad (25)$$

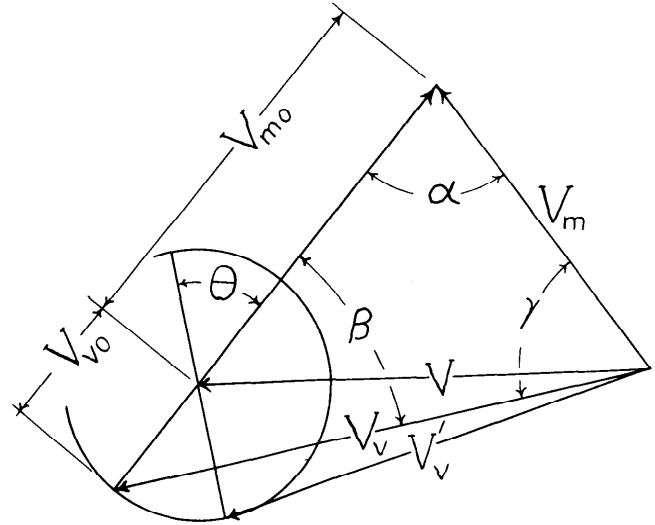


Figure 2. This shows the relations and angles between the various velocities, as discussed in the text. Note that $V_{vo} + V_{mo} = V_o$.

Since $V_{mo} = 7V_o/8$, Equation 25 becomes

$$f = \frac{49}{128} \frac{V_o^2}{V_m^2} = \frac{49}{128} \frac{\sin^2 \gamma}{\sin^2 \beta} \quad (26)$$

Now $\sin \beta$ is determined as a function of γ . By the law of cosines, and from Figure 2,

$$\sin^2 \beta = \frac{V_m^2 \sin^2 \gamma}{V_m^2 + V_v^2 - 2V_m V_v \cos \gamma} \quad (27)$$

Consequently, Equation 26 for f becomes

$$f = \frac{49}{128} \frac{(V_m^2 + V_v^2 - 2V_m V_v \cos \gamma) \sin^2 \gamma}{V_m^2 \sin^2 \gamma} \quad (28)$$

Rewriting the expression for ΔE in Equation 24 gives

$$\Delta E_v = \frac{MV_v V_m}{4} \frac{\sin \beta}{\sin \gamma} \left[\frac{1}{1 + 131f} \right] \left[\frac{\cos \beta}{1 + 131f} + \sin \beta \left(1 - \left(\frac{1}{1 + 131f} \right)^2 \right)^{1/2} \right] \quad (29)$$

By defining $\xi = (V_v^2 + V_m^2 - 2V_v V_m \cos \gamma)/V_m^2$, Equations (27) and (28) which will be used in Equation 29, simplify to the following

$$\sin^2 \beta = \frac{\sin^2 \gamma}{\xi} \quad (30)$$

$$f = \frac{49\xi}{128} \quad (31)$$

Therefore, Equation 29 becomes

$$\Delta E_v = \frac{MV_v V_m}{4(1 + 50\xi)^2} [(\xi - \sin^2 \gamma)^{1/2} + \sin \gamma ((1 + 50\xi)^2 - 1)^{1/2}]$$

When ρ is set equal to V_v/V_m , Equation 31 becomes

$$\Delta E_v = \frac{\rho MV_m^2}{4(1 + 50\xi)^2} [(\xi - \sin^2 \gamma)^{1/2} + \sin \gamma ((1 + 50\xi)^2 - 1)^{1/2}] \quad (32)$$

It will be recalled from Equation 1 that the kinetic energy of Venus, in its present orbit, is $3.6 GMM_s/R_j$, and the total required energy loss E is $2.9 GMM_s/R_j$. Now put MV_m^2 in Equation 32 into terms of E , by the following argument. When Mars was in Venus' present orbit, according to Velikovsky's theory, its kinetic energy could be set equal to the total energy (i.e., to its magnitude; the total energy is nega-

tive), as is generally true for a circular orbit. Thus, before the encounter, $mV_m^2/2 = 3.6GmM_s/R_j$. Multiply both sides of that equation by M/m . Then $MV_m^2/2 = 3.6GMM_s/R_j$. So $MV_m^2 = (2 \times 3.6)(E/2.9) = 2.5E$. Therefore, Equation 32 can be modified to

$$\frac{\Delta E_v}{E} = \frac{0.63\rho}{(1+50\xi)^2} [(\xi - \sin^2\gamma)^{1/2} + \sin\gamma((1+50\xi)^2 - 1)^{1/2}] \quad (33)$$

Now, if Mars must dispose of 40% of the excess energy of Venus, then the first near collision of Venus and Mars must have occurred when Venus' kinetic energy was at least $3.6GMM_s/R_j + 0.4 \times 2.9GMM_s/R_j = 4.76GMM_s/R_j$. Since $MV_m^2/2 = 3.6GMM_s/R_j$, the least that V_v^2 could be for the initial collision is

$$V_v^2 = \frac{4 \cdot 76}{3 \cdot 6} V_m^2 = 1.32 V_m^2 \quad (34)$$

So $\rho_{\min} = 1.32^{1/2} \approx 1.15$.

In Table I some calculations are shown of the percent change in the energy of Venus after one near collision, for various magnitudes of ρ and γ . Note that these are the maximum possible losses, since losses tend to get smaller as ρ gets larger. As can be seen, the maximum possible loss of energy per near collision by Venus is always less than five percent of the total energy which Venus would need to lose.

$\rho \backslash \gamma$	0°	5°	10°	15°	20°
1.00	0	2.6	4.1	3.7	3.1
1.05	2.6	4.4	4.5	3.8	3.1
1.10	3.1	4.6	4.4	3.7	3.1
1.15	2.4	4.0	3.9	3.4	2.9
1.20	1.7	3.1	3.4	3.1	2.7

This shows the maximum possible percent change in the energy of Venus in one near-collision with Mars, in terms of the orbital intersection angle γ and the ratio ρ , defined in Appendix III, as being less than 5% of the total needed to be lost.

Appendix IV Magnetic Interaction

Whatever be the finer details, it would seem reasonable to suppose that the planet's magnetism arises from its being magnetized uniformly throughout, both as to magnitude and as to direction.

Each infinitesimal element of the planet, then, could be considered to contain a magnetic dipole, consisting of two magnetic poles (in the sense in which that term is used in physics, not as it is used in geography) of strength $+\mu$ and $-\mu$, a distance l apart in a direction parallel to the magnetic axis of the planet. The magnetic axis is likely not much different from the geographical axis. Note that the question, whether it is possible to obtain magnetic monopoles as actual isolated physical entities, does not affect the present discussion.

The result then is that one may consider the planet as composed of two interpenetrating spheres, one of positive ("north-seeking") "magnetic charge", the other of negative ("south-seeking"), the centers of the two spheres being displaced one from the other by an amount l , as shown¹⁰ in Figure 3.

Consider each of these spheres separately. It is a uniform sphere of magnetic charge. Since the charge acts according to the inverse-square law, the sphere of charge acts, as far as places outside it are concerned, as if the charge were all concentrated at the center of the sphere.

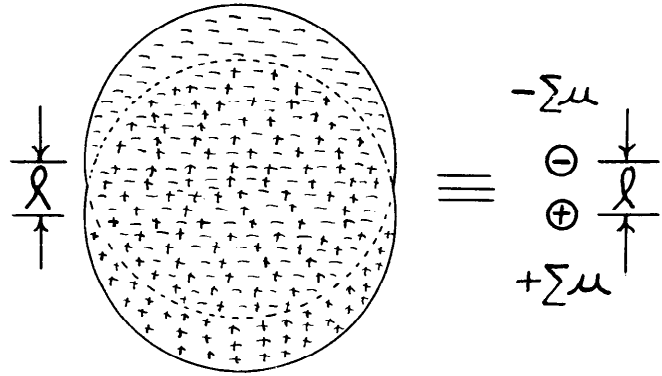


Figure 3. The uniformly magnetized sphere is equivalent to two interpenetrating spheres, one of negative "magnetic charge", the other of positive. These, in turn, as shown, are equivalent to a dipole. The distance l is supposed to be infinitesimal in comparison with the size of the spheres. Actually, l is not determined separately; only its product with the "charge" matters.

So the two imaginary interpenetrating spheres, and hence the planet itself, act, as to points outside, the same as two magnetic charges, of magnitude $+\Sigma\mu$, the total positive magnetic charge on the planet, and $-\Sigma\mu$, at the center of the planet, a distance l apart. This arrangement is just a magnetic dipole, of moment $l\Sigma\mu$. But the moment of each of the elemental dipoles which make up the magnetization was $l\mu$. Hence the effects, e.g. magnetic field, due to a uniformly magnetized sphere, at points outside the sphere, is the same as that due to a dipole, of moment equal to the total magnetic moment of the sphere, placed at the center of the sphere.

Moreover, two uniform spheres, attracting (or repelling) according to the inverse-square behaviour, affect each other as if they were each one concentrated at its center. Thus the force between two uniformly magnetized spheres is the same as that between two dipoles, of moments equal to the respective moments of the spheres, placed one at the center of each sphere. So all that is necessary is to find the force between two dipoles.

Suppose that the dipoles are lined up end to end, as shown in Figure 4. This would correspond, for instance, to two bar magnets placed end to end. Let the moments be M_1 and M_2 respectively. Note that the l 's are supposed to be infinitesimal in comparison with the other dimensions, such as r . Actually, neither l nor μ enter the formulae separately, but only their product, the moment.

The end to end arrangement, as shown, gives the strongest force between dipoles at a given separation. So this assumption is the most favourable possible for the magnetic forces.

Since in the arrangement in Figure 4 both attraction and repulsion are involved, the net force must be found, and it

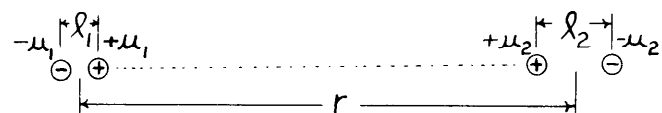


Figure 4. This shows the two dipoles to which the two uniformly magnetized spheres have been shown to be equivalent. The force is then easily calculated. Note that l is supposed to be infinitesimal compared with r .

comes to be

$$F_m = \mu_1 \mu_2 \left[\frac{1}{\left(r + \frac{l_1 + l_2}{2}\right)^2} + \frac{1}{\left(r - \frac{l_1 + l_2}{2}\right)^2} - \frac{1}{\left(r + \frac{l_1 - l_2}{2}\right)^2} - \frac{1}{\left(r - \frac{l_1 - l_2}{2}\right)^2} \right] \approx \frac{6\mu_1 l_1 \mu_2 l_2}{r^4} = \frac{6M_1 M_2}{r^4} \quad (35)$$

This result comes by expanding and neglecting higher powers of the l 's, which have already been assumed to be infinitesimal.

Next, estimate the M 's, the moments of the planets.

Suppose that each planet was made of solid iron, and that in each atom of the iron the six outer electrons each contribute three Bohr magnetons of magnetic moment due to orbital motion, and two each due to spin.¹¹ The magnetic effects of the remaining electrons will pair off, and cancel.

Thus each atom will contribute 30 Bohr magnetons of magnetons of magnetic moment. In one cubic centimetre of iron, of density about 8 and atomic weight 55 there are $(6.025 \times 10^{23} \times 8)/55 = 8.8 \times 10^{22}$ atoms. The number 6.025×10^{23} is Avogadro's number.

So the magnetic moment per c.c. of the iron is, according to this argument, $30 \times 8.8 \times 10^{22}$ Bohr magnetons. Since a Bohr magnet is about 9.27×10^{-21} c.g.s. units of magnetic moment in these units, the magnetic moment per unit volume, or magnetization, of the iron is about 2.44×10^4 .

Actually, a more realistic estimate for the iron would have been 2 Bohr magnetons per atom. That would make the magnetization of iron at saturation about 1,600, which figure agrees fairly well with experimental results. But continue here to use the figure 2.44×10^4 .

The volume of Venus is about 1.06×10^{27} c.c.; that of Mars about 1.68×10^{26} . So multiplying by 2.44×10^4 gives the magnetic moments of the planets: 2.60×10^{31} and 4.10×10^{30} respectively.

Consider the planets when they are just about touching, their centers being say 10^9 cm apart. (Which is approximately the sum of their radii.) From what was said above, the force between them, the magnetic force that is, would be $6 \times 2.60 \times 10^{31} \times 4.10 \times 10^{30} / 10^{36} = 6.4 \times 10^{26}$.

From what was said during the discussion of electrostatic forces, the force of gravity between the planets (their centers being 10^9 cm apart) would be about 2.05×10^{29} dynes.

Thus the magnetic force is less than one percent of the gravitational. Moreover, since the magnetic force varies inversely as the fourth power of the distance, the gravitational as the square, at greater distances the comparison would be even less favourable for the magnetic force.

Thus it appears that magnetic forces between the planets could not have had an appreciable effect in re-arranging orbits.

References

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AN APT APHORISM BY ATHANASIUS

"In regard to the making of the universe and the creation of all things there have been various opinions, and each person has propounded the theory that suited his own taste. For instance, some say that all things are self-originated and, so to speak, haphazard. The Epicureans are among these; they deny that there is any Mind behind the universe at all. This view is contrary to all the facts of experience, their own existence included. For is all things had come into being in this automatic fashion, instead of being the outcome of Mind, though they existed, they would all be uniform and without distinction. In the universe everything would be the sun or moon or whatever it was, and in the human body the whole would be hand or eye or foot. But in point of fact the sun and the moon and the earth are all different things, and even within the human body there are different members, such as foot and hand and head. This distinctness of things argues not a spontaneous generation but a prevenient Cause; and from that Cause we can apprehend God, the Designer and Maker of all."

"Others take the view expressed by Plato, that giant among the Greeks. He said that God had made all things out of pre-existent and uncreated matter, just as the carpenter makes things only out of wood that already exists. But those who hold this view do not realise that to deny that God is Himself the cause of matter is to impute limitation to Him, just as it is undoubtedly a limitation on the part of the carpenter that he can make nothing unless he has the wood. How could God be called Maker or Artificer if His ability to make depended on some other cause, namely on matter itself? If He only worked up existing matter and did not Himself bring matter into being, He would not be the Creator but only a Craftsman."

(From *De Incarnatione Verbi Dei* by St. Athanasius. Translated and edited by a Religious of C. S. M. V. Second Edition. Published by A. R. Mowbray and Co., Ltd., 1953.)
(This item was called to my attention by B. B. Knopp, Eastbourne, England—Editor)

NITTING OR KNITTING

WILLIS E. KEITHLEY*

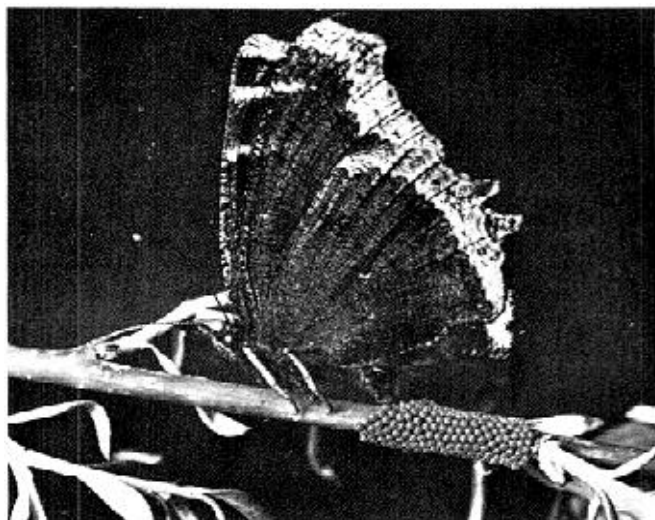


Figure 1. Mourning Cloak butterfly, *Vanessa (Nymphalis) antiopa*, depositing eggs on willow.

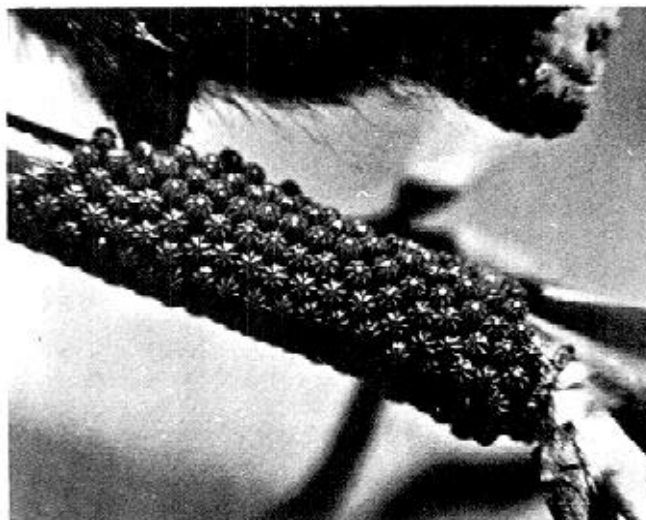


Figure 2. Eggs of Mourning Cloak butterfly, much enlarged. Actual size 0.5 mm. diameter.

Nit-picking is a popular pedantic pastime. Nowhere is this seen more clearly than in the creation controversy.

The battle lines are sharply drawn against the nits of naturalism and the nots of negativism. The daggers of dogma are honed to a fine edge, and the spears of satire are pointed and poised.

But when the decks are cleared and the smoke screen is lifted, we find the Mourning Cloak butterfly in Figure 1 still impassively laying her eggs on the willow branch, giving tacit credence to the fact that nit-planting is a more constant pastime than nit-plucking.

As the arrows of argument fall, the sheer symmetry of this elegant egg clutch in Figure 2 forcibly banishes all banal debate of capricious chance or random variation. Their mosaic of sculptured shells realign one's perspective to a new appreciation of things "no bigger than a nit."

The creationist or design rationale has been blunted by the abstract dialectics of chromosomes and genes, and most minds are boggled by the revelation of the staggering potential stored in each of those pin-sized mini-worlds.

Who could guess that each of those micro-marvels contains the entire blueprint for a completely self-acting aircraft, with power plant, stabilizing systems and aerodynamics already verified for quality control and reliability? Nor is there any evidence that the plans were ever subjected to any preflight testing, or trial and error operations, but come exquisitely packaged with the proven guarantee that the trillionth copy will be a perfect duplication of the original.

Think with me for a moment on the complexity of this self-contained airship. Imagine a fuselage of three compartments supported by six highly maneuverable landing gears capable of adhering to almost any surface at any angle. Constructed of rigid tubes with internal joints and musculature, they provide the highest degree of strength and efficiency with a minimum of weight.

A pulsating tube circulates nutritive fluids throughout the ship, while a separate plumbing system of trachea and spiracles provides oxygen for metabolism and temperature control. Thermal balance seems to be further maintained by rod-like body hairs which allow heat dissipation in flight, and may also aid in navigation by acting as a kind of TV antennae for infra-red radiations.¹ The operating efficiency is one of the highest known, with capacity for cruising hundreds of miles on little or no fuel.

The wing structure is one of intricate and functional design. The delicate venation of ribs and struts is so designed as to provide the ultimate in stress and stability. The framework is tightly covered with an imbrication of a million microscopic scales, each one a perfect diffraction grating, and each one individually placed to produce a consistent color pattern. And the whole thing comes folded up like a parachute, to be unfurled and inflated a few moments before takeoff!

The navigational equipment of this animated space ship defies description or comprehension. The antennae are covered with thousands of sensory receptors capable of detecting minute temperature and environmental changes, and even dainty odors from several miles away. It was this delicate sense that directed her to a particular willow branch on which to deposit her eggs.

The eyes are a composite of thousands of lenses; and they are sensitive not only to ultraviolet light for higher resolution and detail, but also sense the polarization of sky light to create a very sensitive optical compass for orientation of flight.

The Central Intelligence Agency that directs this phenomenal flying machine is a built-in computer, complete with a prerecorded life-time tape. Here is already logged, not only assembly instructions for pupation and metamorphosis, operating manuals for each instinctive response and all future flights, but even directions for replication before obsolescence.

And all this is contained within a few submicroscopic strands of DNA, about which volumes have already been written; enclosed in a dramatically decorated urn no larger

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than the dot on this *i*, with a complex of aeropyles for diffusion of oxygen that comprises a mystery²; and the motivating power and design initiated by—oops—I almost said “by a Divine Creator!” But then, that would be nit-picking, wouldn’t it? Surely if a miniscule butterfly egg can produce such wonders of development from gene to genius, it shouldn’t need any outside help, should it?

But nitting is just like knitting; for every design there must be a Designer. For every plan there must be a Planner; and for even the lowliest nit there is the evidence of a sacred

knitting. “For the invisible things of Him from the creation of the world are clearly seen, being understood by the things that are made, even His eternal power and Godhead, so that they are without excuse.” Romans 1:20.

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AMINO ACID RACEMIZATION IN MARINE SEDIMENTS

LARRY S. HELMICK *

The spontaneous diagenesis which occurs after death of an organism results in hydrolysis of the peptide bonds in proteins and racemization of the amino acid residues. The extent of racemization of amino acids has therefore been suggested as a potential dating method for samples containing proteins, such as marine sediments. In order for the method to be useful, however, three general requirements must be met: (1) the environmental conditions since deposition must be known; (2) the experimental method must provide accurate quantitative data concerning the extent of racemization which has occurred; (3) the mechanism of diagenesis must be known under the environmental conditions. The problems associated with each of these topics are discussed in detail. The existing data are then reinterpreted in a teleological framework and shown to be in agreement with the Genesis account of a worldwide flood.

Introduction

Living organisms are known to contain proteins consisting almost exclusively of L-amino acid residues. During the spontaneous diagenesis process which occurs after the death of the organism, the proteins are hydrolyzed and the L-amino acid residues are racemized to thermodynamically more stable racemic modifications consisting of equal quantities of the L- and D-amino acids. If environmental conditions are such that racemization occurs at a rate which can be determined, then the extent of racemization observed in material of biogenetic origin might provide an indication of the length of time which has passed since the death of the organism.

Consequently, the extent of racemization of amino acids has been suggested as a new and independent method for determining the age of biogenetic material. Since the basis of the method was first reported in 1967, it has been used to determine the ages of ocean sediments, shells, bones, and corals.¹

Independent dating of marine sediments by the racemization of amino acids is based on five assumptions: (1) proteins contained amino acid residues of only the L-configuration when deposited; (2) no alteration of the sediments has occurred since deposition; (3) the extent of racemization can be accurately determined; (4) the mechanism and rate of racemization are known; (5) the mechanism of diagenesis is known.

In this paper each of these assumptions will be examined in detail, the problems associated with the application of this dating method to marine sediments will be analyzed, and a reinterpretation of existing data, consistent with the Genesis account of a recent worldwide flood, will be presented. Some of the problems associated with the amino acid racemization dating method have been presented recently.^{2,3}

Original Configurations of Amino Acids

It has been assumed that amino acid residues preserved in sediments originally consisted of only the L-enantiomers.

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Racemization then produces increasing concentrations of D-enantiomers with time. The extent of racemization is, therefore, proportional to the length of time since formation of the sediment. Presence of D-enantiomers in the sediment at the time of formation, however, would cause the sediment to appear older than it actually is.

Consequently, the magnitude of the calculated age is highly dependent on the enantiomeric purity of the original amino acids in the sediment. For accurate results this purity must be known.

Amino acids are preserved primarily in the form of proteins. The proteins of living organisms are known to consist almost exclusively of L-amino acids although D-amino acids have been reported to occur in small quantities in bacteria, insects, worms, and algae.⁴ D-amino acids are also formed in equal quantities with L-amino acids in all synthetic reactions not involving chiral reaction conditions. Furthermore, D-amino acids are continuously being formed by spontaneous racemization of biogenetic L-amino acids.

The extent to which D-amino acids from any of these sources have been included in marine sediments, however, appears to be small. Bound amino acid⁵ and total amino acid⁶ analyses of the top few centimeters of marine sediments, which are apparently of recent origin and therefore would contain very small amounts of D-amino acids produced by racemization after the sediment was formed, indicate that they contain L-amino acids almost exclusively.

Thus it may be assumed that deeper sediments also contained only L-amino acids when they were formed, unless there has been a marked change in the stereochemistry of the proteins in living organisms in the recent history of the earth. Such a change is not predicted by use of either the evolutionary or teleological theory.^{**} Furthermore, the complexity of the chemistry of living cells makes this alternative seem highly unlikely.

Alteration of Marine Sediments

Alteration of marine sediments may involve either large-scale mixing of old and new sediments or diffusion of

^{**}Teleology refers to the study of evidence relating to design of natural processes, as opposed to a purely mechanical causation. The teleological theory of origins refers here to a recent highly ordered divine creation, followed by degeneration and a worldwide flood, as described in Genesis.

amino acids into or out of the undisturbed sediments. Neither method has been investigated in detail, but either one could result in serious problems for researchers using the racemization dating method. The possibility of mixing of gross sediments on a worldwide scale is undoubtedly the most serious and will be considered shortly.⁷

Studies on the diffusion of amino acids into or out of shells⁸ indicate that both can occur to some extent under simulated geological conditions, and thus might also occur in sediments. Similarly, diffusion of free amino acids into or out of fossil bones⁹ has been suggested in order to explain anomalous results, and a method has been developed for determining whether contamination has actually occurred. However, the validity of the method has not yet been confirmed, and disagreement exists as to whether some bones are actually contaminated when data are analyzed by this method.^{10,11}

Contamination by recent amino acids has also been suggested in order to explain the lack of racemization and the presence of thermally unstable amino acids in much of the geologic column,¹² including Precambrian strata such as the supposedly three billion-year-old Fig Tree chert¹³ and two billion-year-old Gunflint chert.¹⁴ Nevertheless, "to what extent these materials can move around in the geologic column is not clear."¹⁵ In fact, these observations may be more consistent with a teleological theory of origins than with an evolutionary theory.¹⁶

Since the teleological theory is based on a recent creation, it is not necessary to suggest that extensive contamination has occurred in order to explain the data. Yet the potential for contamination of marine sediments exists, and the effects need to be considered.

Since free amino acids in sediments are known to be more extensively racemized than peptide or protein-bound amino acids, preferential diffusion of free amino acids into or out of the sediment would alter the extent of racemization observed for the total amino acid analysis of the sample. Due to lower solubility, the peptide and protein fractions would presumably be much less susceptible to alteration by diffusion. However, as the concentration of amino acid residues in a sample decreases, as it does with increasing age, the potential effect of alteration increases.¹⁷

Both diffusion of highly racemized free amino acids out of the sediment and contamination by recent L-amino acids would serve to lower the ratio of D- to L-amino acids found in the total amino acid analysis and cause the sediment to appear younger than its true age. Except for very old sediments, however, alteration by diffusion is probably insignificant. Although laboratory blanks are often run in order to detect contamination during processing, they reveal nothing about *in situ* contamination before collection.¹⁸

Major Factors Affecting Analytical Data

In order to use the extent of racemization of amino acids for determination of absolute ages of sediments, quantitative data are required. Thus the investigator must be able to determine accurately the precise concentration of each stereoisomer of the amino acid of interest in the sample.¹⁹ The ratio of concentrations of D- to L-amino acid then gives the degree of racemization. At this point, several major analytical problems have been encountered.

In any given sample, amino acids exist in at least three different states (protein, peptide, and free) due to incomplete hydrolysis of the proteins. Some investigators have not distinguished between these three states but simply reported the ratio of D-alloisoleucine to L-isoleucine for only the bound, free, or total amino acids present. However,

one attempt has been made to determine the extent of epimerization²⁰ of L-isoleucine for all three states of amino acids.²¹ Thus it is now known that the extent of racemization increases with the extent of *in situ* hydrolysis. Protein exhibits very little racemization while free amino acids are highly racemized.

Although data undoubtedly would be more meaningful if they were all separated in this way, accuracy and reproducibility appear to suffer when they are. While results by different workers on the same core are only slightly different for total amino acids, they are grossly different for the free amino acid fraction.²²⁻²⁴ This difference has been attributed to the use of a new method of analysis involving esterification of the free amino acids.²⁵ This method may have also resulted in hydrolysis and esterification of some of the peptides present in the free amino acid fraction. Since peptides have a lower degree of racemization than free amino acids, this would greatly lower the apparent extent of racemization in the free amino acid fraction. It still remains to be determined whether this is indeed the case.

Furthermore, Wehmiller and Hare²⁶ have reported that racemization in the free amino acid fraction of core V23-110 decreases with depth, rather than increases. Yet Kvenvolden *et al.*²⁷ reported increasing racemization with depth for the same core. In addition, Bada²⁸ has reported that the D-alloisoleucine/L-isoleucine ratio in the free amino acid fraction is only 0.61 for a 20,000-year-old sample and 0.81 in a 93,000-year-old sample, while Wehmiller and Hare²⁹ reported much larger ratios for supposedly younger samples (1.3 for a sample greater than 0 years old and 1.0 for one 3,000 years old).

The validity of the independent geological dating methods used to verify the racemization dating method is also highly significant. For example, Bada originally thought that ages for sediments could be calculated directly from laboratory data on the rate of racemization of free amino acids and the present ocean bottom temperature.³⁰ In this way, the age for the bottom of a sediment core from the Mid-Atlantic ridge was determined and thought to be in agreement with the age determined by paleomagnetic and radionuclide decay techniques.³¹

However, the age was later revised downward from 1.23 million years to 96,000 years for two reasons: (1) it had been demonstrated that racemization in shells³² and sediments³³ occurs at elevated temperatures about an order of magnitude faster than free amino acids under similar conditions, and (2) the extent of racemization in other supposedly younger cores dated by magnetic reversals, paleontology, and radionuclide decay had been found to be considerably greater than in Bada's core.³⁴ Thus the original results from the paleomagnetic and radionuclide decay methods were assumed to be invalid.

In addition, the elevated temperature data and geological data were thought to provide concordant ages.³⁵ Nevertheless, as will be noted later, there are problems associated with determining rates of racemization at elevated temperatures and extrapolating to determine rates at environmental temperatures. Furthermore, application of ¹⁴C dating to sediments does not always give consistent results,³⁶ and results from application of the various geological dating methods on fossil bones has been termed "strongly discordant."³⁷ Finally, use of radionuclide decay dating methods to empirically calibrate the amino acid racemization method^{38,39} results in a secondary dating method. This approach would simply magnify the uncertainties already noted in the radionuclide decay methods,^{40,41} and would not result in independent dates.

Minor Factors Affecting Analytical Data

Three minor factors affecting the accuracy and reproducibility of the analytical data have also been identified. While some work has involved analysis of the gross sediment from a core segment, other studies have been done on only the foraminifera fraction. Application of these two procedures to the same core segment (400 cm segment of core CH96-G12), however, resulted in detection of slightly different degrees of racemization.^{42,43} Although the differences are small, the exact extent of racemization detected may depend somewhat upon the fraction of the core segment selected for analysis.

Secondly, the concentration of amino acids may be extremely low under certain conditions and difficult to measure accurately. Consequently, results may not be reproducible.⁴⁴ This generally occurs for D-amino acids in young sediments, due to insufficient time for extensive racemization to occur, and for both D- and L-amino acids in old sediments. Extremely low concentrations can result in relatively large percentage errors in measurement and thus large errors in the calculated extent of racemization.⁴⁵

Even at higher abundances, 30% errors in determination of concentrations in duplicate analyses have been reported⁴⁶, although the error in the ratio of D- to L-amino acids was considered to be only 5%. To reduce the possibility that minute amounts of amino acids in reagents might dominate the analysis of samples with low amino acid concentrations, reagent blanks are often run.

Finally, acid hydrolysis of proteins to free amino acids is necessary in order to identify the amino acids and determine the extent of racemization which has occurred in the sample. Any racemization which occurs during hydrolysis must be deducted from the observed degree of racemization in order to determine the extent of *in situ* racemization which has occurred. However, the literature contains contradictory reports as to whether racemization occurs to any appreciable extent during acid-catalyzed hydrolysis of proteins in refluxing 6N hydrochloric acid.

Bada reported that no detectable racemization occurred,⁴⁷ although a latter report claimed that a small amount is produced.⁴⁸ Hare reported that "insignificant" amounts of D-amino acids are formed from either free L-amino acids or shell protein under acid-catalyzed hydrolysis conditions.⁴⁹ Yet Wehmiller and Hare stated that "significant" racemization occurred in three out of four samples of marine sediments tested.⁵⁰ Perhaps the following discussion of the mechanism of acid-catalyzed racemization of free amino acids and the mechanism of acid catalyzed hydrolysis of proteins would help to resolve this question.

In solutions more acidic than pH 1, racemization of free amino acids proceeds by protonation of the carbonyl oxygen, followed by enolization (Figure 1).⁵¹ Experiments designed to detect hydrogen exchange and thus racemization, using tritium labeling, indicated that ten free amino acids, including isoleucine, racemize less than 3% when refluxed for 22 hours in 6N hydrochloric acid.⁵² Although this demonstrates the stability of amino acids after hydrolysis, it reveals nothing concerning the potential for racemization during the hydrolysis reaction itself.

Some amino acid residues in peptides are racemized to the same extent as the corresponding free L-amino acids. This may indicate that protonation of the peptide bond, which is favored over formation of the conjugate acid of the free carboxylic acid group, results first in hydrolysis followed by racemization of the free amino acids which are released. Increased

racemization of amino acid residues compared with that observed with free amino acids may be due to an interaction between adjacent residues, as in bacitracin A, or to an increased ease of protonation of the α -CO₂H group of a peptide caused by the decreased tendency of protonation of the adjacent peptide group.

Several of racemization during hydrolysis of peptides have been reported. Thirteen percent racemization of glutamic acid in myoglobin, and 9% racemization in insulin have been attributed to acid hydrolysis. Approximately 8% racemization of the two phenylalanine residues in bradykinin has been attributed primarily to the residue in the L-Phe-L-Ser sequence. "Acid hydrolysis of one of the ergot alkaloids causes complete inversion of configuration of a L-proline residue."⁵⁴

Twelve percent racemization of the only leucine in bacitracin A may be due to interaction with the adjacent cystine. One of the L-isoleucine residues in bacitracin A "forms a thiazoline ring with the adjacent cystine" and is completely epimerized during acid hydrolysis. Since there are three isoleucine residues in bacitracin A, the observed⁵⁵ degree of epimerization for isoleucine is 33%.

Since L-isoleucine has been used more extensively than other amino acids in dating marine sediments, epimerization of L-isoleucine when bonded to cystine demonstrates that a potential problem exists for the racemization dating method. Even a small degree of racemization during hydrolysis would result in apparent ages which are older than the correct ages.

Thus there are presently several unresolved analytical problems involving primarily accuracy and reproducibility of data. Some of the problems may originate in the different analytical methods used for determination of the extent of racemization. Still others may originate in the dates which have been determined for the cores by other geological dating methods.

Mechanism and Rate of Racemization

The importance of knowing the rate constant for racemization under environmental conditions cannot be overestimated. "Obviously, the rate constant for the reaction must be known accurately if age is to be calculated, but its value is difficult to assess."⁵⁶ The major factors generally considered to influence the rate constant for racemization of amino acids in sediments are peptide bonds and temperature.

In order to determine the rate constant for racemization under environmental conditions, it is necessary to have an understanding of the mechanisms by which racemization occurs in free amino acids, peptides, and proteins. Each of these might be expected to have a particular mechanism and rate of racemization, and also a specific set of factors which would influence the rate. Thus far, only the factors involved in controlling the rate of racemization of free amino acids have been determined quantitatively. Qualitative results on the racemization of peptides are also available. However, little is known concerning the racemization of proteins under environmental conditions.

In solutions between pH 1 and pH 13, three different species of free amino acids are generally involved in racemization: $\dot{N}H_3CHRCO_2H$ (+0), $\dot{N}H_3CHRCO_2^-$ (+-), $NH_2CHRCO_2^-$ (0-).^{57,58} Due to formation of carbanions of different stability, racemization proceeds at different rates for each species. The cation (+0) is most reactive while the anion (0-) is least reactive. The observed rate (k_{obs}) is the sum of the individual rates of racemization: $k_{obs} =$

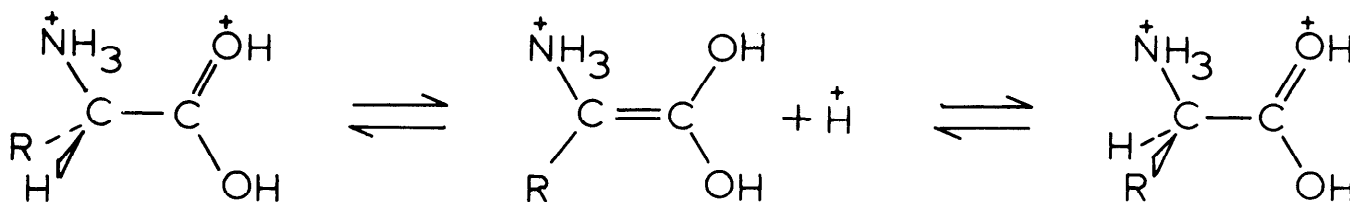


Figure 1. Acid-Catalyzed Racemization of Free Amino Acids.

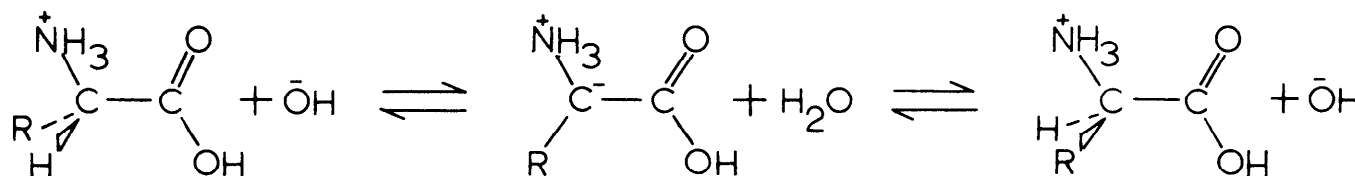


Figure 2. Base-Catalyzed Racemization of Free Amino Acids.

$(k_{+0} [+0] + k_{+-} [+-] + k_{0-} [0-]) [OH^-]$, where k is the rate constant and $[]$ is the concentration of each species.

Carbanion stability and thus rate constants for racemization of different free amino acids have been found to be dependent upon the relative inductive effects of the corresponding substituents, R .⁵⁹ Similar effects of substituents in aromatic nitrogen heterocycles have been observed.⁶⁰

The rate-determining step of the reaction involves abstraction of the α -hydrogen by hydroxide⁶¹ (Figure 2). Racemization is, therefore, a second-order reaction. If the hydroxide concentration is constant, first-order kinetics is observed. However, since the relative concentration of each species is also dependent on the hydroxide concentration, the observed rate of racemization appears to be independent of hydroxide between pH 5 and 8.

Consequently, racemization occurs at a minimum but nearly constant rate in the environmental pH range from 5 to 8 and increases as the medium becomes either more acidic or more basic.⁶² Since ocean bottom environments have probably not experienced extreme fluctuations from their present pH of 7.6, it is unlikely that changes in acidity would have any major effects on the rate of racemization of free amino acids in sediments. However, small local fluctuations would probably serve to increase the rate, making the sediment appear older than its true age.

The rates of base-catalyzed hydrogen-deuterium exchange, and consequently racemization,⁶³ have been determined for individual residues in peptides using nuclear magnetic resonance spectroscopy.⁶⁴ At room temperature and pH 13.1, it was found that the central residues of tri- and tetrapeptides showed considerable exchange after only a few hours. For example, in Gly-Gly-Gly, the half-time for exchange of the middle Gly was approximately 5 hours. The terminal residues were inert.

Furthermore, free glycine and the dipeptide, Gly-Gly, showed no exchange of the α -hydrogens in 21 hours. For comparison, the half-time for racemization of free aspartic acid at 25° and pH 12.0, calculated from elevated temperature data, is 4×10^6 hours.⁶⁵ Thus it appears that racemization occurs at considerably faster rates in the central residues of polypeptides than in terminal residues or in free amino acids in strongly alkaline solutions.

This tremendous reactivity difference may be attributed primarily to stabilization of the intermediate carbanion by two peptide bonds. Indeed, the strongly activating effects of acylation of the amino group and conversion of the carb-

oxylate group to a carboxamide have been demonstrated.⁶⁶ From this, the following order of reactivity can be established: $RCONHCHRCONHR > RCONHCHRCO_2^-, NH_2CHRCONHR > NH_2CHRCO_2^-$. Thus racemization occurs at reasonable rates under these conditions only for amino acid residues which are activated by two peptide bonds.

The mechanism for base-catalyzed racemization of free amino acids has been shown to change from rapid racemization of $NH_2CHRCO_2^-$ at pH 12.5⁶⁷ to rapid racemization of NH_3CHRCO_2H at pH 7.5.⁶⁸ Thus the mechanism of racemization in peptides might also be expected to depend on acidity and to change when the pH is lowered from 12.5 to 7.5. This increase in acidity would have two effects.

One would be to greatly decrease the rate of racemization of the central residues due to the 10^5 fold decrease in hydroxide concentration. The second would be to increase the concentration of the protonated N-terminal residues. Since the protonated amino group has been shown to be a stronger activating group than the acetamido group,⁶⁹ the protonated N-terminal residues should then be the most reactive residues present ($NH_3CHRCONHR > RCONHCHRCONHR$). Consequently, these two effects would result in a change from rapid racemization of the central residues of peptides at pH 12.5 to rapid racemization of the N-terminal residues at pH 7.5.

Qualitative Rate Comparison

A qualitative comparison of the rate of racemization of N-terminal residues with free amino acids may also be made. It has been shown that $NH_3CHRCONHR$ and NH_3CHRCO_2H have approximately the same rates of racemization.⁷⁰

Although NH_3CHRCO_2H is the major species contributing to the rate of racemization at pH 7.5, it represents only one part in 10^5 of the total amount of amino acid present. The rest exists as $NH_3CHRCO_2^-$, which is much less reactive.⁷¹

In the case of N-terminal residues, however, essentially all of the material is present in the more reactive form, $NH_3CHRCONHR$, since ionization of a carboxyl group is not possible. Thus the N-terminal residues of a peptide should be subject to racemization at a rate which is considerably faster than that for either central residues, C-terminal residues, or free amino acids, under environmental conditions.

This mechanism is in agreement with previous suggestions that racemization in marine sediments may be occurring via the N-terminal residues of peptides.⁷² It also would explain the rapid rate of racemization which is thought to be occurring during hydrolysis of proteins to free amino acids under environmental conditions,⁷³ but for which no satisfactory mechanism has yet been proposed.⁷⁴

Effect of Temperature

The effect of temperature on the rate constant for racemization also has been investigated. The rate of racemization of free amino acids is highly temperature dependent, generally doubling for each 4 to 5°C rise in temperature.⁷⁵ Attempts to determine the effect of temperature on the rate of racemization of *in situ* amino acid residues in sediments have not been as successful.⁷⁶

Apparent first-order rate constants for racemization were determined by heating samples with water in sealed tubes at various temperatures.⁷⁷ An Arrhenius graph of these rate constants appeared to give a straight line from which the apparent energy of activation for racemization was calculated.

However, this method for determining the energy of activation for racemization of *in situ* amino acid residues is acceptable only if racemization of proteins is fast relative to hydrolysis or if hydrolysis of proteins and peptides is fast compared with racemization of free amino acids, and only if the rate constant for racemization can be determined. As will be noted shortly, there is evidence that neither one of these mechanisms of diagenesis is correct.

Furthermore, for one sediment sample heated at 148.7°C, it was clearly shown that a plot of the kinetic data was not linear. The reaction did not follow first-order kinetics. Consequently, the first-order rate constant could not be determined. Instead, only the initial rate was estimated from the graph and used to determine the Arrhenius energy of activation. Kinetic data were not reported at other temperatures, but apparently only the initial rates were estimated and reported for the same reason.

Consequently, it is not at all clear just what is represented by the energies of activation which have been determined. It is clear, however, that these energies of activation may result in invalid rate constants for racemization of amino acid residues in sediments under environmental conditions. Obviously, use of an inaccurate rate constant to calculate the length of time required to produce the observed degree of racemization in a sediment core would result in an inaccurate age for the sediment.

In any event, the maintenance of a constant known temperature is necessary to obtain rates of racemization from which ages may be calculated. Consequently, only samples such as marine sediments, which are assumed to have experienced minimal temperature fluctuations during their history, are selected for racemization dating. The temperature fluctuations represented by the well-established and recent worldwide warm climate,⁷⁸ and an even more recent ice age,⁷⁹ are generally ignored. Instead, the present temperature is considered to be representative of the average temperature during the history of the sample, and is used in age calculations.⁸⁰

Although average temperatures in the southeastern United States may have dropped as much as 15°C during the glacial period,⁸¹ cooling effects during a short glacial period would be expected to introduce minimal errors in the calculated ages for marine sediments, since the ocean bottom temperatures are already 2° to 4°C and could not become much colder. (Ocean water freezes at -1.5°C.)

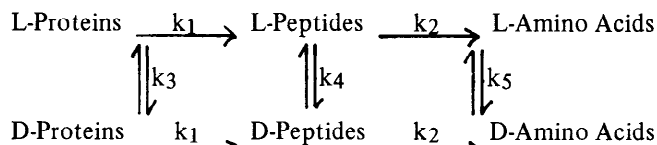


Figure 3. Diagenesis of L-Proteins to Racemic Free Amino Acids.

However, considerably higher ocean bottom temperatures, and thus faster rates of racemization, may have been experienced due to the absence of cold bottom water flowing from the Arctic and Antarctic during the period of a worldwide warm climate.⁸² Consequently, any errors in this assumption would tend to make marine sediments appear older than they actually are.

Mechanism of Diagenesis

"In any event, the use of racemization as a chronological tool will depend on a thorough understanding of the diagenetic reactions of amino acids in the particular system under study." However, "the kinetics of racemization observed in hydrolysates of fossil or sediment samples depend on a variety of time constants, none of which is easily evaluated."⁸³ Consequently, determination of the mechanism of diagenesis is a significant but complex problem.

Several mechanisms for diagenesis of proteins to racemized free amino acids (Figure 3) are conceivable: (1) fast racemization of proteins followed by slow hydrolysis to peptides and free amino acids ($k_3 > k_1, k_2$); (2) fast hydrolysis of proteins and peptides followed by slow racemization of free amino acids ($k_1, k_2 > k_5$); (3) slow hydrolysis of proteins and peptides followed by fast racemization of free amino acids ($k_5 > k_1, k_2$); (4) slow hydrolysis of proteins and peptides followed by fast racemization of N-terminal residues of proteins and peptides.

Two kinds of evidence eliminate the first mechanism (racemization followed by hydrolysis), but support the remaining three (hydrolysis followed by racemization): (1) the large extent of racemization observed in the free amino acid fraction relative to the protein and peptide fractions of sediments,⁸⁴ and (2) the absence of racemization in fossil bones preserved under anhydrous conditions,⁸⁵ and in shells heated without water.⁸⁶ The following data concerning the relative rates of hydrolysis and racemization are significant when considering the remaining three mechanisms:

Partial hydrolysis of proteins has generally been found to produce a fairly specific set of peptides under a given set of conditions.⁸⁷ This is because some peptide bonds are considerably more susceptible to cleavage than others. Rates may vary over two or three powers of ten.⁸⁸ Hydrolysis of the most labile bonds occurs rapidly, then the rate decreases as less labile bonds remain to be hydrolyzed. This decreasing rate of hydrolysis of protein has been cited to explain the presence of incompletely hydrolyzed proteins in presumably old samples.⁸⁹

Due to both acid and base catalysis, the rate of hydrolysis of amides depends upon the acidity of the solution. The reaction is fast in acidic solutions, decreases in rate as the acid concentration decreases, then increases in rate again as the solution becomes basic. The rate of hydrolysis of proteins to free amino acids via peptides may be similar, with minimum rates observed in neutral solutions.

It is well known that hydrolysis of proteins is faster than racemization in strongly acidic solutions.⁹⁰ However, in basic solutions, hydrolysis is slower than

racemization.^{91, 92} Thus the relative rates of hydrolysis and racemization reverse as the acidity decreases. In neutral solutions, little comparative data is available.^{93, 94} However, in 50% deuterioacetic acid-deuterium oxide solutions, hydrogen-deuterium exchange of amides has been reported with no mention of hydrolysis.⁹⁵ Thus hydrolysis of peptides may still be slower than racemization in neutral and weakly acidic solutions.

Racemization of free amino acids is known to follow first-order kinetics⁹⁶ while hydrolysis of proteins does not.⁹⁷ If the *second mechanism* of diagenesis (fast hydrolysis of proteins and peptides followed by slow racemization of free amino acids) is correct, then rates of racemization determined at elevated temperatures on recent sediments would be expected to exhibit first-order kinetics. This has not been observed.⁹⁸ Consequently, the rate-controlling step in diagenesis at elevated temperatures appears to be hydrolysis rather than racemization. If this is the case under environmental conditions, then the second mechanism may be eliminated.

If the *third mechanism* of diagenesis (slow hydrolysis of proteins and peptides followed by fast racemization of free amino acids) is correct, then the rate of racemization in sediments should be slower than the rate determined for free amino acids. However, it has been shown that amino acid residues in sediments⁹⁹ and shells¹⁰⁰ racemize an order of magnitude faster than free amino acids under similar conditions. Thus it has been proposed that rapid racemization of free amino acids under environmental conditions is occurring by a mechanism involving metal ion catalysis.¹⁰¹

Catalysis of racemization of amino acids by metal ions such as Cu^{+2} and Al^{+3} has been reported in dilute alkaline solution.¹⁰² Catalysis is produced by stabilization of the intermediate carbanion due to chelation of the amino group. Racemization of alanine and valine in the complex $Co(ethylenediamine)_2$ amino acid⁺² is first order in hydroxide. Extrapolation of rate data obtained at 34.3°C indicates that chelated alanine is about 3000 times more reactive than nonchelated alanine at pH 7.6 and 0°C.

Thus such a mechanism involving metal ion catalysis may be able to account for the high degree of racemization observed in the free amino acid portion of older sediments if the amino acids are completely complexed. If only a small fraction of the amino acids is complexed,¹⁰³ the rate enhancement may be insufficient to account for the high degree of racemization found in the free amino acid portion of recent sediments.¹⁰⁴

However, the *fourth mechanism* (slow hydrolysis of proteins and peptides followed by fast racemization of N-terminal residues of proteins and peptides) is able to account for the high degree of racemization in the free amino acid fraction even in recent sediments.

Peptides represent a general class of low molecular weight amino acid polymers including dimers, trimers, tetramers, etc. The process of hydrolysis to free amino acids may involve cleavage of the central peptide bonds of larger peptides to produce two smaller ones, or it may involve cleavage of either of the terminal peptide bonds to produce a free amino acid and a smaller peptide.

If racemization of the N-terminal residues is faster than hydrolysis of the N-terminal peptide bonds under environmental conditions, then the N-terminal residues should be highly racemized before hydrolysis to free amino acids occurred. Consequently, a high ratio of D- to L-amino acids in the free amino acid fraction should be observed even in young samples. However, whenever C-terminal re-

sides are hydrolyzed, only L-amino acids would be produced. Thus the free amino acid fraction should not be completely racemized.

Furthermore, the ratio of D- to L-amino acids in the free amino acid fraction should be considerably higher than the corresponding ratio in the peptide fraction. This would be due to the large number of unracemized central and C-terminal residues relative to the number of racemized N-terminal residues in the peptide fraction. In addition, the ratio of D- to L-amino acids in the protein and peptide fractions should increase with time, as the larger proteins and peptides are hydrolyzed to smaller ones, producing a larger ratio of racemized N-terminal residues relative to unracemized central and C-terminal residues.

Observations are in agreement with all of these predictions.^{105, 106} Consequently, the major features of this mechanism of diagenesis involving slow hydrolysis of proteins to peptides followed by fast racemization of N-terminal residues of peptides and slow hydrolysis of peptides to free amino acids appear to be in agreement with the geological data from marine sediments as well as the laboratory data on proteins, peptides, and free amino acids.

If this mechanism is correct, the concentrations and rates of racemization of peptides and free amino acids will be controlled primarily by a decreasing rate of hydrolysis of proteins. Therefore, the observed rate of racemization for the total system would not fit first-order kinetics. Consequently, observations of first-order kinetics for racemization in marine sediments over long periods of time under environmental conditions would not be expected.

Thus it is now difficult to understand how meaningful ages for sediments could be calculated from the extent of racemization observed for the total amino acid fraction of the sample and the first-order rate constant for racemization of either free or *in situ* amino acids, as has been attempted. Nevertheless, according to geological data, the degree of racemization is a function of depth, and this may have a significant impact on the evolutionary and teleological theories.

Reinterpretation of Data

Evolutionary theory is based upon the principle of uniformitarianism which involves the concept that processes have always occurred at rates which are similar to those observed today. Use of the racemization of amino acids as a dating method is no exception. It is assumed that the rate of sedimentation in a given locality during the last several million years has been nearly constant and can be determined by dating one or two levels of the sediment core.¹⁰⁷ Consequently, a direct relationship between depth in ocean sediment and age is presumed to exist.

Since the rate of racemization of amino acids in ocean sediments was expected to be constant, it was assumed that the extent of racemization was not only a function of depth in ocean sediment, but also of age.¹⁰⁸ Therefore, the extent of racemization has generally been plotted versus age determined by other methods, rather than depth. If the theory is correct, nearly linear plots of racemization versus age would be expected (Figure 4,A).¹⁰⁹ Use of such a graph has been suggested as a means for determining the age of sediment when other dating methods are unavailable.¹¹⁰

The teleological theory is based upon the Genesis account of a recent creation, degeneration, and worldwide flood. The worldwide flood has tremendous implications for dating methods,^{111, 112} including those involving marine sediments.¹¹³

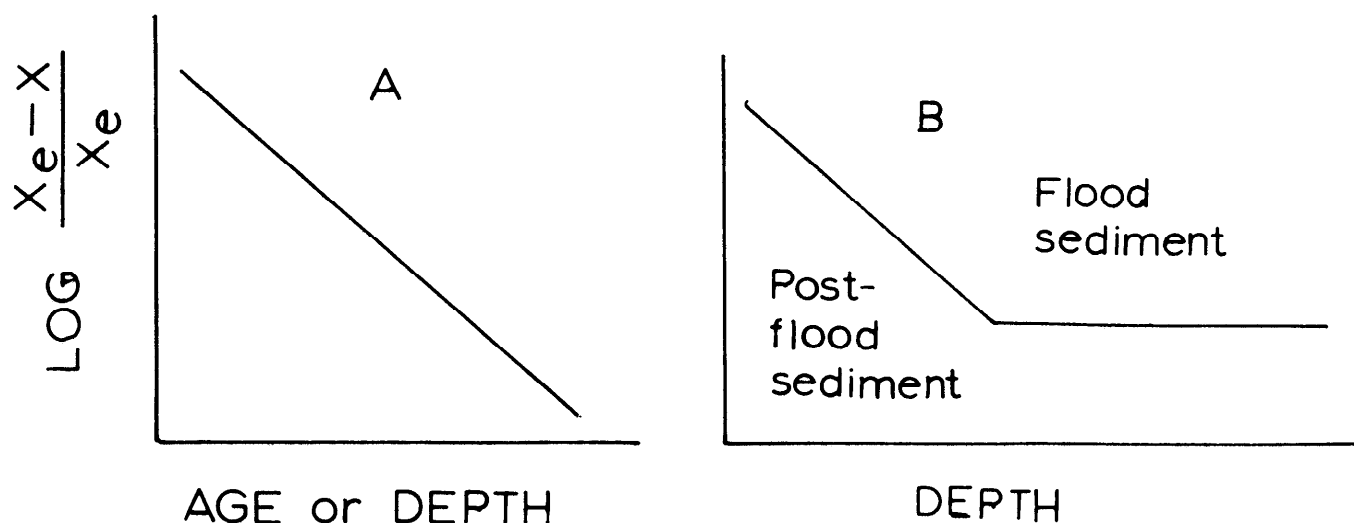


Figure 4. Extent of Racemization Versus Depth for Marine Sediments Predicted by (A) Evolutionary Theory, (B) Teleological Theory.¹¹⁰

Sediments laid down previous to the flood would have undergone more rapid amino acid racemization than is observed today, due to the higher ocean bottom temperatures produced by the worldwide warm climate. Rates of sedimentation during and immediately following the flood would also have been large,¹¹⁴ but rapidly decreased as the earth adjusted to the new geological conditions after the flood. Consequently, it may be concluded that the rates of racemization and sedimentation during the recent history of the earth have not been constant.

In addition, the effects of extensive alteration of marine sediments during the flood must be considered. Mechanisms by which this may occur are known. The extensive reworking of marine sediments due to volcanic and seismic upheavals, tidal waves, and currents during the flood have been amply described.¹¹⁵ Furthermore, the eroding effects of the first torrential rains, flooding rivers, and erupting subterranean waters would have introduced numerous layers of new sediment from land masses. Phenomena such as these might easily produce such vast and thorough mixing that little increase in the average extent of racemization would be observed for considerable depths. However, pronounced differences in the extent of racemization from one layer of sediment to the next might be expected.

These effects of a worldwide flood would result in plots of racemization versus depth in marine sediments which are not linear. Instead, it might be expected that the extent of racemization would increase with depth in present ocean sediments only for the period of time since the flood. Sediments laid down rapidly during the flood, which includes most of the geologic column, might show erratic changes from one layer to the next, but little increase in the average degree of racemization with depth. Consequently, the graph of racemization versus depth (Figure 4, B) predicted by use of the teleological theory would be strikingly different from the one predicted by the evolutionary theory (Figure 4, A).

This change in slope has actually been observed for one long sediment core (V23-110), and may be present in data from other cores (V16-39, RC8-93, V12-18, V16-205) as well.^{116, 117} It also appears to be observed for fossil corals and shells,¹¹⁸ and would account for observations of incomplete racemization throughout the geologic column.¹¹⁹

Such a change in slope is not predicted by use of the evolutionary theory and thus far has not been explained by it. However, it is predicted by the teleological theory, and would coincide with the termination of unprecedented marine turbulence and rapid sedimentation at the end of the Genesis flood. Consequently, the teleological theory appears to be superior to the evolutionary theory in accounting for the extent of racemization of amino acids in marine sediments.

Conclusions

Proteins preserved in marine sediments originally consisted almost exclusively of L-amino acids. Alteration due to diffusion of free amino acids into or out of the sediment is probably insignificant except in very old sediments. Mixing of gross sediments on a worldwide scale, however, must be considered.

Major factors affecting the accuracy and reproducibility of results include: (1) selection of the protein, peptide, free or total amino acid fraction for analysis, (2) the choice of experimental procedure for the analysis, and (3) the validity of the geological dating methods used for verification and calibration.

Minor factors include: (1) selection of the foraminifera fraction or the gross sediment for analysis, (2) the absolute concentrations of amino acids present in the sediment, and (3) the extent of racemization which occurs during acid-catalyzed hydrolysis of the proteins.

Under environmental conditions, base-catalyzed racemization occurs. Related kinetic data indicate that racemization probably involves the N-terminal residues of peptides rather than the central residues, C-terminal residues or free amino acids. N-terminal residues would be expected to racemize rapidly due to the extensive carbanion stabilization afforded by the protonated amino group and the peptide bond. Attempts to determine the first-order rate constant for racemization under environmental conditions by determining the energy of activation of *in situ* amino acids at elevated temperatures have not produced applicable results.

The mechanism of diagenesis probably involves slow hydrolysis of proteins to peptides followed by fast racemi-

zation of N-terminal residues of peptides and slow hydrolysis of peptides to free amino acids. If so, meaningful ages for sediments cannot be calculated from the extent of racemization observed for the total amino acid fraction of the sample and the first-order rate constant for racemization of either free or *in situ* amino acids.

A graph of the extent of racemization versus depth in marine sediments is not linear. Instead, a change in slope has been detected which is not predicted by the evolutionary theory. Nevertheless, it is consistent with the teleological theory, and would coincide with the end of rapid sedimentation at the close of the Genesis flood. Thus the teleological theory appears to be superior to the evolutionary theory in accounting for the geological data.

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A CATASTROPHIST JOURNAL

Many readers of the C. R. S. *Quarterly* were no doubt familiar with the journal *Pensée*, though it is no longer being published. Another journal is now being published which contains much the same kind of material.

The new journal is called *Kronos*. Inquiries about it can be sent to Warner Sizemore, Glassboro State College, Glassboro, New Jersey 08028.

The items in *Kronos* relate especially to questions raised by Velikovsky. On some points creationists will disagree, but on others they will find some common ground. Velikovsky and his followers believe in catastrophism; and catastrophism is a natural counterpart of Creationism. Most

creationists believe in at least one great catastrophe; and possibly several others, still extensive but not worldwide.

Moreover, while Velikovsky does not seem to hold a very strong doctrine of Biblical inspiration, yet in practice he uses the Scriptures with great confidence as trustworthy records. It is true that he uses other sources also; but it is likely that he uses Scripture as much as all of the other sources together.

Creationists, then, can likely find some things of interest in such a publication, and they will wish the publishers of *Kronos* success.

— Editor

A MOST URGENT JOB FOR CREATIONISTS IN 1976

REV. T. ROBERT INGRAM *

The author argues that creationists have accomplished much in the scientific aspects of their work; now it is necessary to consider very seriously the political implications, if the job is not to be left half done. Some of those political implications are considered in some detail.

Introduction

The general advance in creationist thinking seems to have reached the point where proponents must now come to grips with certain political implications. For the political implications are almost overwhelming, and they are already being skirted in efforts to force state schools to present the teaching of creation with equal fairness alongside the teaching of evolution. The school question, however, is not even the tail of the tiger; it is little more than a scouting expedition to test the strength of evolutionary forces.

To avoid the political implications is to attempt to limit the truth or falsity of historical creation to the academy, and so fall into the practice of imagining there can be somehow a separation between the truth in some or all of its aspects and its application to human affairs; or to consign the question to the realm of private opinion, which may or may not affect actions, commitments and goals that relate to the common good. For the very belief that there is or can be such a thing as "the common good" is a direct corollary of the belief that God really did create all things.

I will attempt to show here that right reason links creation unerringly to any understanding of authority, law, order, peace and wholeness of human kind. I hope this attempt will not inspire any rash attempts to ferret out some hidden deism, or naturalism, or other godless notions about how to reason without revelation.

Common Ancestor, Common Heritage

It is the Voice of God revealed in Isaiah which invites the individual to reason with Himself. (Isaiah 1:18). And I can do no better than to endorse the Puritan writer, John Flavel, in saying, "Though there be some mysteries in religion above the sphere and flight of reason, yet nothing can be found in religion that is unreasonable."¹

It is further to be believed that man, having a common ancestor in Adam, has also a common heritage. Although God confounded human speech into many tongues at Babel, speech and language retains a universality and oneness in form and structure as well as vocabulary, making translations possible. The Gospel is the same in all tongues. Had the Gentiles not been highly schooled in right reason, they never could have followed the preaching of the Apostles. Had there not already been many common assumptions held by the heathen as well as in Israel, there could have been no grounds for conversion.

Thus the early Church assumed, as did the Apostle Paul, that God had not left Himself without witness (Acts 14:17), that all human beings had a knowledge of the moral law implanted in our nature (Romans 1:18ff), and although the Image of God in humankind may be said to have been left in ruins by Adam's sin, the mark of that Image remains. Man, though a sinner, is better than the rest of the created order, saving perhaps angels.

Human nature in Christ is raised even above them, showing its potential; and even evolutionists assume that man

has dominion over the earth. Evolutionists may say man has conquered the earth instead of being put in charge, but all the same his dominion is an acknowledged state of affairs. It was fallen human nature in Noah that was commanded once again to have dominion over all living creatures.

Politics Is Dominion

It is at this point that the political implications of creation thinking become clear. For politics is dominion. Strictly speaking, the questions of politics are all eventually reduced to the question of authority. And this question, in ultimate form, may well be said to be the first and last issue of life.

The answer to this question is called religion, and the recognition of authority among men is derived therefrom. Human order, which is political by definition, must either rest upon the authority of God in the broadest sense of that word (That than which nothing higher can be imagined), or it will be found to have no ground at all.

Christ spoke of the Centurion's understanding of authority as faith (Matt. 8:10). David and Paul ascribed unreservedly all authority to God (Psalm 62:11; Rom. 13:1ff). Lord Acton, speaking for the socialist-evolutionary mind, renounced God as the absolute corrupter, flying in the face of an ancient and honored dictum that power ennobles. The saving formula, "Jesus is Lord," is an ascription of absolute authority, as was the traditional shout at the coronation of monarchs among Christians, "Christ has conquered, Christ rules, Christ is King." The duality of powers in Christian political order is required by subordination of all to the Sovereignty of Jesus Christ.

Reasonable: Things Made Have Maker

All this may be referred to what is revealed. Now for the reasonableness of it.

Creation scientists are furnishing evidences from studies of the order of nature supporting the truth of the proposition that "all things were made." This leads inescapably to the truth that there is a Maker.

Since the word "god" is not a name, it may be defined as that than which nothing higher can be imagined. Since the maker is always greater than what he made, He who made all things in heaven and on earth, things visible and invisible, must be God.

It is further necessary that this Maker be Himself unmade, therefore eternal, and may be said to be sheer being: "I AM" is His Name to Moses (Exodus 3:14). I AM is alone truly good (Luke 13:19), and so we understand that sheer being is sheer goodness.

It is good to be, like the dust of the earth; it is better to be and be alive, like the birds, fish and animals; it is better to be alive and to have the power of reason which gives power and authority, like men. It is still better to have a measure of the Divine uniqueness by being human and an individual, sharing in distinctive properties of race, family and personal name.

While the Divine Nature is revealed uniquely by His work of creation, God being the Maker of all things, He is

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revealed more fully to us by His work of governing that which He has made, which is called providence.

The image of God in which man was made seems to be most fully expressed by the Divine fiat, "Let them have dominion," (Genesis 1:26) which capacity to be under authority is given by the power of speech and reason. Augustine sees the image of God imprinted on man in man's threefold powers of memory, will and imagination, all faculties of reason.

While undoubtedly God reveals much of Himself through faith that "the worlds were framed through the word of God, so that things which are seen were made of things which do not appear," (Hebrews 11:3), and we understand that it was by Wisdom that all things were made, still this Wisdom to create is farther away from the grasp of man's mind than that same Wisdom by which God rules all that He has made.

Wisdom as revealed to man is supremely seen in ruling—not simply the ability or capacity to rule, but in actually doing it. This precept of the pagan philosophers accords with the Biblical description of Solomon as the wisest of men. The Wisdom or Word of God, who is God, is most directly and continuously manifested to man, then, in God's providence.

That Wisdom who assumes responsibility to rule that which has been made by it shows also that it is good to govern, and that it would be irresponsible and bad for God to have failed to govern what He had made. Those deists who deny God's providence, like some moderns who deny that Christ actively rules the world, ascribe evil to Him who alone is good—the evil of irresponsibility.

It remains only to be said that the greatest of all God's works is His redemption of that which He had made by the same Word or Wisdom by whom He made all things, Jesus Christ. It was under His own justice that man went in bondage to sin and death for man's misuse of his will; and that same justice was not only satisfied in the sacrifice of the Redeemer, but it also decreed that present active government of the earth be in the hands of Him who purchased man with the price of His own blood.

Truth: Maker, Ruler, Redeemer

To establish by reason and scientific evidence that creation is a historical fact as described in Scripture is to establish that truth which is not passive, inactive and merely academic; it is to give support to belief in a Truth which by its nature must actively rule and govern the cosmos. It ceases to be true that moment it fails of being recognized as law-giver, judge and king. One may not take this Truth or leave it without drastic consequences either way. There is no discharge from this war.

God in His providence rules all things that He has made, then, and He rules them consummately by law. Man, His vicegerent by Divine appointment and authority, is the executor of that law and is charged not simply to refrain from breaking the law; he must enforce it with just penalties and rewards. It is God's law that he must keep, so exercising the dominion which is given as part of his nature. It was Adam's sin to seek to set up his own law, to know good and evil; God's law is given and unchanging.

This law of God is universal. It is called Natural law because it is embedded in the very nature of things and is written in the hearts of all men as far as knowing the difference between right and wrong. It is fatuous to discard the term "natural law" because the term has been abused. It has a far more ancient and honorable usage as given by the Puritan writer, William Ames:

Natural Law, is the same, which usually is called the Eternal Law: but it is called eternal, in relation to God, as it is from eternity in Him; it is called natural, as it is engrafted and imprinted in the nature of man, by the God of nature.²

The chief principles of this law are given in the Ten Commandments, but it is to be emphasized that all men, whether they know the Ten Commandments as such or not, are responsible under the system of law it symbolizes. The essence of natural law lies in the fact of its promulgation by God at the time of man's creation.

Clearly he who believes it is true that God created as recorded in Genesis is bound to spend his chief energy in the worship of God, as per all the Prophets, in doing justice, in keeping the law. This is the fruit God looks for from His people, that they do righteousness, or justice, so exercising that dominion over the earth instituted at the creation of man.

Until the time of the Enlightenment and the rise of Deists who acknowledged God as Creator but not as Governor, I know of no time or place in history when men generally did not accept the universality of the natural law. That is not to say it has always been kept, of course. Scripture is filled with denunciations of Israel for failure to do righteousness. But that is just the point. The failure was known. Justice, even if neglected by men, held sway.

It is necessary to take note here of the enormity of civilized man's fall from justice since the Enlightenment, in order to take the measure of the task that confronts creationists today. Government until now has been the task of keeping the law. Now it is seen as being charged with reducing all individuals to equality, thus repudiating rank, order, degree and authority itself, or dominion.

Since men are equal only in death, the political passion for equality is a passion for death. Justice is seen as a procedure, as with the Pharisees: if the rules of procedure are known and followed, justice is believed to follow automatically; it is the art of the magician.

Chief Principles of Law

The chief principles of law set forth in the Ten Commandments form a wall or fence around men, so to speak, within which they have great freedom of action. These principles specify those points in the fence which, if breached, threaten the whole law and the safety and peace of the people. It is clear that the main purport of these particular laws is to punish whatever interferes with man's dominion under God. God's authority or dominion is secured under the first five Commandments, following the Reformed numbering. It is a major part of man's dominion to enforce those laws securing obedience to Divine authority. This is love toward God.

The second five Commandments specify what is essential to the securing of man's dominion. This is love of neighbor. While on the one hand these statutes are central to the natural law and are required to be enforced, on the other hand it is soon found that there is no rational basis for these laws other than that they are ordained of God to uphold the dominion He has made man to exercise.

This is strikingly clear in the case of murder. Modern so-called philosophers have been unable to put forth any ground for capital punishment, even in the case of murder. It is doubtful if they ever will. For the rationale is explained to Noah very simply:

The fear of you and the dread of you shall be on every beast of the earth, and upon every fowl of the air, upon all that moveth upon the earth, and upon

all the fishes of the sea . . . And surely your blood of your lives will I require; at the hand of every man's brother will I require the life of man. (Genesis 9:2,5)

Man's dominion, supported by the fear of man, is threatened if man can be killed with impunity. But only by acknowledging God as governor, ruling by law and justice, is it possible to justify man's authority to rule and to uphold his own place of authority. There is no chain of command, so to speak, if things were not created. Since they were, authority reigns.

Man's power to own property is likewise derived solely from the Divine command to have dominion. Blackstone wrote of the right of dominion as the right of property (Bk. II, Ch. 1), then:

In the beginning of the world, we are informed by holy writ, that all-bountiful Creator gave to man "dominion over the earth." . . . This is the only true and solid foundation of man's dominion over external things, whatever airy metaphysical notions may have been started by fanciful writers upon this subject.

The rest of the statutes securing man's dominion over all things punish violations of his authority over his wife, his

goods, his real property, his good name and his vulnerability to fraud.

Dominion: Responsibility to Keep Law

Responsibility for keeping this law of God is given to all men living. This is expressly his dominion. Failure to do so is the essence of sin. And while law enforcement, like all things, must be done decently and in order, following the established line of authority in each community, things are so ordered that means are at hand to keep the law even in the face of wicked rulers.

It would seem that one thing required is that which follows inescapably from the work of creation scientists, namely to understand that he who believes in the truth of creation is bound to devote himself to the enforcement of God's law. This is politics.

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PROBLEMS IN THE GLACIAL THEORY

DOUGLAS E. COX *

The drift phenomena around the world have been interpreted by modern geologists in terms of the Glacial Theory. A great many problems of a fundamental nature are involved in this interpretation. The cause for the ice ages has not been determined. The distribution of the drift has given rise to numerous complicated and unlikely theories of events in the earth's past. Movement of great ice-sheets, necessary for a theory of distribution of the drift by ice-sheets and for the formation of streamlined landforms in a glacial environment, is postulated through some unknown mechanism. Mysteries abound in the glacial explanations for drumlins, kames and eskers, the formation of stratified drift, and ice-disintegration features. Fossils of the Quaternary include mammals not usually associated with cold climate. All of these facts suggest that the reality of the ice ages has not been proved.

Evidence Commonly Cited For the Theory

The glacial theory is the presently accepted explanation for the layer of unconsolidated material that covers the solid sedimentary and igneous rocks in the temperate zones of Europe and North America. The material consists of gravel, sand and clay, with many large boulders of variable composition, and innumerable rounded stones and pebbles of all sizes. Often it is hundreds of feet thick. Frequently stratification exists, and it is usually present in the sand in the pattern of cross stratification.

A mantle of unconsolidated material similar to that of Europe and North America also occurs in parts of India, in South Africa, the tropical zones of South America, and in many mountainous areas of the world. Usually referred to as "drift", the material is also known as boulder-clay, diluvium, outwash deposits, glacial moraine, and till.

The surface of the mantle of drift is shaped into a wide variety of structures, that have been invariably associated with a glacial origin. *Kames* are conical mounds usually composed of sandy material, that are thought to have been caused by the dumping of glacial debris when the great ice-sheets of the glacial age melted. *Eskers* are long, winding ridges of gravel and sand, that are explained in the glacial theory as the debris of rivers formed in or on the glaciers, that was let down when the ice melted. Sometimes branch-

ing eskers occur. The eskers are known to stretch for great distances, go up and down hills, and disappear and occur again further on.

In the prairie regions of Canada and in the northern states of the United States there are various kinds of *rimmed plateaux*, composed of drift. Often these have central depressions containing clay sediments. The rims are often composed of stony material and contorted drift layers. Some of the rimmed plateaux or prairie mounds are of large size, with areas of several square miles, and may reach as much as 150 feet above the surrounding hummocky and pitted regions.

The rimmed plateaux and prairie mounds are explained in the glacial theory as landforms created during the melting of the great ice-sheets. The glaciers, it is believed, sometimes melted in such a way that isolated blocks of ice were formed, that wasted away and deposited their debris in various kinds of rimmed structures and plateaux.

Drumlins and *flutings* are streamlined landforms that are explained as the effects of the movement of the ice in the glacial theory. The ice-sheet flowing across the countryside shaped and moulded the rocks and previously deposited layers of glacial debris into these remarkable streamlined landforms, that occur in swarms sometimes covering thousands of square miles. In drumlin swarms the drumlins all have locally parallel orientation.

Drumlins are hills shaped like the inverted bowl of a spoon. Glacial flutings are similar, elongated parallel ridges

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and troughs. These may stretch for several miles in the prairies of Canada and parts of North Dakota and Montana. Drumlins and flutings are often composed of drift, but many are bedrock or partly bedrock. Some have a mass of bedrock at their upstream ends.

In general the landforms composed of drift have a remarkably fresh appearance. Although they contain loose material, the effects of erosion have been minimal, showing they could not be of great age but must have been formed recently. Geologists believe that the last of the ice disappeared only a few thousand years ago.

Striations are frequently present on the surface of the bedrock underlying the layer of drift. In some areas the bare rocks uncovered by drift are also scratched and grooved, as if by movement of stones across them, and this is attributed to the ice-sheets in the glacial theory. As the ice-sheet moved, it is supposed, there were large numbers of stones being carried along in its base, that gouged the bedrock as the ice-sheet went along.

Within the layers of gravel in the drift there are many rocks and boulders that are striated. These are thought to have been transported by ice and abraded in the process.

In the bedrock underneath the drift, and at many places where the bedrock is exposed, there are deep vertical pot-holes, that are often explained by reference to the glacial theory. These are attributed to glacial "moulin" or waterfalls tumbling down crevasses in the ice, that eroded the bedrock and caused these deep holes. Potholes are usually filled up with the drift material, sand and gravel and large boulders.

Large boulders are found in some regions with a composition quite different from that of the bedrock in the vicinity. In the drift there are stones and pebbles of varying composition and appearance, but most of the rocks reflect the composition of the bedrock underneath. The large boulders of quite different composition are known as "erratics", and are considered to have been transported from regions afar by the moving ice-sheets. These may sometimes be as large as houses, and are usually rounded, though some are of irregular shape.

Earlier Interpretations of the Evidence

The layer of drift was once attributed to the flood, rather than ice ages. The term "drift" goes back to the idea that the transported rocks, those with compositions differing greatly from that of the bedrock in the region, were thought to have been rafted about during the flood by icebergs. These rocks, it was supposed, dropped down through the waters when the ice-floes melted.

An American version of the theory that ice-floes transported the drift material during the Noachian deluge was proposed by Peter Dobson of Vernal, Connecticut in 1826. He reached his conclusions from observations of striated boulders found on the surface and at considerable depths in excavations of the drift.¹

The Rise of the Glacial Theory

A leading exponent of the diluvial theory of the drift was William Buckland of Oxford, England. He was among the first, however, to abandon this idea in favor of the glacial theory of Louis Agassiz. Buckland supported Agassiz's claim that Britain and much of Europe had been inundated by land-ice after Agassiz visited Scotland and England in 1840. Charles Lyell, however, still favored the iceberg theory for most of the drift.

The Glacial Theory Accepted, but with Some Opposition

Agassiz came to America in 1846 and energetically proclaimed the glacial theory while teaching at Harvard University. Gradually the theory of a great glacial age gained acceptance, although strong opposition was voiced by geologists such as J. W. Dawson and Sir Henry Howorth. Howorth wrote numerous articles in opposition to the claims of glacialists that appeared in the *Geological Magazine* of London. He also wrote books such as *The Glacial Nightmare and the Flood*, and *Ice or Water*, a two-volume sequel arguing against the glacial interpretations and proposing instead a violent flood as the cause of the drift phenomena.

For many years a controversy raged about the reality of the Ice Ages, but Howorth's arguments were not taken very seriously by geologists who favored the glacial interpretation. His idea of a violent catastrophic origin of the drift was ridiculed. Referring to one of Howorth's books, Warren Upham wrote in 1894:

The attention and general approval which have been accorded by English and Scottish reviewers to the recent book by Sir Henry H. Howorth, which sets aside the glacial theory, and substitutes for it the debacle theory, earliest thought out and long ago abandoned by geologists, seem surprising to American readers, since a most wonderful and unique but gentle agency of formation of the drift is by these authors discarded in favour of a still more strange and extravagantly violent hypothesis . . . they seek to revive an old opinion which had its day at the beginning of investigations of the glacial drift, but long ago became entirely obsolete.²

Howorth's Objections Considered Especially

No answer to Howorth's scientific objections to the possibility of the mechanisms involved in the glacial theory seems to have been published, however; and it would seem that the principles he appealed to have not become dulled over the years. Many of the assumptions involved in the glacial theory, Howorth argued, are contrary to physical laws and known facts about the properties of ice.

Howorth believed that the motivation of geologists who favored the glacial theory was their reluctance to accept a catastrophic alternative. He advocated a return to the older view, that the drift layers were the deposits of the Noachian flood, and that these materials had been transported by violent currents. In his book *Ice or Water* he discussed the reluctance of his contemporaries to accept this alternative:

This alternative, I have always maintained, exists, and was universally accepted before the world was dazzled by the factitious glamour of Agassiz's rhetoric, and especially by the escape it seemed to offer the fanatical adherents of the theory of uniformity as expounded by the disciples of Lyell, more especially Ramsay and Jukes. Their real inspiration has been the fervent hope embodied in the words with which Sir R. Ball concludes his ill-fated book on the *Glacial Age*. "The appeal to ice," he says, "removed the glacial period from the position of a 'catastrophic' phenomenon. It placed the ice-sheet as an implement at the disposal of the geological uniformitarian." That was the real basis and inspiration of the new theory. That was what gave it its hold upon the geologists of a generation ago. They did not stay to ask whether in their zeal in favour (not of a real doctrine of uniformity, but a bastard one) they were not giving themselves up to a Scholastic figment and appealing to a fic-

titious and imaginary instrument in order to save them from what they deemed the most pestilent of heresies, namely, catastrophism in any form.³

How the Present State of Opinion Arose

Whatever the reasons, most geologists slowly accepted the theory of ice ages and the idea of a world-wide flood was relegated to the limbo of having no geological effects whatsoever. And that is its present status, although there have been some voices in the wilderness all along proclaiming the faults inherent in the Geological Time Scale.

The intellectual climate at the end of the nineteenth century was overcast by the heated debates amongst the scholars about evolution. Intense opposition to Biblical teachings no doubt hindered a really objective attitude to the evidence for or against the glacial theory. There cannot be any doubt that geologists were aware of the many contradictions and seemingly impossible assumptions involved in the postulated ice-sheets.

It was thought that while the whole theory might eventually prove to be wrong, it was still a useful framework for observation. Perhaps because of the unsolved problems in Quaternary geology it has been the most studied of any of the geologic eras, but a progress report of the last century could still aptly apply to the state of affairs today. T. Melard Reade wrote in 1896:

The phenomena of the Glacial Period in Britain contain some of the most interesting problems it has yet been the lot of geologists to attempt to solve. It therefore behoves us to approach the subject in a spirit of humility. That such varied explanations have been proffered from time to time, that most contradictory conclusions should be drawn from well-ascertained and generally acknowledged facts, is curious and somewhat depressing. There is, however, this reflection to comfort us: however strange, however contradictory, however devoid of common-sense the various explanations and theories of the Glacial Period appear to the various observers and reasoners upon them, the total effect is, like that of the hypothetical Ice-Sheet, a push forward. Without opposition, observation stagnates, so that the first effect of enthusiasm, even if directed in lines that afterwards prove to be mistaken, is to advance the science we love so well. Even if a theory be utterly false, it may prove of great educational value, for, until every possible line of reasoning has been traversed, secure ground cannot be reached.⁴

With this rather uncertain foundation, the Glacial Theory became the backbone of geological research on the drift phenomena. As the most recent of the geological eras, the Quaternary forms the bridge from hypothetical geologic ages of the past to the present. As can well be expected, textbook writers have not emphasized too much the negative aspects of the theory.

Perhaps the background of doubt in the last century has even resulted in a defensive unanimity amongst geologists, that resists questions and ideas that do not conform to and support the basic framework of the geologic story of the earth's past. Variations within the superstructure are allowed, and these have proliferated. But it is not kosher to seek alternatives, or to deny the faith altogether by resorting to catastrophes.

Difficulties in the Glacial Theory

The layer of drift is the main body of evidence for the glacial theory. When one considers how this material is

distributed, considerable difficulties arise in the notion that it has been caused by glaciers. It is not present in many areas where one would expect to find it, and it is present where one would least expect it. Thus in the northernmost parts of Greenland, and in the islands of northern Canada, no drift is present. But it is found in tropical areas such as the Amazon jungles. Regarding the tropics, right at the equator, no less an authority than Louis Agassiz wrote: "There were drift accumulations, and scratched rocks, and erratic boulders, and fluted valleys, and the smooth surface of tillite . . ."⁵

The presence of drift has been reported from such places as British Guinea, equatorial Africa, Madagascar, and India. Wherever the characteristic features of the drift are found, it seems necessary to postulate former glaciers to explain it. The theory of continental drift is partly an attempt to explain how the ice-sheets could have existed in these areas at various periods in the past.

The glaciers of mountain regions and the ice-sheets of the Antarctic and Greenland do not seem to be forming any deposits similar to the layer of drift that has been attributed to ice-sheets of the past. Present glacial moraines contain fragments of angular rocks unlike the boulders in the drift, which are rounded; and the glacial deposits of the present have none of the features of the structure of the drift, but are more aptly described as a heterogeneous muck.

The postulated ice-sheets of North America and Europe are also somewhat lop-sided, and do not conform to the polar regions as one would perhaps expect they should; and accounting for this has been a brain twister for the glacial theorists.

Charles H. Hapgood proposed that the continents were dislocated from time to time from their present relationship with the poles, as the earth's crust shifted over its interior. Hapgood's idea was that the north pole was located in the Yukon 80,000 years ago, shifted to a point northwest of Norway, from there migrated to Hudson Bay, and moved to its present location at the end of the last Ice Age.⁶

One reason why this idea has not been afforded very great favor amongst Quaternary geologists is that the structures composed of drift around the world are all very well preserved, and there does not seem to be good reason for attributing some to a much earlier period than others. All of the drift landforms actually must be quite recent, and of similar age, if the degree of erosion is considered as an indicator of age.

The Cause of an Ice Age Still Undetermined

The many astronomical theories proposed in the last century to account for the ice ages were discussed and refuted by Sir Henry Howorth in the first volume of *Ice or Water*. Today the problem is still much the same as then, no nearer a solution, and a statement by Coleman in 1929 is still valid:

Scores of methods of accounting for ice ages have been proposed, and probably no other geological problem has been so seriously discussed, not only by glaciologists, but by meteorologists and biologists; yet no theory is generally accepted. The opinions of those who have written on the subject are hopelessly in contradiction with one another, and good authorities are arrayed on opposite sides . . .⁷

The problem in recent years has been restated. Rather than attempting to discover a cause for glaciation at various places around the world, emphasis should be placed on causes of climate change. On this "fundamental problem"

R. F. Flint wrote in 1971: "Research in the impressively wide field of possibilities has not yet progressed sufficiently far to enable us to choose among the various published theories, many of them conflicting."⁸

Conflict is perhaps all-pervasive in the glacial theory. But it is generally assumed that the ice-sheets in various parts of the world existed, the problem of causes being inconsequential to the evidence that they did not occur. So attention should rightly be directed to the geologic evidence, the drift layer and the landforms composed of drift and other features associated with it, that have been attributed to glacial action; and to the properties of ice.

Problems About the Motion of the Ice

In considering the layer of drift and its origin, the basic assumption in the glacial theory is that material was formed by ice-sheets, and that rocks and stones from various places were ground up by the movement of the ice, transported in its lower parts and redeposited when the ice-sheets melted. The presence of erratics in the drift, scratched surfaces of the stones and the bedrock underneath, and other facts are considered to be proof of the involvement of ice. Inherent in this assumption is the notion that a great ice-sheet would actually move, and that it could carry along the material it over-rode and deposit the glacial debris in layers like those characteristic of the drift.

The motion of the postulated ice-sheets is a necessary assumption for a glacial explanation of transport of erratic boulders by the ice, and for the streamlining of the surface of the drift into flutings and drumlins. The physics of ice would lead one to expect that ice-sheets of the past would move under the influence of gravity, once the ice had obtained a sufficient thickness; and that the direction of this movement would be from higher to lower ground.

It would be a viscous flow, and would be controlled by topography and the slope of the upper surface of the ice-sheet. This would mean that there would be flow over level country only in the upper layers of the ice, while movement of the base of the ice-sheet should be limited to downhill gradients in the topography underlying the ice.

Movement of the ice-sheets of the past, that are proposed in the glacial theory, does not seem to have obeyed the normal rules, as the erratics are found in areas hundreds of miles from their supposed sources. This would require transport of the base of the ice-sheets over irregular country without any downhill slope indicated by present topography. Writing about the difficulty in explaining the required motion of the ice-sheets of the glacial theory, Howorth commented:

A more important and far-reaching difficulty which the glacial champions have to face is the proved incapacity of glacier ice, as of any other viscous body, to travel over enormous stretches of level country, and up and down long hills, as it must have done if the glacial theory is to become the final and effective explanation of a large part of the drift phenomena.⁹

To get the debris of the base of the ice-sheets moved over sufficient distances, the idea of sliding of the base of the ice-sheet over the countryside, due to an unknown factor in the ice-sheets has been conceived. It is pointed out that the bases of the ice-sheets and glaciers existing today are rather inaccessible for study, and this has resulted in a lack of understanding of the processes that were involved in former ice-sheets. Flint suggested that basal sliding of these ice-sheets possibly exceeded the flow due to viscosity that

would be confined mainly to the upper layers of the ice-sheets. Flint wrote:

The mechanics of the process is not yet understood, partly because the base of a glacier is far less accessible to study than its upper surface. Apparently the sliding process consists partly of relegation (pressure melting of ice followed by refreezing), in which, therefore, transport of water is involved. In some glaciers, at least at some times, basal sliding may possibly account for most of the motion that occurs.¹⁰

The need for some mechanism for sliding of the ice-sheets over their beds, sometimes for great distances, up and down irregular country, is indicated by the presence of erratics in areas far from their supposed sources. The erratics, or boulders different in composition from the bedrock of the areas in which they are found, really constitute a minority of the boulders in the drift. Most boulders resemble the bedrock of the vicinity. Flint reported:

A small proportion of the rock matter picked up does, nevertheless, travel long distances. Stones and boulders from Scandinavia and Finland were carried in the Scandinavian Ice Sheet through hundreds of kilometers to points in Britain, Germany, and Poland, and (1250 km) to Russia. Stones from Ontario were carried by the Laurentide Ice Sheet as much as 1000 km to positions in Missouri. Most such stones consist of durable rock types containing hard, resistant minerals, and with few joints or other surfaces of weakness. They may have survived long-distance travel in the base of the ice at the expense of considerable loss of size by attrition, or may have traveled in englacial positions where there were few other rock fragments to abrade them.¹¹

The theory that these stones and boulders have been transported by the sliding of the ice-sheet at its base rests on an assumed process the mechanics of which is not yet understood. It is not known how the movement of the ice was accomplished, but geologists accept as a fact that somehow basal sliding of the ice-sheets over vast distances occurred. Perhaps it is less difficult to attribute unexplained properties to a vanished ice-sheet than to imagine a different explanation for erratic boulders that are obviously real.

Howorth claimed that the movement of ice-sheets is viscous flow and that there could be no "unknown" or mysterious properties in the ice of the glacial theory, that could cause movement in ways not evident in the ice known today. In this he appealed to true uniformity, and causes in line with those existing at the present time.

To postulate that causes in the past were different to those of present experience is quite contrary to the principle of uniformity that geologists claim to uphold. Regarding the possibility of a basal motion of the ice-sheets, apart from the viscous flow of the upper layers, Howorth wrote:

If there be any such motion *en masse* it cannot be great, nor can it exceed a certain amount without the force inducing it becoming dissipated. This seems plain, as I showed before from some simple considerations. Every solid known to us will crush and disintegrate under a sufficient pressure, and it does not matter whether this pressure is applied perpendicularly downwards, or laterally. It follows, therefore, that if a solid be so heavy and so big that it requires more than a certain force to move it, it will crush rather than move, that is to say, the whole thrust will be dissipated by the object being reduced to pulp, or

even liquid, which will flow away rather than move *en masse*.

This argument applies to all solids, and notably to what is almost a solid, i.e., to ice. The crushing point of ice has been roughly ascertained. It enables us positively to say that a mass of ice which is longer than (according to Oldham in his paper on the modulus of ice) about seven miles cannot be moved *en bloc* along a flat surface without crushing. If the ice has to move up-hill, and therefore to overcome gravity, the difficulty of moving it *en masse* will, *a fortiori*, be increased, and the length of the column of ice capable of being moved will be proportionately lessened. If it is on a slope and gravity gives its assistance, this motion will be reversed, and the greater the slope the greater the distance to which the mass can be moved. This is of course treating the problem apart from friction. There is also evidence that when glaciers reach level ground their motion, however caused, rapidly ceases.¹²

Not only is it necessary to assume that the base of the ice in the great ice-sheets of the glacial period was capable of moving for great distances, over irregular country, and frequently uphill, but the boulders it transported are thought to have been lifted upwards by the ice, so that now they are often found at altitudes much higher than those of the source beds from which the erratics are supposed to have been derived. See, for instance, Figure 1.

Flint provides a table of some examples of uplifted erratics, citing the following examples: (1) In Maine, erratics on Mount Katahdin have been transported at least 18 km and uplifted 1000 meters. (2) Erratics in the Adirondack Mountains, New York, have been transported at least 100 km and uplifted 900 meters. (3) On the Allegheny Plateau, central New York, rocks are supposed to have been moved 160 km and lifted 500 meters vertically. (4) On Killington Peak, Green Mountains, Vermont, rocks have been transported possibly 80 km and lifted 900 meters, apparently, by the ice. (5) In the Rocky Mountains of Alberta rocks have been moved a distance of 1,300 km and uplifted 1,300 meters. Other similar examples are cited from Alberta, Manitoba, Northwest Territories, and from Eire, Wales and Northern Germany.¹³

These erratics perched higher than their sources, if they are to be attributed to ice, would require that the direction of the flow of the ice was opposite to the slope of the land. Flint suggested that the stones were carried in the base of the ice, which flowed uphill, rather than that they somehow migrated upwards through the ice.

Discussing the notion that stones have been transported upwards by glaciers, Howorth accused the glacialists of departing from the principles of physics and appealing to "transcendental causes". Howorth wrote:

The question is one of mechanics, to be dealt with by mechanical arguments, and it seems to me to be the height of rashness for geologists who are quite guiltless of any training or knowledge as physicists to appeal to transcendental causes, whose potency they have not tested, and which are treated as contrary to the laws of physics by those specially familiar with the latter.

They habitually argue in a circle. Finding a big stone on a mountain many hundreds of feet above its bed rock, *and having made up their minds*, a priori, *like the schoolmen in the dark ages*, that their *deus ex machina*, ice and ice alone, did it all, they have to attribute to ice qualities which it not only does not

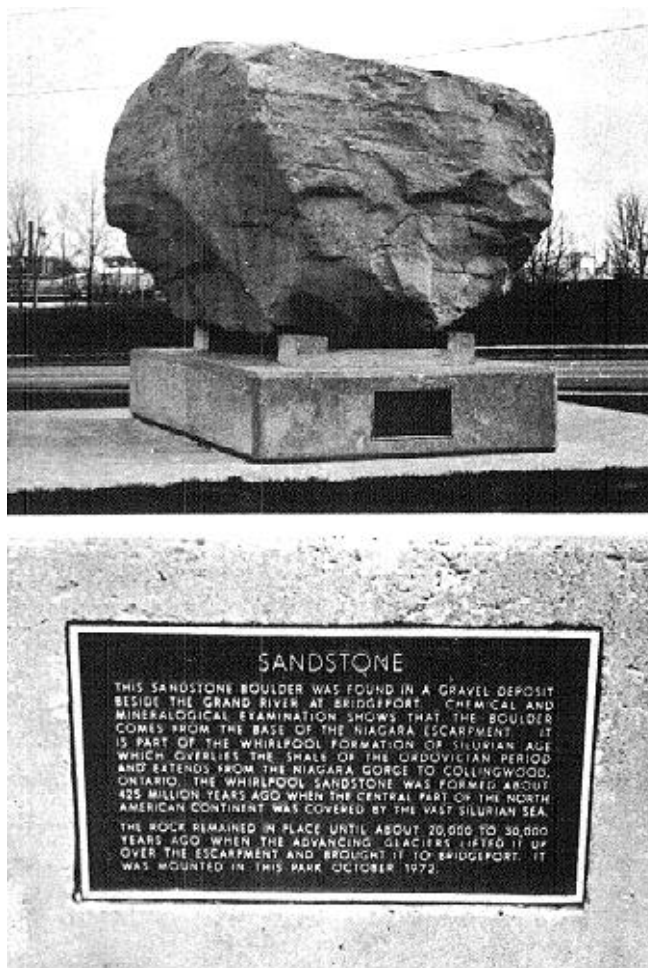


Figure 1. The upper part shows a boulder in Gzowski Park, at the corner of Westmount Road and Chopin Drive, Kitchener, Ontario. The lower part is a plaque on the boulder.

The boulder shows cross stratification, with small iron ore concretions, arranged in planes that cross the pattern of cross stratification. It is suggested that the boulder was not carried up hill from below the Niagara Escarpment at all, but was formed *in situ* from the local bedrock.

possess, but which are contrary to the very elementary laws of matter.¹⁴

How Could the Ice Move Uphill?

Far from actually proving the reality of ice ages, erratic boulders in fact pose a perplexing problem for this theory to explain. The ice not only has to be capable of basal movement over very great distances, it also has to move uphill for distances of hundreds of miles, which is contrary to any experience we have of glaciers and ice-sheets today.

Ice-sheets that are known from present experience tend to obtain a fairly uniform slope at which they are in equilibrium. The thicker they are the more quickly this equilibrium will be obtained. The ice will spread and thin out, by viscous flow confined to its upper layers, as long as thickness is sufficient to cause a flow.

No cause for upwards sliding of the base of ice-sheets is apparent from the study of present-day ice-sheets. No reason for the motion of ice over great distance is known. Yet this movement of the ice is a basic assumption of the glacial theory, and it must be supposed that ice in the past would act in the same way that ice acts today.

Any other ice will not do; the properties of ice that we know from experience set bounds and limits to scientific hypotheses about the ice of the glacial theory. If a transcendental ice is appealed to, such as is not observed today, then the glacial theory should be relegated to philosophy, and placed in the category of the celestial spheres of the astronomers of antiquity.

As Sir Henry Howorth insisted, ice as we know it moves downhill, under the influence of gravity. Motion of the base of the ice has no foundation in present day experience, particularly uphill motion, such as the glacial theory requires for the explanation of the distribution of the drift. Howorth complained:

It is, however, I know, useless to quote glaciers to the ice men. They repudiate glaciers as tests altogether, just as they repudiate laboratory experiments upon ice. With them all inductive methods and arguments fail, since they always reply that the ice they appeal to is something entirely different to the ice of glaciers. It is ice-sheets they rely upon, portentous ice-sheets, such as no longer exist anywhere. A Saturnian postulate, in fact, is their platform, and not a mundane one. Yet it ought to be a condition even of such a transcendental postulate as this that the ice in an ice-sheet should act in accordance with, and not contrary to, the nature and the physical qualities of ice. If it does not, the appeal ceases to be a scientific appeal, and it is, in fact, very largely an unscientific appeal which is continually being made by this noisy, clamorous school of writers, who never verify their premises and make assumptions as readily as they abandon them.

An ice-sheet is only a great mass of ice after all; a mass of ice which, instead of lying on a mountain slope or being embayed in a valley or on a plane surface, is supposed to have smothered and covered a stretch of uneven country and swathed it in a continuous mantle. Such a mass of ice cannot acquire properties not possessed by other ice. If it moves it must move according to the mechanics of ice, and, as we have seen, ice moves in no other fashion than by the influence of gravity.¹⁵

Basal movement of the ice-sheets is also a necessary assumption in the glacial explanation of the formation of drumlins and flutings. Again, the cause for all this motion is a mystery. The drumlins are streamlined, their form giving a clear indication of the direction of the streamlined flow that formed them. Paradoxically, this flow must have been frequently uphill.

In northern New York the drumlins are oriented north-south and the direction of flow was uphill from Lake Ontario; and in Northern Ireland, the pattern of the drumlins in one region indicates the flow was from out of the sea in Belfast Lough, and overland to Dundrum Bay.

If the drumlins were shaped by ice, the flow would have to be uphill, requiring a cause that is quite outside the forces of present experience. In an attempt to explain the nature of the forces that caused an ice-sheet to flow uphill in the New York region, Fairchild wrote:

The drumlins were shaped by the sliding movement of the lowest ice, that in contact with the land surface. This fact implies that the whole thickness of the ice-sheet participated in the motion. Such motion was not due to gravitational stress on the ice over the drumlin area, but to effective thrust on the marginal ice by the gravitational pressure of the rearward mass. As the margin of the ice-sheet thinned by abla-

tion, there came a time when the drift-loaded ice in contact with the ground was subjected to less vertical pressure by the deep ice in the rear, and was pushed forward bodily. In this fact is believed to lie the key to drumlin formation.¹⁶

It is postulated that "gravitational pressure of the rearward mass" caused the ice to flow uphill, but why would this presumably thicker mass of ice not have simply spread in the upper layers, instead of pushing the southward ice bodily and forcing it to slide over its bed, across high hills of rock? The trends in the shape of the New York drumlins do not confirm a theory of pushing bodily from the north, for the drumlins at higher altitudes to the south become more intricately streamlined, smaller and having steep sides and narrow crests.

Drumlins in the vicinity of Lake Ontario are large, flat topped and poorly streamlined.¹⁷ Trends in the form of the drumlins indicate that streamlined flow of the agent that caused them was faster at higher altitudes to the south, and so a bodily push from the north, which could only cause motion as fast as the ice-mass causing the pressure, is incompetent as a cause.

More Mechanical Difficulties: Ice not Strong Enough

Sir Henry Howorth pointed out that there is a limit to the size of an ice mass that could be pushed bodily. If the extent of the ice-sheets were greater than seven miles, he claimed, the ice would crush and dissipate the forces causing the horizontal push.

The ice-sheet causing the New York drumlins must have extended at least 50 miles from the shores of Lake Ontario, while the drumlins of the region were being formed. That they were formed contemporaneously is proved by the patterns of orientation over wide areas. A cause for the uphill movement of the ice-sheets is once again a missing ingredient of the glacial theory.

When one considers the pattern of the drumlins over broad areas of the North American continent, the vast areas over which streamlining occurs precludes the transfer of a force within the ice-sheet that could cause movement of its base over the countryside. Howorth wrote:

... it is not possible to pile up a mass of ice to an indefinite height, or to force a mass of ice of greater length than about seven miles along a level surface by any pressure, however obtained, without its crushing, and without, therefore, the thrusting force being dissipated.¹⁸

Not only is the cause for the movement of the ice-sheets over vast areas of irregular and uphill country unexplained, but the streamlined landforms are frequently composed of drift, which is supposed to have been deposited when the ice-sheets melted. Streamlining of the surface of the drift requires the existence of moving ice after it had melted!

This seems to be a contradiction within the glacial theory, and one that requires the utmost of ingenuity to explain away. Drumlins and flutings are thought to have been formed by movement of the ice, that over-rode the material left behind when the ice-sheets melted.

How Could the Ice Have Melted, and Still be at Work?

How could the ice carve the surface of the drift, after it had melted? Somehow the ice must have returned to do its mysterious work of streamlining the drift, and when this resurgence of ice melted, it failed to deposit any debris. The streamlined surfaces are undisturbed by deposits of this last ice-sheet. Even drumlins and flutings that are explained

by erosion, bedrock drumlins and those containing stratified material, evidently contributed no debris to the glacier. For when the ice disappeared no layer of debris was left behind on the streamlined topography.

These are paradoxical facts inherent in the glacial explanation of the drumlins, and streamlined landforms do not in any way support the idea that ice ages have occurred. They are actually objections to the idea of great ice-sheets, that ought to have planed off the country they over-rode rather than moulding it into streamlined forms. This was admitted by Warren Upham, who wrote:

Instead of amassing the till in such prominent accumulations, we should expect that the ice-sheet would tend constantly to wear away the hill tops and leave thick deposits of subglacial drift only in depressions of the country and on low or nearly level land.¹⁹

Both the drift phenomena and the glacial theory would indicate that the possibility of ice eroding drumlins from drift deposits and bedrock alike is doubtful. The moving ice would have destroyed every trace of stratification in the material it over-rode, especially when this was unconsolidated sandy material.

Yet drumlins are composed of sand and gravel with the pattern of cross stratification in an excellent state of preservation, as well as other types of drift such as clay and till. How could moving ice have carved these drumlins, without even disturbing the delicate patterns in the material comprising them?

Erosion of the surface of the drift by an advancing glacier has been proposed by Gravenor as the explanation for drumlins. He supposed that if the glacier advanced in an irregular fashion, halting and starting up again, the drift could have been deposited just prior to its streamlining by the advancing glacier. In effect, the glacier laid down for itself a carpet of drift in its path, which became streamlined as the glacier advanced. Grovenor wrote:

Since some drumlins are made of pre-existing materials, it is known that erosion can produce a drumlin. It is believed that halts or a slow advance during the forward movement of a glacier can give rise to a wide irregular surface of drift which would be shaped into drumlins by the advancing ice.²⁰

In this environment of drumlin formation the layer of drift is assumed to have been deposited during the advance of the ice-sheet, and if this were so there must have been a growth of the ice-sheet at the same time that it was being melted. One would expect, however, that the time of advance of the ice-sheets could hardly be the time of melting and deposition of their drift load.

If drift was deposited even while the glacier was advancing, how much more should we expect to find a thick accumulation of drift above the streamlined surface that could have resulted from the ice-sheets' melting! But no layer of drift occurs above the streamlined surface. In order to account for drumlins with internal stratification the glacial theory requires numerous conflicting and unlikely hypotheses.

Equally improbable is the idea that bedrock drumlins and flutings that occur in rocks harder than ice could have been eroded by the ice-sheets. On the one hand the great ice-sheets are supposed to have carved drumlins from loose drift materials without disturbing the pattern of stratification evident in the sand, and in other regions the same ice-sheet became much more competent than rocks of the hardest varieties; and shaped them into hills of the same dimensions.

In the process the ice-sheets apparently failed to accumulate a load of debris that had to be deposited on the drumlinized surface as the ice melted. What happened to the debris contained in the ice-sheet that eroded the drumlins? Rather than confirming the reality of the ice-sheets, the drumlins have so far proved inexplicable in terms of the glacial theory.

Could Ice Have Carved the Rocks?

According to the glacial theory the layer of drift on the continents was formed during the melting of the ice-sheets. The gravel and stratified sand in the drift was deposited by "outwash" streams flowing from the melting ice. The unstratified material, known as "till", is thought to be the direct deposit of the ice. Till materials became stratified as they were transported and redeposited by the outwash streams, according to the glacial theory.

These conditions are considered sufficient to explain the characteristics of the stratified sand and gravel of the drift, with the pattern of cross stratification, rounded stones and pebbles and "sharp" sand. The stones of different composition are thought to have originated from widely separated source areas.

The ice flowing over various kinds of bedrock broke off bits of bedrock as it went along, which became embedded in the base of the glacier. As it passed over other territory, and areas where different kinds of bedrock predominated, it broke off other rocks that became embedded in the ice, and mixed in with other varieties of stones. Sir Henry Ho-worth objected to the assumption that the ice-sheets could have broken up their beds as they moved. He wrote:

Ice is much softer and more easily crushed than the great majority of rocks, and would itself be crushed and reduced to slush by its own pressure long before the rock upon which it stands could itself be broken . . . We must always remember the kinds of materials upon which the supposed crushing was effected. These are not lumps of soft rock showing crushed outlines, but clean broken and shattered masses with their surfaces still raw and unhealed, consisting of the hardest crystalline rocks such as granites, syenites, porphyries, etc., as well as limestones, sandstones and chalk, and we are asked to believe that the same ice-sheets which thus shattered such intractable materials *in situ* after passing on a few yards travelled over beds of laminated and stratified sand and loam with such a gentle touch as not to disturb the laminations . . .

The word impossible is not a favourite one of mine, but I am bound to say that, if it is to be applied to any physical operation, I know of none where it seems so applicable as to the process appealed to by the ultraglacialists for the manufacture of drift by an ice-sheet smashing its own bed.²¹

If it is admitted that an ice-sheet could have moved over sufficient distances to accumulate a load of drift of variable composition, and broken up underlying rock by some process, would these conditions cause the surfaces of the stones to become rounded and smooth? The glacial theory requires that the stones, once broken off from the bedrock, would be rounded by abrasion in the process of transportation in the ice or in the streams that flowed from the ice when it melted.

Of course it is unlikely that stones would be mobile enough while embedded in the ice for them to have been rounded very much. But when we examine the till, the unstratified drift gravel and so forth, the stones are rounded.

Supposedly these must have been rounded by a previous erosional environment before they became embedded in the ice.

Effects of Contemporary Glaciers Different

In mountain glaciers today there are examples of stones and boulders being deposited after transportation from their source areas by moving ice. These mountain glaciers form end moraines and lateral moraines composed of this debris once embedded in the ice or lying on top of it.

In glacial moraines of mountain areas, the fragments are angular in shape. They are not rounded and smooth like the stones and boulders of the drift on the continental lowlands. The glacial theory must assume once again that conditions in the past were quite different, contrary to the principle of uniformity.

The sand in which the stones of the drift are often embedded is explained in the glacial theory as originating in the environment of the melting of the ice at the end of the ice ages. However, in contrast with the stones of the gravel, the sand is composed of tiny grains of angular shape. Describing the characteristics of this sand, Reineck and Singh wrote:

An important feature of glacial sediments is the presence of numerous labile minerals, e.g. feldspar, ferromagnesian minerals as unaltered, angular grains even in silt and clay-sized fractions. The sand fraction is characterized by extremely angular sediment grains . . . Sand grains of glacial sediments show characteristic surface features if studied by the electron microscope. Such surfaces show abundantly conchoidal fractures, minor striations, imbricate breakage blocks, and small-scale indentations.²²

The presence of the fragile particles in the sand and clay of the drift has been interpreted by glacial geologists as evidence that the ice-sheet eroded fresh rock rather than decomposed or weathered material. The angular shape of the particles is interpreted as evidence of crushing and shattering processes at the ice-bedrock contact.

These fragile particles could not have been transported in outwash streams for any great distance, since they would be easily broken apart. The disintegrated boulders in the drift likewise cannot have been rolled great distances.

On the one hand, particles of fine size are thought to have been deposited quickly, while on the other, large stones with composition much different from that of the bedrock are thought to have been abraded and striated, moved great distances and finally deposited in swift-flowing outwash streams. Paradoxically, conditions of sedimentation would lead one to expect the opposite effects: the larger stones ought to have been deposited *before* the finer sized particles.

Why is the Sand so Different from the Stones?

The contrast between angular sand grains and rounded stones and boulders, referred to as "clasts", in the drift is problematic for the environment proposed for its deposition in the glacial theory. In conditions where rocks can be rounded by abrasion it would seem that sand particles also would become rounded and the fragile particles disintegrated.

Problems Concerning Cross Stratification

Stratified material in the drift usually exhibits the pattern of cross stratification, regarded as evidence for sedimentary deposition in rivers. However, a sedimentary environment for the formation of cross stratification has not

been demonstrated by experiment. In the cross stratified materials stones and boulders are embedded in such a way that bedding does not wrap around them. No turbulence effects are present that could indicate currents aided in depositing the stones.

The direction of inclination of the strata in the pattern of cross stratification is variable, making the actual mechanism of formation of the stratified drift a mystery. However, in the glacial theory the drift is assumed to have been formed in a glacial environment.

Difficulties About Kames and Eskers

Another enigmatic topic in the glacial theory is the origin of kames and eskers. According to the glacial theory the eskers were formerly river courses in the ice-sheets, and these may have been either surface rivers or rivers flowing in tunnels underneath the ice. The river beds became chock full of sand and gravel, that was deposited when the ice disappeared.

Kames are thought to be related structures, since they frequently occur in association with eskers. They are interpreted in the glacial theory as accumulations of debris from the melting ice-sheets, at the perimeter of the ice or in crevasses. They are composed of stratified drift, usually with abundant sand and gravel, and form irregular or conical mounds of various sizes.

Kames and eskers are apparently confined to thick accumulations of drift, and have not been reported from areas where a cover of unconsolidated material is absent. In a glacial environment, it would seem that rivers may have been present in the ice even where the ice over-rode bedrock, and one would expect that kames and eskers may have been deposited on all kinds of terrain, whether or not a layer of drift was present.

Since the eskers wind over irregular country, going up and down slopes, it is thought that they have been formed by accumulations of debris on the surface of the ice-sheets or in tunnels within the ice. But how the gravel could have migrated upwards in the ice, to become part of the beds of these rivers is not clear. If the eskers have in fact been formed by rivers in the ice, rather than rivers underneath it, there should be an easily discernable boundary underneath them, but such a boundary has not been reported in the literature.

A difficulty with the idea of glacial rivers forming eskers is the fact that the height of the drift on either side may vary considerably, which is not consistent with a glacial river concept. The layers of drift in the vicinity of eskers also appear to be continuous with the material in eskers, indicating that eskers and the drift of the region are of the same age. Sometimes the eskers occur in regions where drumlins are present.

To account for the drumlins, the ice is postulated to have been moving in the glacial theory, and yet the eskers are thought to have been formed during the melting of the ice. The drift of the drumlins appears to be continuous with the material comprising the eskers. The eskers have not been let down on top of the drift that has been streamlined, but appear to be continuous with the drift of the vicinity.

Studies of the internal structure of eskers have not clarified the problems of accounting for them in the glacial theory. Some contain vertical clay walls parallel to the axis of the esker. The direction of inclination of the cross stratification within eskers has led some investigators to the conclusion that the river that formed one esker flowed sideways, across the axis of the esker!²³

Flint suggested that most eskers have been formed in tunnels underneath the ice, or in open canals near the perimeter of the ice-sheet. The ice was stagnant and the ice-sheet was thin. Meltwaters flowing from the surface of the glacier sought the lowest channels, and thus topography influenced the course of the esker. Flint wrote:

Most large eskers do not trend indiscriminately across country, as they should do if superposed from upon or within the ice. They are highly selective, following valleys through long distances and crossing divides at conspicuous low points. This could happen only if they were built on the ground, under the guidance of the local topography. Indeed the englacial hypothesis is an attempt at a compromise by keeping the ice tunnel close enough to the ground to be influenced by the terrain.²⁴

However, the difficulty of the eskers following courses that go up and down hills is unexplained. It seems that for the common phenomenon of a sinuous ridge winding over the countryside many different theories are required, including (1) squeezing up of the drift by weight of the ice on either side, (2) deposition of sediments in crevasses, (3) deposition from rivers flowing in tunnels underneath, (4) deposition from rivers flowing in tunnels within the glacier, and (5) dumping of debris at the glaciers' snout as it melted away. Eskers are actually enigmas in the glacial theory, as the variety of hypotheses proposed to account for them shows.

Prairie Mounds and Related Structures

Prairie mounds, rimmed plateaux, and a wide variety of landforms known as "ice disintegration features" are interpreted in the glacial theory as the effects of stagnating ice during the melting of the ice-sheets. According to the glacial theory ice sheets sometimes disintegrated in isolated blocks, that wasted away in place. In some regions these caused hollows such as kettles, and in other places raised mounds and plateaux resulted.

One of the most complex areas of investigation in the glacial theory involves the interpretation of events at the close of the ice ages in places where ice disintegration features predominate. The wide variety of these structures that may be present has given rise to conflicting interpretations for many areas. Quaternary geologists argue about how the ice melted, whether the debris was deposited underneath the ice, or on top of it with the ice buried underneath, or if rivers in the ice were responsible for intersecting ridges, etc.

In general the basic assumption that ice would disintegrate in isolated blocks, rather than the ice-sheet melting at its perimeter and gradually shrinking, seems essential for the glacial interpretation of the vast numbers of mounds, hollows and plateaux over the Great Plains of Canada. Yet this assumption is not confirmed by present experience with ice in glaciers and ice-sheets.

Actually melting ice influences the temperature of the environment in such a way that isolation of various blocks would be most unlikely. The glaciers melt at their perimeters, and one would expect that an ice-sheet would do the same. Studies of the so-called ice disintegration features only add to the mysteries of the glacial theory.

Anomalous Fossils in Supposed Glacial Deposits

Another area of difficulty in the glacial theory involves the types of fossils that occur in the drift. If the Quaternary was a time of glaciers, one should expect that the fossils of the period would be restricted to life forms associated with cold climate.

A wide variety of life forms seem to have been present at the time of the deposition of the drift, which is interpreted as the material deposited during the melting of the ice-sheets, and which has been modified at its surface by the melting and movement of the ice.

The remains of the Cohoes mastodon were discovered in 1866 in the Pleistocene deposits of New York. Woolly mammoth and woolly rhinoceros bones have been found in many parts of the United States. A cave lion, one third bigger than the African lion of today, is representative of the middle Pleistocene of Europe. The strata containing abundant fossils of the Quaternary are interpreted as Interglacial deposits in the glacial theory.

Multiple ice-sheets are required for the interpretation of the fossils contained in the drift. In some instances these fossils seem to be more tropical than representative of cold climate. The kinds of fossils present do not really provide confirmation of an Arctic environment. Describing the variety of fossils present in the Quaternary of Alaska, Flint wrote:

The extensive silty alluvium, now frozen, in central Alaska contains a numerous mammal fauna. The stratigraphic position of the alluvium is not well known, although C¹⁴ dates show that the sediment antedates, at least in part, the Late Wisconsin drift. Freezing has preserved the skin and tissue of some of the mammals. The faunal list includes dog, wolf, fox, badger, wolverine, a large cat, lynx, woolly mammoth, mastadon, horses, camel, saiga antelope, bison, caribou, moose, stag-moose, elk, mountain sheep, musk-ox, musk-ox and yak types, ground sloth, beaver, and other rodents. The number of individuals is so great that the assemblage as a whole must represent a rather long time. The large cats and the ground sloth may seem surprising in a cold country, but their significance must remain unexplained until their stratigraphic significance is better known. The general rarity of fossil mammals in glaciated as compared with nonglaciaded North America suggests that the rich Alaskan faunas are probably interglacial.²⁵

Certainly the list of mammals does not confirm the idea that the Quaternary was really a time of cold climate. As with the many other topics involved in the glacial theory, unsolved problems, contradictions and mystery surrounds the question of the fossils of the glacial period.

Is it Time for a New Explanation?

Inconsistencies in scientific theory, and poor correlation between theory and observational data, sometimes are indicative of a wrong approach or a fundamental error in assumptions. Perhaps the data that have been interpreted in terms of the effects of ice ages can actually be explained in a completely different way.

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A CREATION MODEL FOR NATURAL PROCESSES

EMMETT L. WILLIAMS†

The author here proposes a creationist model for natural processes. In summary: natural processes act to conserve or to degenerate. Improvement by spontaneous natural processes acting without intelligent direction is impossible. Nature could be viewed as a battleground for the struggle between processes of conservation and of degeneration. It is necessary to be careful in studying these; for processes of conservation are often mistaken for improvement.

I. Types of Natural Processes

An irreducible classification of natural processes* would include three types:

1. Improvement processes—things get better and become more complex
2. Conservation processes—things stay the same
3. Degeneration processes—things get worse, fall apart, and disorder

Assuming all natural processes can be placed into one or two of the above categories,** a logical scientific question to ask is, "Are all of these types of processes possible?" It has been ascertained particularly in the science of thermodynamics that categories 2 and 3 are definitely possible and observable. The interested reader should consult the papers listed in References 1-4 for a technical exposition of the first and second laws of thermodynamics as related to natural processes.

Supposed evolutionary processes fall into category 1. They are impossible and unobservable. This paper is not primarily intended to be a polemic against the philosophy of evolutionary progress.*** The bibliography in Reference 1 may be consulted for such an argument.

II. Evolution as History

Many evolutionists admit that the so-called natural process of evolution is not going on now. It occurred supposedly once in the far past, but being irreversible it cannot now be demonstrated, for it is history. Obviously such an imagined sequence of steps required by evolutionary philosophy (molecules-to-man) cannot fall within the pale of science.

History cannot be subjected to scientific investigation for the reason that the *exact* condition of an event cannot be duplicated. The arrow of time, among other things, prevents this. Another requirement of the scientific method, repeatability, cannot be satisfied by historical events. Evolution, therefore, is unscientific.

Many evolutionists are aware of this limitation of their philosophy. Some evolutionary scientists are trying through research to outline the *supposed* conditions under with evo-

lution, particularly chemical evolution, could have occurred. Any forced improvement processes generated by such experiments are automatically rejected by creationists because they are not spontaneous, are conducted under artificial conditions, are carefully guided by intelligence, and have no necessary relationship to any possible primeval natural condition.⁶

Even if a logical sequence of painfully sensitive improvement processes from molecules-to-men could be developed by scientists, no one could guarantee that it has ever occurred; thus it would not pass the test of observation.

III. Creation as History

The creationist accepts the creation account in Genesis 1 and 2 as historical fact. It is obvious that the creation account, like evolution, cannot be subjected to scientific investigation. It offers, moreover an additional difficulty to an investigator: it is supernatural.**** Supernatural events are beyond scientific investigation.⁷

The physical creation at the end of the six-day creative period was in a state of perfection as deduced from Genesis 1:31—"and God saw everything that He had made and it was very good." Perfection is characteristic of everything done by the perfect, holy God, Whose personality is revealed in Scripture. Immediately after the creative period no improvement process would be possible since nature was in a state of perfection. Thus improvement processes have no place in a creationist model.

*A natural process is defined as a spontaneous change occurring in nature in a sequence of steps over a period of time.

**A natural process possibly could be a combination of categories, such as 1 and 2, or 2 and 3, but not 1 and 3.

***Natural evolution fits into the general philosophy of progress that is deeply ingrained in human thought and can be traced very easily back to Greek thought. Consider this comment on Aristotle's metaphysical theory.

Everything in the cosmos, from stones, animals, and people up to heavenly bodies, goes through its natural process of change and development in order to approach the perfection, the immutability, of the Unmoved Mover.⁵

****However as Dr. John N. Moore has pointed out since molecules-to-man evolution cannot thrive on strictly natural processes, evolutionists must appeal to *supranatural* processes for the improvement they imagine.

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IV. Which Philosophy?

Neither the creation nor the evolutionary philosophies can be subjected to any kind of scientific verification. Yet they form entirely different frameworks for the facts of science. Which philosophy is superior? Or putting the question in another way: into which model do the facts of science best fit?

In the discussion of natural processes the evolutionary model allows for categories 1, 2, and 3. The creation model allows for only categories 2 and 3. Since improvement processes have not been observed, the creation model is more scientific than the evolutionary model, which demands molecules-to-man improvement.

The creationist claims scientific superiority for his model on this and many other points. The evolutionists may claim that the creation model cannot be tested scientifically (ignoring the fact that his model has the identical defect). The creationist must answer yes to this charge; however he can simulate conditions that he feels may have existed in the past and conduct experiments to verify or disprove such claims.

For instance, one aspect of the creationist model is the rapid formation of stalagmites and stalagmites. Experiments are being conducted at Bob Jones University to find the conditions that would allow for such rapid formation. Then these conditions must be evaluated in the light of expected natural conditions as forecast from the model. Of course, the model may undergo modification as the test results dictate. The creationist model offers many research opportunities.

V. The Creationist Model and Conservation Processes

A. Suggested Origin of Conservation Processes—At the end of the six days of creation a fully-functioning, finished physical universe existed. One might ask how did the Creator intend to insure the continuance of His creation? Each day or at certain chosen times God Himself could have appeared in His physical universe and personally attended to it to guarantee that it would operate properly. Or He could have had angels do the janitorial work.

Or, He could have set in motion certain physical, chemical, and biological processes to insure the proper continuance of His physical creation. The author suggests the latter possibility as the origin of conservation processes. God ordained them to conserve, maintain, or preserve His creation.

B. Purpose of Conservation Processes—Following the framework of the previous suggestion, conservation processes are the means employed to insure the continuance of the created order.

C. Conservation Processes and Living Organisms—God commanded many living organisms to multiply and fill the earth. This reproduction is after its kind (the phrase "after its kind" is found in Genesis 1:11, 12, 21, 24, 25 in the creation account). Creationists have not been and may not be able to determine the extent of the kind.⁸⁻¹⁰ But whatever the kind, it was to reproduce itself. In other words, living organisms were to be *preserved* on the earth through reproduction.

As trite as it may sound, reproduction guarantees conservation of kind. Reproduction, therefore, is a conservation process. Also many maintenance and repair processes in living organisms can be considered conservation processes. These operate so that organisms can continue to reproduce and fill the earth.

As a means of preserving original created order, growth is no more than a conservation process. Many organisms grow to maturity to reproduce to conserve the kind. Also God created fully-mature organisms when He created the earth (creation with apparent age).¹¹ Thus during growth to maturity the organism is simply replicating in limited degree the original created order. As the number of organisms increases, the *quantity* of order increases but not the *quality*. Growth, incorrectly, is considered an ordering process by many evolutionists.¹²

D. Conservation Processes and Reproducibility—Conservation of energy, momentum, etc., form a theoretical foundation for much of physics. Likewise conservation of mass forms a foundation for most of chemistry. Scientific conservation laws are laws of prohibition.¹³ It is theoretically possible for anything to happen that is not counter to conservation laws.

Conservation laws depend on certain symmetry properties of the physical universe. For instance, conservation of energy depends upon the symmetry of time. That is, energy can be conserved regardless of when an experiment is performed as long as the experimental conditions are identical. Time is not a variable affecting the outcome of a physical event conducted under identical conditions. If hydrogen gas had been reacted with oxygen gas to form water in 1575, this reaction ($2\text{H}_2 + \text{O}_2 \xrightarrow{\text{spark}} 2\text{H}_2\text{O}$) would have occurred the same way as in 1675, 1775, 1875, and 1975. Reproducibility is a prime requirement of scientific work.

The author calls this repeatability "conservation of event" for want of better terminology. Four grams of hydrogen combined with 32 grams of oxygen to form water vapor [$2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{H}_2\text{O}(\text{g})$] will always yield about 58 kcal. of heat energy. Oak trees will bear acorns which will grow into oak trees which will bear acorns which will grow into oak trees. Dogs will have puppies which will grow into dogs. Humans will have babies which will grow into adults. The same thing repeats over and over again.

As the consequence of an orderly operating universe, reproducibility is indirect evidence that an intelligent Being created the universe. It is also a teleological circumstance. Symmetry properties and conservation laws (scientific statement of conservation processes) imply design.¹⁴

Examples of Conservation Laws and Symmetry

Conservation Law	Symmetry in Nature
energy	translations in time
linear momentum	translations in space
angular momentum	rotations in space

VI. The Creationist Model and Degeneration Processes

Another type of process observed in nature is degeneration. Things tend to fall apart, living organisms die and decay, and there is a continual drift toward disorder.

When did such a principle become operative in the physical universe? No one can be sure. The Bible is silent, and scientists offer no answers. Any suggested solution is purely conjectural. The author *assumes* that degeneration processes originated at the Fall and unidirectionality in natural processes existed before the Fall.*

*There has been considerable discussion¹⁵ in past *CRS Quarterly* about when the second law of thermodynamics came into operation. To clarify the argument, Harold Armstrong¹⁶ suggested that any discussion of the second law should be compartmentalized. Statements of the second law^{16,17} fall into two categories, those dealing with the unidirectionality of natural processes and those dealing with degeneration (the tendency toward disorder).

Much of this interpretation depends upon the passage "and God saw everything He had made and it was very good" in Genesis 1:31. A state of natural perfection existed with no degeneration—every process operating at 100% efficiency—and with no death in the animal kingdom.

Such a world staggers the mental processes of anyone living in our present world. It is incomprehensible. With the introduction of degeneration processes, nature did not "run" as smoothly. Conservation processes attempt to preserve the created order. However degeneration processes operate countercurrent to any conservation. The net result of degeneration is destruction of order.

VII. The Interrelation of Conservation and Degeneration Processes

A natural "war" ensues in nature, conservation vs. degeneration. Created order is "eroded" by degeneration processes. Conservation processes, however, continually operate to "hold back" degeneration and in many cases may actually overcome the effects of degeneration processes for awhile.

An example will be given to illustrate the interplay of the processes. Lammerts and Howe^{18,19} recently performed some excellent plant succession studies on wildflowers in California. In good years when there was proper rainfall, suitable temperatures, and generally good growing conditions (conservation processes operating efficiently and/or favored by natural conditions), the wildflowers put on a "good show" with many colors per variety, ruffled flowers, lush foliage, etc.

In bad years when there were unfavorable growing conditions (degeneration processes prevailing), the wild flowers were stunted: the blossoms were of the usual color per variety and had no ruffled flowers and less foliage, and many varieties became extinct.

Conservation processes operate more efficiently under conditions suitable to living organisms. Degeneration processes prevail under conditions unsuitable to living organisms, causing them to suffer, die and even become extinct.

What evolutionists attribute to improvement processes is in actuality the result of conservation processes overriding degeneration. The natural changes they would be prone to consider as evolutionary are in reality the result of the interplay of conservation and degeneration processes, by means of which the organism either degenerates or appears to improve. Any apparent improvement would have to come through genetic recombination or change similar to that observed by Lammerts and Howe.

Which organisms survive? Those that are able to utilize the conservation processes available to them. Those that cannot utilize them cannot cope with the degeneration processes and consequently die out. Struggle does not improve organisms. The less the struggle, the more improved the organism. Struggle weakens organisms (as Lammerts and Howe have shown).

Evolutionists often confront creationists with the following argument. If degeneration processes are so important in the universe, why hasn't everything collapsed into a state of total disorder? This is an excellent question considering the emphasis put on degeneration processes by creationists. The answer is that degeneration processes do not have full sway in the universe. They are opposed by conservation processes. This writer feels that conservation processes are by far the stronger of the two.

†Many writers try to separate the concepts of progress in history and naturalistic evolution. This writer considers them as two manifestations of a single idea.

It is true that even conservation processes are inefficient. This inefficiency results in a slow deterioration of living organisms. The final result is death for the individual organism. Over a period of time the kinds themselves may degenerate. The order of the Universe is slowly being "destroyed" by degeneration processes. However, conservation processes insure that life will continue.

Intelligence aids conservation processes. Man has conquered many diseases and many other things that would have destroyed him. Man in learning about his environment (as he was commanded in Genesis 1:28) has learned how to take care of himself in the face of universal degeneration.

This achievement, coupled with his seemingly remarkable material progress, has lent weight to the idea of evolutionary progress since the Middle Ages.† Man appears to be advancing. Yet man is only employing previously ordained conservation processes for his good.

VIII. Conclusion

A creationist model for natural processes is superior to any evolutionary model. Nature is minimally a battleground of conservation and degeneration processes. Conservation processes are the stronger of the two. The persistence of order in the universe is due to their superiority, not to improvement processes. Degeneration processes reduce the order in the universe.

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WHAT ABOUT THE ZONATION THEORY?

CLIFFORD L. BURDICK *

Some creationists, taking it for granted that the existence of a geological column in the fossil record is well established, have proposed the theory of zonation as a way in which such a column could have been established in a relatively short time. The author proposes, however, that it is not necessary to account for the universal existence of a geological column, for it does not exist universally. Thus Creationist Geology may be relieved of the job of trying to account for a phenomenon which in fact does not exist in any world-wide or universal way.

Since the theme for this issue is "Creationist Thinking in 1976", this may be also a good time to do some re-thinking—about things which creationists have perhaps been taking for granted. May I suggest that one topic on which some re-thinking may be in order is the notion of zonation?

As readers will recall, zonation has been considered an alternative to or corroboration of the geological column. The geological column was the (often assumed) order of occurrence of fossils in the rocks; and according to uniformitarianists represented the historical order of the evolution of the creatures which produced the fossils.

Those who have held the theory of zonation have allowed the evolutionists' order of fossils for the most part, but differ in the interpretation. They believe that the fossil record covers, at most, a few thousand years, rather than 500 million or more years. Moreover, and most important of all, the order does not represent that in which the creatures evolved, for they did not evolve at all. Rather, the order is the order of burial.

Marine life was buried first, as mud flowed into the oceans; and the resulting rocks are those called Paleozoic. Later, as flooding continued, lowlands and swamps were flooded, and creatures, such as dinosaurs, living in such places were buried. The resulting deposits are those called Mesozoic. Still later, the uplands, inhabited by mammals, were flooded; and the deposits from them are those called Cenozoic. Thus the (supposed) order of fossils was explained in terms of Flood geology.

It is quite likely that there has been some zonation, in some places and in some cases. But may I suggest that recent discoveries make it appear that zonation was by no means universal, and that it is not needed to explain the order of fossils generally?

Recent studies of fossil spores, in rocks from the Grand Canyon and elsewhere, have shown that Conifers, belonging to Gymnosperms, have been dominant back to the Permian, and even back to the Precambrian Proterozoic, which is often alleged to be more than a billion years old.¹

The geological column is also commonly interpreted to include a gap of 80 million years between the extinction of the dinosaurs at the close of the Cretaceous and the appearance of man within the last million years or so. The theory of zonation will likely include such a gap in the rocks, although not such a long period of time. But there is now evidence to indicate that man co-existed with the dinosaurs, as well as with the sabre-toothed tigers or other giant felines.²

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Galully, a leader in geology, has remarked that a theory can be wiped out by one sound line of evidence which contradicts it. I firmly believe that the dominance by the geological column is becoming a thing of the past. The theory of zonation, then, if too closely tied to the geological column, might go down with it. For there is other evidence, too.

Not only have fossil conifers been found in the Precambrian, but also Angiosperms, the flowering plants, claimed by evolutionists to have evolved in the Cretaceous. The U. S. Geological Survey** has discovered fossil arthropods in Sierra Ancha Mountains, of Arizona, in rocks considered to be Precambrian, and over a billion years old. According to conventional views, this is about half a billion years too early for such fossils. Other fossil arthropods have been found in rocks, of the Keweenaw formation, ascribed to Precambrian, Proterozoic, times, on the south shore of Lake Superior.***

Moreover, it is only by alleging that rocks have been thrust one over the other, in formations such as the Lewis or the Glarus, that uniformitarianists are able to continue to hold the notion of the geological column at all. But there is no independent evidence that these formations are overthrusts; in fact, the evidence shows otherwise. So to depend on this allegation of overthrusting is to indulge in a circular argument.³

What can be concluded from all of this? I suggest that the following are in order:

(1) The complete geological column does not exist in the rocks; it exists, if at all, in the geologists' minds, in textbooks, and in museums.

(2) There is no necessary connection between the assigned age of a rock and the kinds of fossils found in it.

(3) Hence all of the creatures represented by fossils could have lived at the same time, or at not very different times.

(4) Likewise, much of the rock which geologists study must have been laid down at about the same time, and that in a relatively short time, certainly not a billion years.

(5) And this is just what one would expect to find, granted that there was a world-destroying Flood a few thousand years ago.

(6) Thus, while zonation likely occurred here and there, and we may study cases in which it seems to have occurred, there is no need to invoke it as a general explanation of the nature of the rocks.

**Dr. Don Elston of the United States Geological Survey presented this evidence in a lecture at the University of Arizona. Also, I have a tape of a lecture Dr. Elston delivered at California Institute of Technology on this data.

***Date from Dr. Anderson of Texas (Midland).

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THE PRECISION OF NUCLEAR DECAY RATE†

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It is commonly supposed that radioactive isotopes decay in a strictly exponential way, so that the process can be characterized by a half-life; and that the half-life depends only on the isotope, not being influenced at all by surroundings. Now both of these assumptions are challenged: it is questioned whether the decay is always strictly exponential, and there is evidence to show that in some cases at least the decay may be influenced by the surroundings, or by something else external to the nuclei. The importance of this possibility in trying to establish ages with the use of carbon 14 is obvious; and the question is of first-rate importance for physics generally.

Introduction

Each of the 1600 known radioactive isotopes has a characteristic rate of decay measured in terms of half-life, $t_{1/2}$. This $t_{1/2}$ is defined as the time required for the decay of one-half of the original excited nuclei.

The precision of nuclear decay rates refers to the exactness and constancy of these measured lifetimes. Such precision is a basic assumption of all radiometric dating techniques. In addition this assumption of constant $t_{1/2}$ is stated as fact in nearly every text book which has treated radioactivity since its discovery by Becquerel in 1896.

The high energies involved in nuclear interactions are thought to make nuclear parameters entirely independent of external conditions. However there is growing evidence and awareness that nuclear half-lives are variables rather than constants. Journal editorials¹ and articles^{2,3} are mute evidence that nuclear physics remains an experimental science.

The implications of variation of nuclear decay rates in the past and their possible control in the future are great. First, all experimental $t_{1/2}$ measurements must recognize the added parameter of nuclear environment. Much $t_{1/2}$ literature is incomplete because the chemical matrix of the nuclei and the laboratory conditions are not specified. All past and future half-life analysis must take into account variation of results depending on extranuclear conditions.

Second, a re-evaluation of radiometric dating and geochronology is needed. There is strong resistance to this specific challenge because radiometric dating results are much publicized.

Third, the control of the time dimension of radioactivity provides a potential energy source. Short nuclear half-lives could conceivably be lengthened and long lives telescoped to provide controlled energy release from decaying nuclei. Also the telescoping of long half-lives could rapidly decontaminate radioactive wastes, thus eliminating one of nuclear energy's major drawbacks.

Fourth, in view of the variability of half-life values a study of other physical constants, laws, and assumptions is in order.

Theory

(1) Half-Life Values: The half-life used to catalog radioactive isotopes may be defined in several ways. In completely random decay events the usual decay equation holds,

$$N = N_0 e^{-\lambda t} \quad (1)$$

Here N_0 and N are respectively the number of radioactive atoms initially and at a time t . The parameter λ represents the individual decay probability per unit time.

This equation is an approximation since the decay process under perturbation conditions is not random and is not properly described by the Poisson distribution assumed in Equation 1.⁴ In the perturbation case λ depends on the nuclear environment, the subject of this paper. Half-life varies inversely with λ ,

$$t_{1/2} = \frac{\ln 2}{\lambda} \quad (2)$$

The nuclear half-life also appears in the Heisenberg uncertainty principle relating energy and time,

$$t_{1/2} \geq \frac{h \ln 2}{\Gamma 2\pi} \quad (3)$$

The energy uncertainty Γ is the width of the excited nuclear state before decay. The time uncertainty is just the half-life, related inversely to the linewidth Γ through Planck's constant h . Note that as uncertainty in nuclear decay energy increases due to broadening by extranuclear interactions, the half-life necessarily decreases.

The inequality sign in Equation 3 is needed when the nucleus is perturbed by its environment, the usual case. Thus the equal sign is invalid along with the long-standing assumption that nuclear events are independent of all external considerations. The equal sign only applies in the case of a free isolated nucleus.

Either definition above shows that $t_{1/2}$ cannot be calculated from theory or from other data such as decay energy. It must be measured experimentally and cannot be known exactly.

The neutron is a good illustration of the profound mystery surrounding nuclear decay. Free neutrons have a $t_{1/2}$ of about 12 minutes. However neutrons bound within a stable atomic nucleus become entirely secure and unradioactive. Thus the lifetime of bound neutrons is entirely unrelated to that of free neutrons.

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Whether or not they maintain a neutron nature within the nucleus is as unknown as why they decay in the free state. Thus in this discussion of radioactive half-life it is well to keep in mind the very limited understanding of decay events.

Published half-life values have a range of 50 orders of magnitude. Extremes include ^8Be (10^{-23} seconds) and ^{144}Nd (10^{+23} seconds). Few other physical properties are measurable over such a large range of values. In view of difficulties (impurities, low counting rate, changes in counting geometry between samples, loss of volatile material) in measuring the longer half-lives, it might be more realistic to say all isotopes are radioactive to some extent, and those with $t_{1/2}$ greater than 10^{10} years are stable. The division between stable and unstable nuclei is arbitrary. Measurement uncertainty increases for both long and short isotopes; $\pm 2\%$ accuracy is typically and optimistically claimed.⁵

(2) First Order Interaction: The energies involved in nuclear reactions are usually much larger than the energies of chemical binding. Nevertheless interactions do result from energy coupling between the nucleus and surrounding electrons.

The effect is seen as a perturbation of the free nuclear-electron Hamiltonian, the function which specifies the energy state of the nucleus. This perturbation produces shifts and splittings of the nuclear energy levels which secondarily perturbs all nuclear parameters including decay rate.

Consider the electrostatic interaction between a nucleus and the electron charge with which it interacts. Let ρ represent a uniform s-electron density. These inner electrons have a finite probability of actually overlapping the nuclear site. Quantum mechanically the s-electron wave functions show penetration of the nucleus for a fraction of the time.

For a simple model assume the nucleus is a uniformly charged sphere of radius R . The shift of the decay energy as a result of the electron-nucleus coupling is then shown by comparing the electrostatic interaction for a hypothetical point nucleus and one of actual radius R .

For a point nucleus of charge Ze where Z is the atomic number and e is the unit electron charge, the electrostatic potential V at a distance r from the origin in electrostatic units is

$$V_{\text{point}} = \frac{Ze}{r}. \quad (4)$$

For a finite nuclear volume the potential is calculated from the definition

$$V_{\text{finite}} = \int \frac{dq}{r}. \quad (5)$$

where dq is the nuclear charge increment. The result for the uniformly charged sphere is

$$\begin{aligned} V_{\text{finite}} &= \frac{Ze}{R} \left[\frac{3}{2} - \frac{r^2}{2R^2} \right] & r \leq R \\ &= \frac{Ze}{r} & r \geq R \end{aligned} \quad (6)$$

The decay energy shift ΔE is given by an integral over the spherically symmetric region of nucleus-electron overlap,

$$\begin{aligned} \Delta E &= \int_0^R \rho (V_{\text{finite}} - V_{\text{point}}) 4\pi r^2 dr \\ &= \frac{4\pi\rho Ze}{R} \int_0^R \left[\frac{3}{2} - \frac{r^2}{2R^2} - \frac{R}{r} \right] r^2 dr \\ &= \frac{-2\pi Ze\rho R^2}{5} \end{aligned} \quad (7)$$

This result shows that nuclear decay is in general not independent of its electron environment. Decay depends on the energy state of the entire atom rather than on the nuclear state alone.

Experimental confirmation of the perturbation thus far has been mainly limited⁶ to atoms with small Z such as ^7Be . The reasoning is that s-electrons in this case are also valence electrons, and their density can be easily changed by external effects.

This emphasis on light nuclei is unnecessary, however, since s-electrons spend a fraction of time further from the nucleus than either p or d electrons. Valence effects on outer electrons of high Z atoms will still perturb the nucleus by screening the s-electrons. This phenomenon is presently seen with Mössbauer spectroscopy.⁷

A variety of experimentors have succeeded in changing nuclear decay rates several percent by changing the inner electron density of atoms. These techniques include:

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

(3) Higher Order Interactions: Other perturbations of the nucleus occur besides electrostatic coupling. Nuclei in energy states with nuclear spin other than 0 or $\frac{1}{2}$ do not fit the spherical model. They are nonspherical and their resulting nuclear quadrupole moment $\bar{Q}$ interacts with any electric field gradient $\nabla \bar{E}$ present at the nuclear site. This field gradient may arise either from charges within the sample itself or by external application. The Hamiltonian H_Q in this case is

$$H_Q = \bar{Q} \cdot \nabla \bar{E}. \quad (8)$$

An applied or naturally occurring internal magnetic field $\bar{H}$ couples with the nuclear magnetic moment $\bar{\mu}$, another nuclear parameter. This magnetic interaction can be written as

$$H_M = -\bar{\mu} \cdot \bar{H}. \quad (9)$$

These quadrupole and magnetic effects shift and split the nuclear energy levels. Just as the electrostatic coupling has been shown to control the nuclear half-life, so these higher order interactions affect the decay rate in ways not exactly known.

(4) Radiation Interactions: Radioactivity should be influenced by incident cosmic particles, electromagnetic radiation, and the disintegration of neighboring nuclei within the sample. A quantitative evaluation of cosmic ray effects involves a comparison of nuclear cross sections with the present and past cosmic ray flux.

However each of these quantities is uncertain. There is a particular shortage of reliable data on nuclear absorption cross sections, one reason why it is impossible to predict closely the efficiency of nuclear power reactors.

One example of cosmic ray effects may be seen in the incredible differences in age shown by returned lunar samples. Since the age of the moon is thought to be of the same order as that of the earth, scientists believed that lunar samples would very accurately correlate with terrestrial dating results.

Instead the radiometric lunar ages vary greatly between 2 million and 28 billion years. Neither value is reliable; and

it may be that the cosmic ray and solar wind particles which are incident on the moon unimpeded by a strong magnetic field or an atmosphere have grossly affected the decay rates of the products being measured.

A special radiation technique which has successfully controlled decay rates involves the construction of a resonant barrier around the nuclei of interest. Nuclei in the excited state are surrounded by identical nuclei in the ground state.

Some of the de-excitation gamma rays from the center region may be absorbed by the barrier and re-radiated back to the original central nuclei. The resonant process continues and has been used to lengthen the radioactive life of an original group of ^{57}Fe nuclei by 3%.⁸

This technique represents a mechanical control of the decay products rather than an actual control of the decay process. Only the nuclear energy levels that show resonance fluorescence qualify for this approach.⁹

(5) Special Effects: Gamow¹⁰ has speculated that all fundamental constants of nature may change with time. Hence the electric charge, speed of light, gravitational constant, and nuclear half-lives are all included as changing parameters that characterize the state of the universe.

Tests of this concept have been negative and thus limit any changes to an infinitesimal scale. An additional argument against this constant drift appears in Psalm 89:2; God's faithfulness is established in the stability of the physical universe.

Relativistic motion of a radioactive source lengthens the nuclear half-life by dilation of time with respect to a stationary observer. For 15 years this phenomenon has been measured for radioactive muons which are formed in the upper atmosphere by cosmic-ray-air molecule collisions.

Muons at rest have a $t_{1/2}$ of about 2 microseconds. When they are traveling at 99% of the speed of light, the $t_{1/2}$ increases 16 times to 32 microseconds. This special case which shows a relative aspect of time actually produces the greatest $t_{1/2}$ variation yet measured.

Data

Early efforts to disprove the assumption of unalterable radioactivity include Kelvin's objections to spontaneous decay in 1905 and Segre's theoretical perturbation predictions in 1947. Today experiments with a variety of nuclei show the control of half-life (Table 1). The changes reported thus far in half-life range from very small to 5.7% for the 73 electron volt metastable state of ^{235}U .

The majority of nuclei examined have been characterized by internal conversion or electron capture, decay types which are especially sensitive to the chemical environment. Notice that the percent variations shown in Table 1 refer to nuclear half-life values, not to radiometric dating ages which are much less reliable.

The list of experimentally perturbed half-lives is growing rapidly. Actually many other isotopes with very short half-lives could be included in Table 1, as for example the 100 different detected Mössbauer Effect gamma transitions. However the longer lived isotopes are of more dramatic interest.

Figures 1 and 2 are presented to show the problems involved in a typical literature summary of $t_{1/2}$ data for ^{24}Na and ^{134}Cs isotopes.¹¹ For these isotopes authors regularly publish $t_{1/2}$ uncertainties that lie entirely outside of the error bars of each other. Either the half-life is varying between samples, the authors do not understand statistical uncertainty, or both are true. It is evident that much nuclear

TABLE 1

Radioactive isotopes showing experimental $t_{1/2}$ variation (References 1, 3, 13). Abbreviations: ns (nanosecond, 10^{-9} second), s (second), m (minute), h (hour), d (day), y (year), EC (electron capture), β^- (electron emission), β^+ (positron emission), γ (gamma radiation). (Note: The last item, the uranium, is in a metastable state.)

Isotope	Average Half-Life	Half-Life Percent Variation	Decay Mode
^7Be	53.5 d	0.18	EC
^{14}C	5730 y	small	β^-
^{24}Na	15 h	0.5	β^-
^{57}Fe	100 ns	3	γ
^{60}Co	5.26 y	small	β^-
^{64}Cu	12.8h	1.7	EC, β^- , β^+
^{85}Sr	65.2 d	0.005	EC
^{89}Zr	78.4 h	0.08	EC, β^+
^{90}Nb	24 s	3.7	γ
^{96}Nb	23.5 h	3.6	EC
^{99}Tc	6 h	0.31	γ
^{119}Sn	18 ns	small	γ
^{121}I	2.12 h	small	EC, β^+
^{125}Te	58 d	0.026	γ
^{131}I	8 d	0.3	β^-
^{134}Cs	3 h	small	γ
^{137}Cs	30 y	small	β^-
^{169}Tm	4 ns	small	γ
^{193}Pt	9.7 ns	4.0 + 2	γ
^{235}U	26.1 m	5.7	EC

lifetime data are untrustworthy; separate measurements simply are not the same.

The generality of this problem and the tremendous economic loss due to worthless data are seen in the current catalog of isotope half-lives.¹² Listed are 57 isotopes with more than 10% variation in measured half-life between researchers, and 35 isotopes with more than a 100% difference in published $t_{1/2}$ values.

Figures 1 and 2 in addition show a tracking phenomenon. Tracking is the tendency of reported measurements to cluster about an incorrect value. Researchers are reluctant to report findings too far different from previous results in their published findings, or defective measurements or assumptions are repeated. Another large-scale example of this clustering effect is seen in the 4.5 billion year age assumption for the earth.

Conclusion

Radioactive nuclei lifetimes have been controlled by a variety of methods. There remains a strong inertial tendency from science text publishers to ignore this new time dimension of $t_{1/2}$. Certainly a new model of the atom is needed in which nuclear reactions involve the entire atom. Half-life must be considered as a stability index, a complex variable with extranuclear dependence.

Presently available nuclear data are very unclear as to possible influence by variable $t_{1/2}$ values. Accuracy of the numerical data reported in the scientific literature cannot

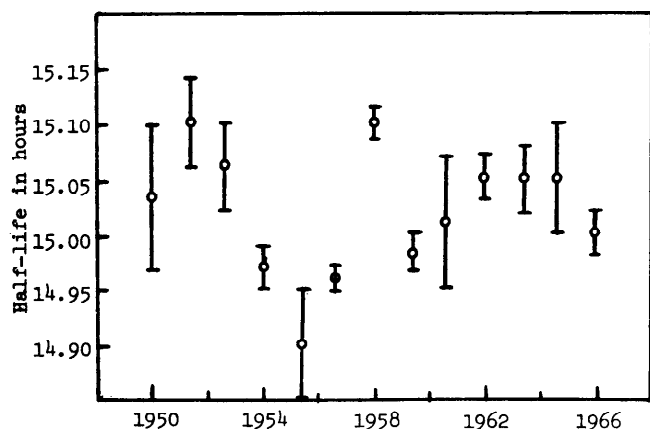


Figure 1. Published values of the half-life of ^{24}Na over a recent period of 20 years.

be determined from the evidence presented. Concurrent error ranges for single isotopes are not the same. Many experiments are underway to increase the list of perturbed lifetimes and to increase the magnitude of variation. It will be of interest to watch this area of $t_{1/2}$ research expand, and watch researchers become more cautious as the implications for geochronology, energy, and nuclear theory are realized.

Acknowledgement

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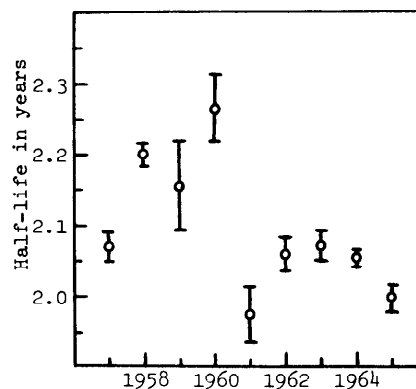


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— Editor

THE PRINCIPLE OF ANARCHY

HOWARD BYINGTON HOLROYD *

The principle of anarchy is the principle that the times, places, and amounts of energy transformations in the world do not, in general, take place according to laws of any kind, as "law" is understood in physics. In other words, the notion, maintained by Laplace and others, that everything is locked in a rigid determinism, is false. Reasons are given for believing that the generalization of experience proposed here is the correct one.

Men cannot form any judgment about the universe without using the thinking process of generalization. They must use inductive reasoning, but all know from many failures of the past that it is dangerous. Dr. R. A. Millikan has written:

This generalizing farther than the observed facts warrant, this tendency to assume that our finite minds have at any time attained to a complete understanding even of the basis of the physical universe, this sort of blunder has been made over and over again in all periods of the world's history and in all domains of thought. It has been the chief sin of philosophy, and the worst stupidity of science—this assumption of unpossessed knowledge, this dogmatic assertiveness, sometimes positive, sometimes negative, about matters concerning which we have no information.

One of the most important generalizations in science is that the universe is controlled according to invariant laws. This view has led to the belief that freewill does not exist, and that man is not responsible for his acts.

It is also a part of this vast generalization that man does not have a soul—that he is a purely physical system. The principle of anarchy denies that this generalization is valid, and insists that common sense is valid in concluding that some things in the universe are controlled according to invariant laws while some other things are not controlled in this way.

How did scientists reach their conclusion that all events, no matter how small, take place according to invariant laws? It appears from history that the general idea was developed in theological discussions in the middle ages.

Descartes made an important addition to the theory by thinking that physical events may be described as matter in motion. His analytic geometry was an important addition to mathematics needed for giving detailed descriptions of motion.

A little later Newton added enough to mathematics to make the calculus a powerful tool, and stated his extremely important laws of motion and his law of gravitation. At this point the human race had made a fine start toward the vast—and false—generalization that the universe is a huge machine.

In human society there is a form of action which may be called the gold rush effect. In a previous generation, miners rushed to stake claims as nearly as possible to the original claim on which gold was found. When Newton made his grand discoveries, other scientists used his *Principia* as their guide book, and tried to find physical laws which are similar to his laws. The history of this long period shows that their success was very great indeed. This great success was basic to the vast generalization that the universe is absolutely deterministic.

It is also a part of the history of gold mining that miners often were so determined to find gold that they gave no attention to other valuable minerals. And this has certainly been true for the "gold rush effect" in science. Newton's

great discoveries illuminated minds in some ways; but like a bright light, they blinded eyes to the existence of things in shadows. But these things in shadows may be important and dangerous.

The belief was developed that everything can in principle be predicted; but this is most certainly a false generalization. Stand a long, straight, slender column having a circular cross section and rounded ends in a vertical position, and have a guide at the top so that it will not fall. Place weights on the top. It is possible to determine at what load the column will collapse, but it is not possible to determine in which direction the bending will take place.

Consider the case in which a wire is loaded, as in the experiment for determining Young's modulus of elasticity, by stretching the wire; it is not possible to determine at which point along its length the wire will break.

Searchers for laws gave little thought to such things as these, for they had made the finding of laws their great objective. Their minds were thus closed to some of the great facts of human existence.

In forming general conceptions, experiences of life in general are surely as important as those formed in laboratories. One great generalization gained from experience is that natural processes destroy all of the works of man. No sooner is a bridge constructed than it starts to deteriorate; and the same applies to buildings, dams, factories, machines, instruments, and all other man-made things.

The facts are so well known that it is not necessary to discuss them. Depreciation is a great principle of the physical universe, but, oddly enough, not a principle of physics and chemistry.

Except in theory, it is not possible to separate macroscopic and microscopic events. On the small scale, the unilateral trend of events is described by the second law of thermodynamics: systems go from a lower to a greater state of probability. One is consistent in thinking that depreciation is described by the second law of thermodynamics extended to include macroscopic events.

This extension is really essential; rusting of steel, which is a microscopic process, may cause a bridge to collapse, which is macroscopic. A hard wind may destroy a roof, allow rain to enter a building, and start many microscopic decay processes.

In developing the statistical explanation of the second law, it was accepted that microscopic events take place according to the invariant laws, but that so very many things are involved that calculations are impossible. The statistical concept was adopted as a practical necessity without theoretical justification.

When one considers this matter from the point of view of the extended second law, he recognizes that in destroying the works of man, natural processes act in such a way that detailed predictions are impossible. There is no way of determining which building will be the next to be destroyed by a tornado or a fire; or when and where a flood will damage a city.

There is no good reason for claiming that nature is predictable when one can predict only a few of the very many

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events which take place. As may be seen from the simple cases of the column and the wire—and many similar cases can be described—no amount of investigation will suffice to predict many things.

The vast generalization that nature is absolutely predictable was based originally upon only a selected part of the evidence, and it is colossally false. Certainly the most simple conclusion, and the one which is consistent with the statistical concept of the second law, is that the principle of anarchy is true, and that nature has an absolutely lawless aspect. The times, places, and amounts of energy transformations involved in depreciation and accidents cannot be described by laws: they are anarchical.

The truth of the principles of anarchy is shown by the statistical character of radioactivity: it is not possible to give any law for describing the behavior of a Geiger counter in the presence of a sample of radium.

In the room in which I write there are many things which are not in chemical equilibrium with the oxygen of the atmosphere. Ordinary experience indicates that most of these things eventually will be burned; but there is no way for determining the place, time, and rate of combustion. Certainly it is more reasonable to say that there are no laws for describing these things than to say that there are laws which scientists cannot hope to discover.

No physicist would consider it worth his time to try to determine in advance the times, places, and amounts of the energy transformations in his automobile engine when he drives to his laboratory. No one will try to find laws for describing the energy transformations in the muscles of the fly which annoys him.

The evidence for anarchy is enormous, and it should not be disregarded. It is extremely misleading to think that events take place according to laws so completely hidden that we can not hope to discover their details.

The physicist and engineer have no difficulties in making apparatus and machines which function in nearly predictable ways. In their bodies there are stores of energy at low entropy, and by being able to control energy transformations in their muscles, properly regulated in time, place, and amount, they produce their highly improbable devices.

In so doing they do not break any law of nature, because there is no law of nature according to which these transformations are regulated. One cannot break a law which does not exist.

I am accepting here the philosophy of dualism, that man is soul and body. This was the ancient view, and it was accepted by the greatest physicists, Descartes, Newton, Maxwell, and Einstein. I consider that biologists and psychologists who attempt to discard the conception of soul have carried a generalization too far.

Physicists and chemists know that they do not know matter directly, and that present conceptions have been reached by long chains of inference from many experiments. Rather, matter is an unknown thing, and not at all the starting point in scientific investigations.

Mathematics comes from within the human mind; and its existence is not known to be physical or chemical. It would be illogical first to use mathematics for explaining physics and chemistry, then to use these to explain physiology, and finally the anatomy and physiology of the brain to explain the mathematics with which one started. The psychologist who attempts to explain mind in physical

terms is trying to understand the known in terms of the unknown, a most foolish attempt.

The principle of anarchy permits freedom of the soul to control the times, places, and amounts of energy transformations without violating any natural laws. Energy at low entropy is necessary for operating the body, but it is not sufficient for explaining its operation.

In order to explain its operation, and to explain how it is caused to exist in a generally lawless universe of matter, it is necessary to recognize the existence of something which creates improbable things and counteracts anarchy. This something, as is apparent from work of design by engineers and others, makes much use of mathematics, which is non-physical.

Many organic molecules are asymmetrical, and their asymmetry must be maintained against a tendency toward symmetry.¹ This shows that an anti-anarchical control exists, and that it operates at the molecular level of organization. It does not show that it may not act otherwise. The body is held in its improbable state by transferring its increase in entropy mostly to heat at high entropy.

One of the general facts of life is that man must repair and maintain his structures, machines, and instruments. In so doing, he counteracts the anarchical processes of the physical universe. His soul controls according to his desires the times, places, and amounts of energy transformations in his body, and he creates improbable things where they would not exist otherwise. Much the same thing must be done in organisms.

Really, there never has been any adequate reason for discarding the conception of soul, or for believing that the universe contains nothing for which physics and chemistry do not provide adequate explanation.

Mathematics exists: the person who labors over a problem in pure mathematics is not dealing with something which does not exist. There is no good reason for thinking that mathematics has the same kind of existence as a kickable rock.

Mathematical and other knowledge exists as a part, or aspect, of the totality of things, that is, as an aspect of the universe, but not as a material part, for it has a property which matter does not have, that of being transmissible at the velocity of light from one place to another. The special theory of relativity shows that mass becomes infinite at the velocity of light, and therefore that it is not possible to move any massive object at the velocity of light. But all of the knowledge of a library may be sent by radio and television from one place to another at the velocity of light.

The conception of soul was discarded for a bad reason, namely to form the false generalization of a universe operating according to absolutely invariant laws. Recognizing that the principle of anarchy is true, can help to restore the conception of soul to its proper place.

The correct generalization appears to be that the universe is anarchical in general, and that order exists only when it is introduced and maintained by soul. After a long detour, it may be that scholars have returned nearly to the point where science left theology.

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THE REIGN OF LAW

WILLIAM J. TINKLE *

In the study of nature, it is easy to concentrate on the laws discovered, to the extent of forgetting that there is anything else. The author points out that two kinds of law, statutory and natural, are quite different. As for natural laws, they are just observed regularities. Thus it is not reasonable to invoke natural law, as some have done, in an attempt to eliminate the need of a Ruler of nature. Neither does the existence of natural laws, that is of regularities which happen usually, make the occurrence of miracles impossible.

Many statements float from lip to ear which, if they were proved would be oracles of truth, for instance. "Order is Heaven's first law." What a wealth of observation and depth of understanding are claimed by the unknown savant who said this! He claims not only the wisdom to discern what is primary in the administration of the universe but he also assumes that it is ruled by fixed law.

It is characteristic of the times to emphasize action by law. This may be done to the extent that little room is left for intelligence or wisdom or personal choices on the part of God. It may even lead to a decision that no God is needed!

P. S. Laplace, a successor to the great Isaac Newton, stated the rule of law in great detail. Laplace had faith that nothing matters except the setting up of laws in the beginning.

We ought then to regard the present state of the universe as the effect of the preceding state and the cause of the state which is to follow. An intelligence which for a given instant should be acquainted with all the forces by which nature is animated, and with all the positions of the things composing it, if further his intelligence were vast enough to submit these data to analysis, would include in one and the same formula the movements of the largest bodies in the universe and those of the lightest atom; nothing would be uncertain for him; the future as well as the past would be present to his eyes.¹

It is my purpose in this paper to show that the Ruler of the universe is more than the sum of the laws which he has formulated. We may say "God is law" or "God is love" or "God is justice", but none of these terse statements is a complete description. A law is somewhat like a computer which is valued highly for some use in a limited way; one never sees a computer acting as the superintendent of a factory.

Two Kinds Of Law

Unfortunately the public confuses two kinds of law, the meanings of which are distinct. They are (a) statutory regulations formulated by states and other authorities, and (b) general statements by scientists as to expected results.

For the welfare of the public a state formulates rules which the people living within it are told to obey. If the people do not do so they are punished by losing property or freedom. Even if the culprit escapes punishment he is looked upon by his neighbors as bearing a moral stigma.

Incidentally such laws emphasize the fundamental difference between mankind and animals. Laws are not made for animals to obey but for people. We would laugh at a government that made laws for animals.

Law passed by the state is not the subject of this paper; consequently attention will be given to natural or scientific law only. Persons who observe the facts of nature learn

that the world is usually orderly. One learns that things can be grouped into classes and that a description of one object applies for the most part to another thing of that class.

It also is true that an action usually causes the same result as another action of that type. These observations enable men to make general statements or laws about things or forces which hasten and facilitate our work with them. Thus one studies science.

Of course two tentative groups are supposed to be recognized before one uses the word *law*, namely *hypothesis* and *theory*. The ideal method of learning truth is to accumulate many data on a question that needs to be solved. The data should be exact, observed without bias, and have a real bearing on the question. Then an estimate or hypothesis is made to solve the question being studied, then the hypothesis is put to test by experiment, and more observations are made.

When observations confirming a hypothesis accumulate, the hypothesis becomes a theory; and a theory unchallenged and consistently supported by facts is called a law after a considerable lapse of time.²

Through making such plans for their work, scientists have been awarded quite a reputation for selfless application and impartial conclusions, but they know that they stand no higher than other groups. Such ideal conduct is attained by only a few, for it is above human nature.

Often a statement that something is "scientific" is taken by the layman to mean that it is *certain* but this shows an incorrect comprehension of the true situation. . . . in this process the generalization does not become fact; the likelihood of its being correct merely increases.³

Examples of Law

As stated above, many laws never were intended to be more than a description of the *majority* of a group or of what usually happens, even failing to apply to large minorities. With respect to Cope's law, there are marked exceptions.

. . . in line after line—horses, elephants, cats, deer, etc.—the mammals have followed Cope's law that in the course of evolution . . . a race of animals tends to become larger in body size. In this too they resemble the reptiles. Note however, that in both groups there are lines, like the rodents, where there has been little if any tendency to increase in size.⁴

With respect to this law and others to be mentioned below creationists do not even admit the truth of the principal statement, that these animals have developed through evolution. Animal fossils are found widely scattered, not little ones below, larger ones a little higher and the largest ones in the highest layers of rock. Then how do paleontologists know that the small types are the oldest? They do not know it; they assume it because this is how it should be in evolution.

Evolutionary geologists actually decide the relative ages of the rock layers by the order of the fossils which they contain, as according to K. L. Currie:

*William J. Tinkle, Ph.D., worked in genetics for many years. He lives at Timbercrest Home, North Manchester, Indiana 46962.

In the case of the geologic record we have seen that . . . the record depends on (1) an ordering of the sedimentary units in order of age, which is based almost entirely on *fossil* evidence, and (2) identification of conditions of deposition from present physical conditions.⁵ (Emphasis added)

Then how is it known that the evolutionary order of the animals is correct? Because it agrees with the order geologists have assigned to the fossils. But how did geologists learn the order of the fossils? Supposedly, it is the order animals and/or plants followed in their evolution. One naturally comes back to the starting point, namely a belief in evolution. Such circular reasoning has been pointed out many times.

Consider now the fruit fly, *Drosophila melanogaster*, to see how well this species illustrated Cope's law. Many strains have arisen from the wild type through mutation and these mutant flies are not larger than the wild. These strains have been seen to arise, researchers have handled them, and every strain is inferior to the wild strain from which they arose.

For instance the strain called *vestigial* not only has crumpled wings but is diminutive in size and crawls about in a manner which arouses one's pity. Mutations in general, a very large group, tend to be exceptions to Cope's law.

According to Dollo's law, the direction of evolution is irreversible and those who believe in evolution believe of course that the direction is upward. Yet both evolutionists and creationists agree that 99 percent of all mutations are harmful to the plant, animal, or person.⁶ Consequently little is heard of Dollo's law now.

Another rule which is being dropped, the Biogenetic law, included such claims as gill slits in the neck of bird and mammalian embryos. It was given up by authorities as much as 20 years ago, but still is occasionally found in the literature.

The laws of physics have fewer exceptions than those mentioned above. While no one knows just what gravity is, no one doubts that heavenly bodies attract each other just as small objects fall toward the earth. Even here, however, it is easy to make statements which are too sweeping about the certainty of the power of law.

Water in the atmosphere does not fall as rain unless the drops are large. Water as single molecules or even fine grains of dust may remain in the atmosphere indefinitely. When the mass of a particle is reduced beyond a certain point it is affected more by other forces such as air currents, than by gravity.

Another example of the failure of gravity is that a needle laid carefully on water does not sink. In this instance gravity is weaker than cohesion of the surface film.

God as Ruler

The reader should now be able to understand how a personal choice on the part of God may be able to rule rather than any single law. God may cause the combined forces to bring about some result that is different from the result of any single force. Or He can stop the action of one force and let another produce its effect.

While it is true that God usually chooses to work by law (in other words, He is consistent), He is not restricted to any particular method, nor does He have to waste time looking through His "chest" of laws to decide which to use.

The readers of this *Quarterly*, along with a big percent of Americans, believe in God. Certainly God can control the various forces of the world and decide which of them in a given situation is to produce the desired result.

To be sure this attitude requires faith and no apology is offered for mentioning faith in a publication devoted principally to science. The situation is not faith versus knowledge as some have alleged, but faith in observation and a trusted record on the one hand, against faith in a man-made, Godless religion on the other.

The evolutionist may finally admit that his theory does still have many serious unsolved problems. Nevertheless he feels it is the only proper belief, since belief in special creation in effect gives up on the problems, relying on a force outside present scientific phenomena to explain the origin of these phenomena.

The creationist acknowledges this. He finally must accept creation and a Creator by faith, since the process of special creation is not accessible to scientific observation.

But neither is the historical process of evolution, he reminds the evolutionist. Evolution also must be accepted on faith, and that faith is more arbitrary than that of the creationist.⁷ Actually faith in a man-made religion.

Miracles

It is quite true that much action is a repetition of that which has gone before just as an oak tree is a rough copy of former oak trees, and that this standard procedure is basic to the work of scientists. But the world is not a slave to natural procedure or to the laws which keep it in operation. The world could not even have started without a miracle, for present natural processes produce only conservation and loss.

Webster's Collegiate dictionary contains four definitions of the word *miracle*, of which the second is preferred: "A wonder or wonderful thing; a marvel." This definition is chosen because of the etymology of the word; it is derived from a Latin word meaning to marvel.

Now it is true that many people have the idea that a miracle must go contrary to a natural law. They confuse natural and statutory laws in their thinking, and remembering that the breaker of a statutory law is disgraced they somehow have an odious feeling toward a miracle.

If they will remember that a natural law may be only a statement of an average and that a miracle does not necessarily break even that average, they should find miracles attractive. I conclude by stating that a miracle is God's *unusual* method of working.

A World-Ruling Person

Granted that the laws of nature (i.e. those which have proved to be valid) are God's regular methods of working, then one may ask if He simply *found* these laws in operation. This would postulate either that there were some previous God or gods who lost their reign or that all things arose by chance. There is no reason to draw either conclusion and to do so would be an effort to discredit God without cause; for God drafted those laws.

But some one has objected that if "with God all things are possible"⁸ *He should be able to make a world where miracles are not necessary*. Of course God could make such a world but who would want to live in such a place?

The first response of the reader to this statement probably is negative. Who would object to a perfect God and a perfect world? But consider the absolute and meticulous control God would have to exercise, making not only monotonous weather but just as monotonous people. Of course it would be well to be rid of annoying sins and even

mistakes but would human beings be human? No, machines. Is the prospect attractive? The proposed world would be more like a clockwork.

The freedom of man is not perfect because of limitations in heredity and environment but men have enough freedom to afford many choices of action. It naturally follows that many mistakes are made—even worse, wrong deeds are committed knowingly.

If God gave man no choice but to do right then man would not have an opportunity to be wrong. If God made man with power to choose but with no provision for repentance when he does wrong, man would be helpless indeed, for all of us have sinned. This need for a man to correct a broken life and rebuild the damaged places is one of the reasons for miracles. Jesus Christ is that man.

All must be reminded that, while law is used, the ultimate rule of the world is by a Person. The words are not vain when repeated, "I believe in God the Father Almighty!"

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ON METHODS OF TEACHING ORIGINS: A PROGRESS REPORT

JOHN N. MOORE *

If creation science becomes an integral part of curriculum in both public and parochial schools, then teachers must learn "how to do it". The author recounts aspects of his course at the university level, and indicates how he is aiding others to do similarly, even at the secondary level of learning.

Introduction

When I began teaching I was an evolutionist and taught evolutionary thinking for almost six years before I became a Christian in 1962. Most instructors in the scientific field are exclusive evolutionists, as that is the only point of view they have been taught regarding origins. Ever since Darwin's *Origin of Species* appeared in 1859, the philosophy of evolutionism has pervaded all the disciplines of human knowledge, so that even an English major is trained to think that way.

After 1962 I changed my teaching of general education science at Michigan State University to include more and more of a two-way presentation about origins. In my present teaching I make it clear that my students will experience a formative confrontation between the evolutionary explanation of the majority and the creation explanation of the minority. Students are encouraged to realize that today, in the 20th century, they still have a real, live option with regard to origins.

The scientist does not have it all "sewed up" when he proposes that the universe began by an explosion. He has no knowledge of such an event as a *scientist*. When he claims that life began by some transcombination of molecules he only expresses his imagination. When he says that humankind is a consequence of mutational mistakes—errors of reproduction or the failures of DNA replication that formed the blacks and yellows, and so on—this is sheer imagination, and he pushes his position at the expense of academic freedom, and good, solid scientific work.

General Course Outline

At Michigan State University the natural science course I teach ("Science, Beliefs and Values") emphasizes discussion of "The Origin of the Universe", "The Origin of Life", and "The Origin of Humankind".

In the *fall term* the theme is, "What are men's ideas about the place of the earth in the solar system and in the universe?" This leads to the question, "Is it possible to study scientifically the origin of the universe?" And the answer is "no". Subject matter is drawn from astronomy with attention to "motion", good scientific theories, contrasts of cosmology and cosmogony; and my students examine carefully the two principal explanations of "evolution" and "creation" regarding the origin of the universe.

Classwork in the *winter term* centers on the question, "What are men's ideas regarding the origin and continuity of life? This leads to the question, "Is it possible to study scientifically the origin of life?" And the answer is "no". Subject matter is drawn from sexual and asexual reproduction and genetics and attention is given to two beliefs about origins: one is spontaneous generation, which is consistent with the philosophy of naturalism; and the other is created life order as coming from the Creator.

The *third term* is the capstone of the year with the question asked, "Is it possible to study scientifically the origin of humankind?" And again the answer is "no". Subject matter is drawn from geology regarding geological changes as basis for consideration of biological changes as to two degrees of change, that is, *within* kind and *across* kind. Application of circumstantial and conclusive evidence to an evolution model and creation model about origins of the variety of living things, including man, is stressed. My stu-

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dents learn that only circumstantial support can be given the evolutionist position; and that the same data can be used to support conclusively predictions from the Genesis account.*

Team-Teaching Explained

In the current Spring Term I am engaged in a unique team-teaching arrangement with an evolutionist colleague, Dr. Donald Weinshank, Ph.D. We are both participating in three lecture sessions per week which are attended by over 250 students. Then we meet in an alternating pattern with these same students in eight separate recitation-discussion-laboratory sessions that are held twice each week. These smaller classroom sessions of about 32 students convene after each Monday and Wednesday lecture session, respectively. (All eight sessions were marked with an asterisk in the *Spring Term Schedule of Courses* with a footnote that the main subject area would be evolution versus creation.)

*A book by Zola Levitt, *Creation: A Scientist's Choice* (1976, Victor Books, Inc., Wheaton, Illinois 60187) presents a great deal of my thinking. Readers learn how the author, a "closet evolutionist" (one who accepts creation on Sundays, and seems to defer to evolutionary thinking during weekdays) gained an objective basis for coming out of his closet and knowing in an objective manner how he can support the creation account of origins scientifically, even in this "scientific age" of the 20th century.

To the best of my knowledge this is the first time such a team-teaching approach has been implemented at a major educational institution. Our project is typical of the innovative tradition at Michigan State University, the original land grant college in this nation—and the two-way approach taught by an evolutionist scientist *and* a creationist scientist is fully in keeping with the academic freedom encouraged at Michigan State University.

Evaluation of student participation is centered in two lecture examinations and a final examination. Just before the first lecture examination, the two instructors explicated their points of agreement and disagreement. See Table 1. Primary disagreement areas are indicated by asterisks. Dr. Weinshank maintained at the beginning of the course that theories are either "contemporary" or "historical", and both kinds were good examples of scientific theories. I disagreed and have continually emphasized the following:

Evaluation criteria:

- | | |
|--|--|
| a. Scientific (Contemporary) Theories | a) Identifiable <i>prior</i> observations |
| Examples: Gene Theory
Atomic Theory
Nuclear Theory
Kinetic-Molecular Theory | b) Predictions, <i>before the fact</i> , that are testable by repeatable experiences, directly or indirectly |

Function: to explain "present" phenomena involving events in life experience of human beings

TABLE 1—A LIMITED OUTLINE OF CREATIONIST POSITION

SCIENCE:	based on authority of repeated direct or indirect observations. First origins of necessity are in separate category from scientific theory of gene*	Similarities:	have been used over the centuries to place plants and animals in distinct, recognizable categories; hence, resulting in turn in emphasis upon <i>differences</i> detectable generation after generation, over thousands and thousands of years
GENE THEORY:	excellent example of scientific theory, meets criteria as based on prior observations, is basis for testable predictions, and modifiable	GRAND CANYON EXPLANATION*:	reasoned, mental reconstruction, use of observation PLUS <i>imagined or proposed</i> origin of rocks, involving basically unnatural processes of mtn. bldg, complete erosion of mtn. ranges, continental glaciation, fossilization
VARIATION:	factual, observational, intersubjective, objective fact of changes of gene frequencies	"Historical" geology*:	<i>imaginative</i> stories, narratives, or proposed scenarios of what <i>might have</i> occurred but which all know are uncheckable
Two degrees of change:	within or across kind	SEARCH FOR EXTRA-TERRESTRIAL LIFE:	activity of the present, <i>extrapolative</i> basis for proposals about past.
Species:	whatever a group of authorities say it is; some reproductively isolated breeding population of organisms		Any production of amino acids = procedures by careful, repeatable experiments
Kinds:	recognizable types, forms of organisms, which belong to some breeding popu. (Known amino acid sequences are specific for each kind—Dickerson article in <i>Scientific American</i> , April 1972.	GEOLOGIC COLUMN*:	does not exist anywhere in total order; a reasoned, mental assembling, use of local observations PLUS <i>imagined or proposed</i> origin of rocks PLUS <i>imagined or proposed</i> origin of life forms
EVOLUTION:	not mere change, or unfolding, or just changes of gene frequencies	Circular reasoning:	rocks dated by fossils, fossils dated by rocks
MICRO-:	change <i>within</i> kind - genetic variation	CONTINENTAL DRIFT*:	<i>imagined, proposed extrapolation</i> into past using known changes of present, no known natural causes from testing
MACRO-(MEGA)-:	change <i>across</i> kind proposed by evolutionists	FLOOD MODEL*:	Canopy, Greenhouse climate, Moderate hilly terrain, Wide migrations, Continental break-up possibly
NATURAL SELECTION:	essentially elimination of existing organisms which were of unknown origin; means for changes of gene frequencies <i>within</i> kind, no criteria really; analog to artificial selection of breeders using specific criteria. Involves selective pressures (agents, aspects of environment) which result in identification of existing variants—some live, some die. Examples given by evolutionists are all closed within same kind of organism as was studied at beginning of research. (That is, a researcher concludes research with same organism as at beginning of research—moths, bacteria, etc.)		
CLASSIFICATION:	arbitrary grouping, ordering per agreed upon criteria		

*Indicates explicit points of disagreement between evolutionist professor and creationist professor.

Evaluation criteria:	
b. "Historical" (Imaginative Narratives) Theories (Arguments) Examples: Big Bang "Theory" Geological reconstructs Macro- (mega-) evolution Continental Drift "Theory" Hominid Macro- (mega-) evolution	a) Identifiable observations of events in "present" life experience of human beings b) Predictions, primarily <i>after the fact</i> , that are testable <i>only</i> by logical reasonableness, internal consistency regarding past events

Function: to explain unobservable *origins* of aspects of the "present" environment

Objective multiple-choice questions used in the first lecture examination were designed in such a manner that students indicated which statements were attributed to proponents of the evolution model and the creation model presented to them at the beginning of the course. Another set of questions called attention to the fact that classwork had been designed to maximize interaction between evolutionist and creationist points of view of the same facts. Students indicated which statements were consistent with the position of either the evolutionist scientist or the creationist scientist. A moderate approximation of a normal curve was characteristic of raw scores on the first examination.

My campus colleagues, in the last three years, have recognized the substantive scientific basis of the creation account of first origins. I have given guest lectures, strictly upon invitation, to graduate students in zoology, honors section students in botany and zoology, students in the special science college, and departmental colleagues have opened their own lecture classes for a total of 30 presentations of a guest lecture, "A Scientific Case Against Evolution", in the same three year period. They have wanted their students to hear a concise, pointed two-way presentation of evolution model versus creation model with regard to first origins. (Interesting point: Colleagues involved have regularly been the younger instructors, with and without tenure.)

Lectures to Science Methods Classes

This year two invitations to speak to education methods students were filled at Michigan State University and Ball State University (Muncie, IN) in which I used the following brief outline:

1. A series of transparencies were projected about the variety of living things and variety of fossils as well: dog genealogy, finches, pigeons, and fossilized skeletons of gopher, spider, and frog—as observables in "real world", and variety to be explained. Also projected: list of so-called "living fossils", and two charts showing duration of major kinds of plants and animals throughout most of accepted geologic time scale (based on English Geological Society publication); hence basis for concept of "fixity of kinds".

2. Transition from observations to explanation (models): Per basic assumption of scientists of cause and effect, what about origins of the great variety of living and dead things?, what about *first* origins?

MAJORITY MODEL:

a. Explosion of dense particle	Origin of: UNIVERSE
b. Spontaneous generation	LIFE
c. Mutational changes (accumulated errors)	HUMANKIND

(Clarification re (b) as not the same as Macroscopic Spontaneous Generation of Greeks, disproved by experiment by Redi, nor same as Microscopic Spontaneous Generation of mid-19th century, disproved by Pasteur's experiments.)

MINORITY MODEL	
Origin of UNIVERSE (order)	a. Creator God (Orderer—pattern)
LIFE (order)	b. Creator God (Orderer—kind fixity)
HUMANKIND (order)	c. Created from dust (Orderer—uniqueness)

A single page was distributed containing brief itemization of more details of each model. (See Table 2).

3. Thus *both* MAJORITY and MINORITY MODELS involve *supra*-natural phenomena for which there are no observables at all; no one has observed such phenomena and none of the phenomena are subject to replication so important to strict scientific methodology!

Attention to transparencies of old, early 20th century diagrams of solid line connections between kinds of plants and kinds of animals, which was contrasted with modern dotted line connectors such that present variety is mostly "twigs" on supposed branches of main tree trunk; with specification that MAJORITY MODEL entails reliance upon the *assumption: the degree of relationship depends upon the degree of similarity*.

Yet no genetic lineage connections can be demonstrated by any known research; hence MINORITY MODEL involves "fixity of kinds" as shown on transparency of contrast between monophyletic tree of modern evolutionism (based on explosion and spontaneous generation) and modern creationism as a forest of trees of variability *within* kind (based on created kinds). Comment on parsimony that one beginning of evolutionary tree is not more simple than multiple created kinds of trees of creation model, since former includes many, many supposed DNA errors and presumed positive outcomes of prey-predator relationships.

These are typical questions and answers that followed the condensed presentation:

Q. What about customary links?

A. Typical reference is made to *Archaeopteryx*, which is basically recognized as a bird by ornithologists, with some unique or peculiar features, such as long tail, teeth, and claws on wings. The Hoactzin bird in South America has claws on wings; is it evolving? Essentially there are missing chains, and not just missing links.

Specifically the MAJORITY MODEL involves the basic assumption mentioned of relationship being a function of similarities, and hence *Archaeopteryx*, *Seymouria* and others are just forms that are similar to other forms, yet without any known or detectable genetic connection.

Q. What do you mean by the term "model"?

A. Explicitly a scientific theory may be thought of as synonymous with the term "conceptual scheme", and each entails a listing of postulates, which are basically assumptions that are taken for granted. Model refers to a particular thought construct that is properly applicable to first origins.

Q. Can you give an example of involvement of other subject areas than science?

A. Projection of transparency of all major areas of human knowledge along the lines of the MAJORITY MODEL leading then to a type of selected indoctrination. Attention was given to Carl Becker and Charles Beard as examples. The latter did not even do the research for the position he wrote of in following thinking of Marx who, in turn, was significantly influenced by Charles Darwin's *The Origin of Species*. (Chart used is available in booklet, "Should Evolution Be Taught?" (p. 26) from Creation-Life Publishers, Box 15666, San Diego, CA 92115 for 30 cents.)

Q. What about some bill on creation teaching in the Michigan Legislature?

A. Such is now in the Education Committee of the Senate I understand and I do NOT favor this approach at all. I hold that it is legal to teach about various people's beliefs about first origins. I should mention a two-column coverage of "Creationists say—, Evolutionists say—" in Stanley Weinberg's, *Biology: An Inquiry into the Nature of Life*. Boston: Allyn and Bacon, Inc., 1974, p.467.

Q. What is your motivation?

A. I am interested in contributing to re-vitalization of science teaching, especially regarding first origins. I am not here to "win", but to communicate, as is the intent of leaders of national organizations, at the "cutting edge" of the creation-evolution controversy, such as the Creation Research Society, an organization of qualified scientists, which publishes the *Creation Research Society Quarterly*

TABLE 2

Statements of Evolutionary Uniformitarianism Model of Origins (based upon world-view of naturalism)	Statements of Catastrophism and Creationism Model of Origins (based upon world-view of theism)
1. Matter has existed eternally (No cause)	1. Universe was created essentially in present state. (Cause: Eternal Creator)
a. Matter continually appears (from energy?)	a. Matter, planets, stars created complete.
b. Matter exploded and continues to expand.	b. Light rays created directly.
2. A whole series of elements was generated (evolved); and stars, planets have evolved by accretion.	2. Universe was created complete and basically stable.
3. Apparent land features resulted from specific causes of vulcanism, diastrophism, gradation (the present is the key to the past).	3. Causes seen in present were not causes of land features (the present is only the key to the present).
4. Forces of origination and integration exist.	4. Catastrophism, decay and conservational activities prevail in antagonism.
5. Geologic column is evidence of vast "history" of the earth.	5. Only local sedimentary columns exist and world-wide destruction is evidenced by world-wide distribution of sedimentary rocks.
6. Because of innate propensity of matter, organic matter came from inorganic matter by spontaneous generation.	6. Since spontaneous generation of life is contradictory to Second Law of Thermodynamics, only special creation of life could be cause of life.
7. Changes in evolutionary sequence of life forms are due to random mutational changes in genes.	7. Mutations are evidence of increased disorder (entropy) and only changes <i>within</i> limits of kinds, group, or species result from mutations/recombination of genes.
8. Changes of complex forms or kinds from less complex kinds are the result of accumulation of random variations.	8. Conservative processes are involved in operation of genetic code resulting in essential stability (fixity) of basic kinds, groups, species, with no accumulation of random variations.
9. Mankind is related to the ape through an unknown common ancestor.	9. Mankind is a special creation.
10. Fossils of genus <i>Homo</i> are immediate ancestors of modern man.	10. "Ape-like" features of pre-historic man may be due to disease and degeneration.
11. Races of man resulted from mutations and segregation in early man-like forms.	11. Human beings all belong to one race and languages are merely tribal differences.
12. Evolutionary humanism can be a guiding faith.	12. Alienation, identity, and relevance can be answered in context of relation to Creator God.

2717 Cranbrook Rd., Ann Arbor, MI 48104); the Institute for Creation Research, which publishes a monthly *Acts and Facts*, (2716 Madison Avenue, San Diego, CA 92116); and the Bible-Science Association, which publishes a monthly newsletter for parents and non-scientists (Box 1016, Caldwell, Idaho 83605).

In the pluralistic society of the United States of America indoctrination in the MAJORITY MODEL is no longer necessary and many materials are available to the classroom teacher, such as a Two Model Minicourse by Richard Bliss (Creation-Life Publishers, Box 15666, San Diego, CA 92115), and the excellent 1976 book, *The Creation-Evolution Controversy* by R. L. Wysong, Inquiry Press, Box 1766, East Lansing, MI 48823 (\$7.95, paperback).

During the current month of May I am teaching a four-week module for two night lectures of two hours each, elected by over 30 senior education majors who have completed their student teaching, prior to graduation in June, 1976. In the eight sessions I will cover use of overhead transparencies to show these teachers-to-be how they also may present an objective, two-way approach to first origins in a science course—or in social studies and/or humanities or history at the secondary level. Description of the elective model was published as:

This module will provide diagrams and charts to help K-14 pupils "explore" creation-evolution interpretations of first origins (i.e., origin of the universe, life, mankind, and man's cultural patterns), and to stimulate individual expressions. Only basic principles of science will be utilized in systematic examination of classes of scientific data used in current confrontations between evolutionist and creationist scientists. With these classroom problem solvers students can give positive assistance on teaching strategies to other teachers and local school boards in pol-

icy making with respect to teaching about first origins.

Conclusion

Selected indoctrination of young people at various levels of education in the United States regarding first origins of life and of humankind need not continue. Because the megaevolution model and the creation model are put forth as conceptual frameworks to explain origins, science teachers are properly exercising their academic freedom and responsibility to present BOTH the megaevolution model and the creation model to their students. On the grounds of constitutional and civil rights of students and science teachers alike, there are no significant reasons why other science teachers in this United States, or in other countries, cannot learn to do likewise for their students.

(Added Note: Numerous other academic pursuits on teaching scientific creationism have been reported in the past, especially in the *Bible-Science Newsletter*. Several current, very successful efforts known to this author are: (1) a course on evolution/creation at Glassboro Community College in New Jersey; (2) "Creationism and Scientific Data" at Lansing (MI) Community College; and (3) Seminar, "Creation: A Scientific Alternative to the Problem of Origins", at Iowa State University. Also a non-credit mini-course ("Creation as a Scientific Alternative to Evolution") has been presented successfully at Watertown (WI) High School. In addition to the Weinberg High School biology textbook mention of two points of view (cited in answer to the fourth question above), reader attention should be given to page 415 of Chapter 17 ("The Origin of Living Systems") in *The World of Biology*. 1974. P. W. Davis and E. P. Solomon. N. Y.: McGraw-Hill, Inc., wherein general arguments put forth by creationists are summarized.)

SOME MATHEMATICAL CONSIDERATIONS ON RADIOCARBON DATING,

JAMES N. HANSON *

Radiocarbon dating according to uniformitarian presuppositions is discredited from a number of points. These points are, (1) numerical sensitivity of the computed age on the decay measurement, (2) improper constitutive equations, (3) prejudicial calibration of the relation of historical and radiocarbon ages, (4) and the failure to set the initial condition in the light of the present specific productivity and specific activity. For uniformitarian radiocarbon ages, a' , say less the 30,000 yr, a straight line relation between a' and the historic age a is derived hueristically by considering the decay of the magnetic field of the earth. This solution seems to fit the data and shows that large a' are grossly overestimated, possible by a factor of five. A creationist comprehensive model for radiocarbon data is discussed.

Sensitivity

The sensitivity of computed age on radio-carbon measurements may be derived from

$$X = X_0 e^{-\lambda t} \quad (1)$$

where for sake of argument and sense we have assumed an exponential decay. This law of radioactive decay has taken on the position of a postulate since von Schweidler¹ first proposed it in 1905. Creationists should be especially alert to tacit assumptions in established science, and should not hesitate to challenge such assumptions, especially when they are counter to biblical evidence. It is in this regard that the exponential decay is held in this paper. More will be said about it later. However, exponential decay probably preserves the sense and order of magnitude when compared with actuality, which is all that is required in this section.

If it is the rate of decay, $\dot{X}$, that is measured then

$$\dot{X} = -\lambda X_0 e^{-\lambda t} \quad (2)$$

where for C-14, $\lambda^{-1} \sim 10^4$ yr. If $\Delta\dot{X}$ is the error in measuring $\dot{X}$ and Δt the induced error in the computed age, then

$$\dot{X} + \Delta\dot{X} = -\lambda X_0 e^{-\lambda(t + \Delta t)} = \dot{X} e^{-\lambda \Delta t} \quad (3)$$

from which

$$\Delta t = -(1/\lambda) \ln(1 + \Delta\dot{X}/\dot{X}), (\approx -(1/\lambda) \Delta\dot{X}/\dot{X}, \Delta\dot{X} \sim 0) \quad (4)$$

This relationship is shown graphically in Figure 1. Since $\dot{X} < 0$ then $\Delta\dot{X}/\dot{X} > 0$ corresponds to an underestimate of $\dot{X}$ and hence requires a negative correction to t whereas $\dot{X} > 0$ requires a positive correction. Clearly the computed age is quite sensitive to the measured $\dot{X}$. Furthermore one might argue that underestimating is more likely since it is inconceivable that *all* radioactivity from a sample is detected.

Stochastic Process Models

Radioactive decay is rightfully a transport problem and *might* be modeled by intro-differential equations of the Ambartsumian² or Chandrasekhar³ type. This writer knows of no serious attempt to relate these equations to the problem of radiocarbon dating let alone solve them for the difficult to formulate circumstances of α or β transport and emission in the biological environment. Putting aside the problem of proper constitutive equations, decay phenomena are invariably modeled as a stochastic process thus avoiding the picking of constitutive equations altogether.

The early analyses of radioactive decay assumed that the rate of decay was proportional to the amount present at any time, i.e.

$$\dot{X} = -\lambda X, X(0) = X_0 \quad (5)$$

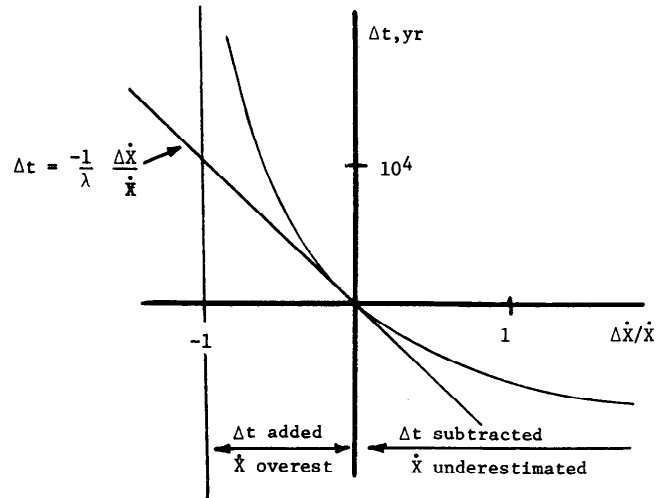


Figure 1. Error, Δt , in years, in the calculated age vs. $\Delta\dot{X}$, the error in determining the rate of decay. The relation probably gives a curve, as shown; but over a certain region the curve may be approximated by a straight tangent drawn to it. The equation of the tangent is $\Delta t = (-1/\lambda)(\Delta\dot{X}/\dot{X})$. The result is that to the left, the rate of decay is overestimated; to the right it is underestimated.

which yields the exponential decay given by

$$X(t) = X_0 e^{-\lambda t} \quad (6)$$

This solution also results from the solution to the linear death stochastic process defined on the positive integers and continuous in time (as shown in Figure 2) where

$$P(X+1 \rightarrow X) = \lambda(X+1)\Delta t$$

$$P(X \rightarrow X) = 1 - \lambda X \Delta t \quad (7)$$

and where the probability of more than one decay in time interval Δt is negligible. Hence the Chapman-Kolmogorov equation is

$$P_X(t + \Delta t) = P_X(t)(1 - \lambda X \Delta t) + P_{X+1}(t)(\lambda(X+1) \Delta t) \quad (8)$$

with boundary conditions

$$P_{X_0}(0) = 1, P_X(0) = 0 (X < X_0), P_X(t) = 0 (X > X_0) \quad (9)$$

Therefore on rearranging and dividing by Δt ,

$$\lim_{\Delta t \rightarrow 0} \left(\frac{1}{\Delta t} (P_X(t + \Delta t) - P_X(t)) \right) = \lim_{\Delta t \rightarrow 0} (-\lambda X P_X(t) + P_{X+1}(t) \lambda (X+1)) \quad (10)$$

$$\frac{dP_X}{dt} = -\lambda X P_X + \lambda (X+1) P_{X+1}; X = X_0, X_0 - 1, \dots, 1, 0$$

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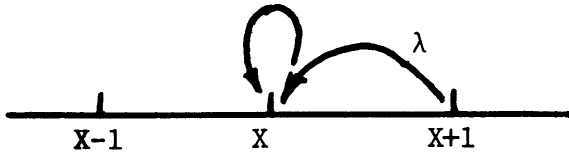


Figure 2. The scheme for decay according to a "linear death" stochastic process. The probability of more than one decay in an interval is here assumed negligible.

This differential-difference equation is readily solved⁴

$$P_X(t) = \binom{X_0}{X} e^{-X_0 \lambda t} (e^{\lambda t} - 1)^X e^{-X} \quad (11)$$

from which we may compute the mean and variance for this process,

$$m(t) = \sum_{X=0}^{X_0} X P_X(t) = \dots = X_0 e^{-\lambda t} \quad (12)$$

$$\sigma^2(t) = \sum_{X=0}^{X_0} X(X-1) P_X(t) = \dots = X_0 e^{-\lambda t} (1 - e^{-\lambda t})$$

Thus the mean value for this sample stochastic model yields the solution of the traditional deterministic model, but with much more information as a by-product. Hence the validity of $X = X_0 e^{-\lambda t}$ should be further tested with respect to the observed variance, $\sigma(t)$. Anderson^{5,6} has recently done this and found the exponential decay to be wanting. Hence there is reason to suspect the very mathematical foundation of radiocarbon dating.

Let us now consider the linear death process but with no restrictions on the coincidence of decay, as shown in Figure 3. In this case the decay constants λ_i ($i = 1, 2, \dots, n$) are assigned for coincident of n decays in time Δt . Let

$$\lambda = \sum_{i=1}^n \lambda_i \quad (13)$$

Then the Chapman-Kolmogorov equation may be applied, as above, to obtain

$$P'_X = -\lambda X P_X + \lambda_1(X+1) P_{X+1} + \dots + \lambda_n(X+n) P_{X+n} \quad (14)$$

where the prime indicates differentiation with respect to time. This differential-difference equation will be solved directly for $m(t)$ by starting from,

$$m(t) \equiv \sum_{X=0}^{X_0} X P_X(t) \quad (15)$$

Hence combining with our differential equation

$$m' = \sum_{X=0}^{X_0} X P'_X = -\lambda \sum_{X=0}^{X_0} X^2 P_X + \sum_{i=1}^n (\lambda_i \sum_{X=0}^{X_0} X(X+i) P_{X+i}) \quad (16)$$

which after some manipulation become

$$m' = (-\sum_{i=1}^n i \lambda_i) m - \sum_{i=1}^n \lambda_i (\sum_{X=0}^{i-1} X(X-i) P_X) \quad (17)$$

Further manipulation of summation indices yields

$$m' = -\Lambda m + Q(t), \quad m(0) = X_0 \quad (18)$$

where

$$\begin{aligned} \Lambda &= -\sum_{i=1}^n i \lambda_i \\ Q(t) &= -\sum_{i=1}^n \lambda_i (\sum_{X=0}^{i-1} X(X-i) P_X) \\ &\vdots \\ &= -\sum_{j=1}^{n-1} (\sum_{i=j+1}^n (j+j(i-j-1)) \lambda_i) P_j \end{aligned} \quad (19)$$

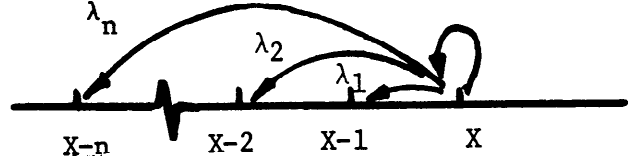


Figure 3. The scheme for the linear death process in which there may be coincidences of decay. The constant λ relate to the coincidence of the corresponding number of decays in the interval.

Hence solving for $m(t)$,

$$m(t) = e^{-\Lambda t} \left(\int_{s=0}^t e^{\Lambda s} Q(s) ds + X_0 \right) \quad (20)$$

For large X_0 the P_j in $Q(t)$ are surely small since they are the probabilities $P_0, P_1, \dots, P_{n-1}$. This may be simplified,

$$m(t) \approx X_0 e^{-\Lambda t} = X_0 e^{-(\sum_{i=1}^n i \lambda_i) t} \quad (21)$$

Therefore if this stochastic model is correct, the decay constant is a composite one. Anderson^{5,6} interprets his data as showing coincidence and a variable decay constant. The more complicated case for small X_0 should not be ignored, as it reduces the computed age.

If the decay constant is $\sum_{i=1}^n i \lambda_i$ rather than λ_1 then one might ask whether the experiments to calibrate radiocarbon decay are performed over a sufficient length of time. This situation is like the orbit of Mercury where it was finally discovered that the apsidal precession was the overall determining feature of the orbit as compared to a strictly Keplerian path.

Clearly $\Lambda > \lambda_1$ and hence the respective computed age will be shorter. This possibility might substantially reduce radiocarbon ages if the sample had experienced an environment where λ_i ($i > 1$) were nonzero and comparatively large. Specifically, if decay rates are equated,

$$\lambda X_0 e^{-\lambda \tau} = m' = \Lambda e^{-\Lambda t} \quad (22)$$

where ages τ and t correspond to decay constants λ and Λ , respectively, then

$$\begin{aligned} t &= \frac{\lambda}{\Lambda} \tau + \frac{1}{\Lambda} \ln \frac{\lambda}{\Lambda} \\ &\approx \frac{\lambda}{\Lambda} \tau \quad (\text{when } \tau \text{ is large}) \end{aligned} \quad (23)$$

There is no compelling reason to choose the linear death process. In fact if the stochastic model is to be retained (for reasons of mathematical tractability, at least), then it should be of prime interests to creationist to discover which stochastic model. A promising candidate should be the nonhomogeneous death process investigated by Kendall.⁷ In this case $\lambda = \lambda(t)$ is a function of time and

$$\begin{aligned} m(t) &= X_0 e^{-p(t)}, \quad p(t) = \int_{s=0}^t \lambda(s) ds \\ \sigma^2(t) &= X_0 e^{-2p(t)} \int_{s=0}^t \lambda(s) e^{p(s)} ds \end{aligned} \quad (24)$$

and

$$m'(t) = -X_0 \lambda(t) e^{-p(t)} \quad (25)$$

This last formula might be of special interest in radiocarbon-treering analyses. However the use of such formulas awaits further research into the nature of the radiation-decay process. A number of effects, other than a variable decay constant, can be incorporated by letting λ vary.

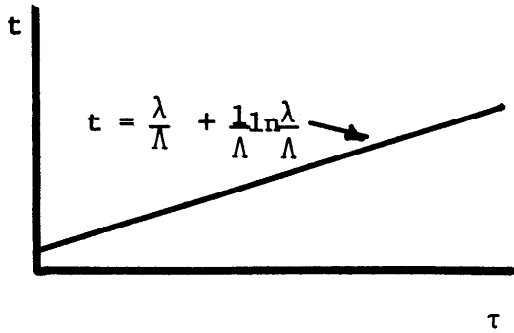


Figure 4. The true age, t , of a sample vs. the age τ calculated on the assumption of strictly exponential decay. Note that t might be considerably less than τ . The relation is given in Equation (23).

A Simple Dating Model

Next attention will be given to a special case of the non-homogeneous model of Kendall. Let the radiocarbon specimen be born at time $t = t_1$ and die at $t = t_2$ and let $t = T$ be the present time at which the specimen is tested. This is shown in Figure 6. Let $X(t)$ be the number of C-14 atoms in the specimen at time t and $C(t)$ is the available input to the specimen. Hence λ will be assumed constant and $\lambda < 0$.

The moment of birth (i.e. at the beginning of growth) may be written

$$X' = \lambda X + C(t), X(t_1) = 0, \lambda < 0 \quad (26)$$

and the solution is

$$X(t) = e^{-\lambda t} \int_{t_1}^t e^{\lambda s} C(s) ds, t_1 \leq t \leq t_2 \quad (27)$$

Define

$$X_0 = X(t_2) = e^{-\lambda t_2} \int_{t_1}^{t_2} e^{\lambda s} C(s) ds \quad (28)$$

Hence for $t > t_2$

$$X' = \lambda X, X(t_2) = X_0 \quad (29)$$

and

$$X(t) = \begin{cases} e^{-\lambda t} \int_{t_1}^t e^{\lambda s} C(s) ds, & t_1 < t < t_2 \\ X_0 e^{-\lambda(t-t_2)}, & t_2 < t \end{cases} \quad (30)$$

from which,

$$X_T = X(T) = [e^{-\lambda t_2} \int_{t_1}^{t_2} e^{\lambda s} C(s) ds] e^{-\lambda(T-t_2)} \quad (31)$$

If $C(T) = A$ then the uniformitarian solution with $C(t) = C(T)$ is

$$\tilde{X}_T = X(T) |_{C=A} = (A/\lambda) e^{-\lambda t_2} (e^{\lambda t_2} - e^{\lambda t_1}) e^{-\lambda(T-t_2)} \quad (32)$$

In order to compare the nonuniformitarian and uniformitarian solutions we observe that $X_T = \tilde{X}_T$ which yields

$$(A/\lambda)(1 - e^{\lambda(t_2 - t_1)}) e^{-\lambda(T-t_2)} = e^{-\lambda T} \int_{t_1}^{t_2} e^{\lambda s} C(s) ds \quad (33)$$

where t_1' and t_2' are the beginning and end of growth for the sample as computed from the uniformitarian model, i.e.

$$t_2' - t_1' = \Delta\tau = t_2 - t_1 \quad (34)$$

Decay rates might also have been equated. Hence

$$(A/\lambda) e^{\lambda t_1'} (e^{\lambda \Delta\tau} - 1) = e^{-\lambda T} \int_{t_1}^{t_1 + \Delta\tau} e^{\lambda s} C(s) ds \quad (35)$$

And, since ΔT is small, then approximations can be

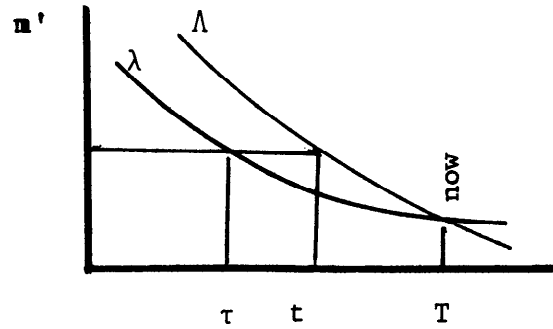


Figure 5. This shows how m' , the mean rate of decay, may have been greater in the past than it would be according to the uniformitarian assumption, although the two rates coincide just now. This possibility would arise from composite decay, and is indicated by the curve marked " Λ ". The one marked " λ " is according to the assumption of simple exponential decay.

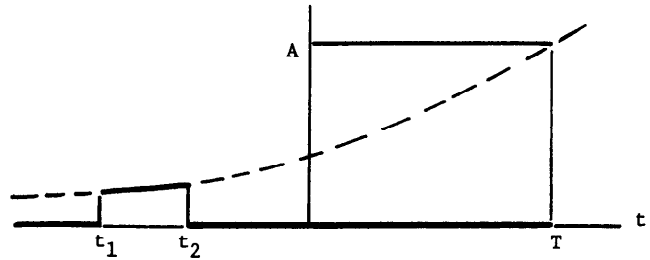


Figure 6. A sample is supposed to have taken up carbon 14 from times t_1 to t_2 . Later, at time T , the present, it was tested; and from the result A , the amount of carbon 14 available to the sample when it was taking up carbon 14, is calculated.

$$\begin{aligned} & (A/\lambda) e^{\lambda t_1'} (e^{\lambda \Delta\tau} - 1) \\ & \approx \frac{1}{2} (\Delta\tau) [e^{\lambda(t_1 + \Delta\tau)} C(t_1 + \Delta\tau) + e^{\lambda t_1} C(t_1)] e^{-\lambda T} \\ & \approx \frac{1}{2} (\Delta\tau) e^{\lambda t_1} [e^{\lambda \Delta\tau} C'(t_1) \Delta\tau + C(t_1)] e^{-\lambda T} \\ & (A/\lambda) e^{\lambda t_1'} (\lambda \Delta\tau) \\ & \approx \frac{1}{2} (\Delta\tau) e^{\lambda t_1} [(1 + \lambda \Delta\tau) C'(t_1) \Delta\tau + C(t_1)] e^{-\lambda T} \end{aligned} \quad (36)$$

where the theorem of the mean for integrals, the theorem of the mean for derivatives, and the Maclaurin approximation for $e^{\lambda \Delta\tau}$, are used, respectively. Finally,

$$A e^{\lambda t_1'} \approx \frac{1}{2} e^{\lambda t_1} [C(t_1) + C'(t_1) (\Delta\tau) + \lambda (\Delta\tau)^2 C'(t_1)] e^{-\lambda T} \quad (37)$$

relating t_1' vs. t_1 .

With this comparatively simple relation the deficiencies of the uniformitarian solution for various models of $C(t)$ can be qualified. The work of Barnes⁸ on the effect of the terrestrial magnetic field on radiocarbon dates would suggest,

$$C(t) = A e^{\mu(t-T)}, \mu < 0 \quad (38)$$

where μ may be decay constant for the field strength. Though it is rather arbitrary to postulate that an exponential specific productivity follows from an exponentially decaying field, it at least preserves the sense and is as good as, if not better than, the associated assumptions found in the uniformitarian literature. For this simple function the indicated integration can be performed

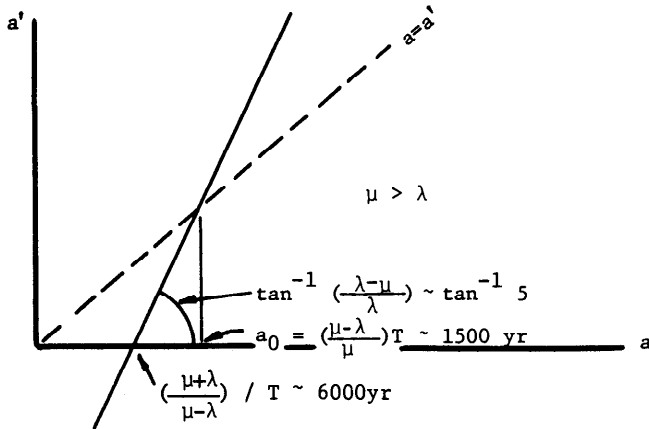


Figure 7. Possible relations between the historic age, a , of a sample dated by carbon 14, and a' , the calculated age. The broken line shows the relation $a = a'$, according to the uniformitarian assumption. The solid line is another possible solution, as is discussed in the text. Its slope is about $(\lambda - \mu)/\lambda$ which is around 5. Note also that a and a' coincide at about 1500 years.

$$(A/\lambda)e^{\lambda t_1'} (e^{\lambda \Delta \tau} - 1) = e^{-\lambda T} \int_{t_1}^{t_2} + \Delta \tau e^{\lambda s} A e^{\mu(s-T)} ds \quad (39)$$

which for $\Delta \tau \ll 1/\lambda$ yields, after some manipulation,

$$a' = \left(\frac{\lambda + \mu}{\lambda}\right) a - \left(\frac{\mu - \lambda}{\lambda}\right) T \quad (40)$$

where a and a' are the ages,

$$a \equiv T - t_1, a' \equiv T - t_1' \quad (41)$$

And according to Reference 8

$$\lambda \approx -1n2 / 5600, \mu \approx -1n2 / 1400 \quad (42)$$

and using $T = 2000$ yr.,

$$a' = 5a - 6000 \quad (43)$$

Also the $a = a'$ point is given by

$$a_0 = \left(\frac{\mu - \lambda}{\lambda}\right) T \quad (44)$$

The exponential decay model for $C(t)$ yields a straight line relationship between the uniformitarian age and the nonuniformitarian age, such as is shown in Figure 7. In comparing this model with actual data we may regard a' as the radiocarbon age and a as the historic age.

Clearly there exist some (many) function(s) $C(t)$ which would cause our computed a to agree with the observed historic age. Though one may suspect the values of the slope and intercept there are some reasons for confidence in the straight line solution, as actual plots of the radiocarbon vs. historic ages shows.⁹ Of course, in such plots made by uniformitarians we see that the slope is very nearly one and intercept zero.

If one examines the variance of the data and does not discount the Bible as a source of highly accurate chronological data, then the straight line is expected relating a' to a . The important feature of this solution is that for $a' > a_0$ the radiocarbon age is an overestimate while an underestimate for $a' < a_0$ and for values of a' large compared to a_0 the radiocarbon age is nearly a constant factor too large where this factor might be on the order of five. If this be correct then large radiocarbon dates are gross overestimations of actual age. In the next section this solution will be applied to Libby's data.¹⁰

This solution must not be pushed too far since choice for $C(t)$ and the very constituent equations were not de-

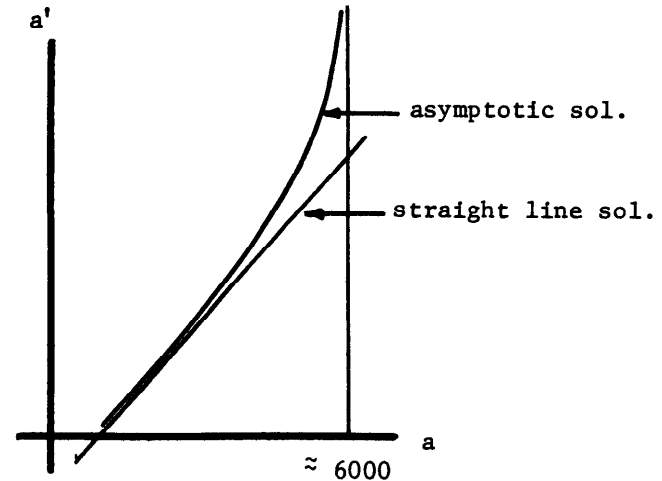


Figure 8. A linear relation between a and a' can apply only over a limited range. Eventually the relation must approach an asymptote, as shown. For even the oldest calculated ages must correspond to true ages no more than about 6000 years, according to the data from Scripture.

rived directly from physical considerations. Firstly, the straight line solution may only be a local approximation for, say, $a' < 30,000$ yr., since the actual solution must have an asymptote at $a \approx 6000$. For, according to the Hebrew Old Testament, creation occurred at slightly less than 6000 years ago.^{11,12} This asymptotic behavior is suggested in Figure 8.

Secondly, $C(t)$ must be derived from quantitative analyses considering the total effects of, at least, the Noachic Flood and the decay of the earth's magnetic field. Having obtained a representative $C(t)$, the associated nonhomogeneous stochastic process of the Kendall type could then be derived in order to arrive at the variance and other statistics.

The Data

In Reference 10 the data Libby used in calibrating his exponential decay equation are given. Some of the better data have been excerpted, including most of those used to draw the decay curve on page 10 of Reference 10; these data are shown in Table 1.

The plot of these data in Figure 9, shows the extent of the data of both the assigned historical age and the individual data (plus-or-minus one standard deviation). Libby carefully chose data from his repository to show that $a' = 1.00a + 0.00$ which is precisely what he wanted and precisely what he obtained. However, here using much the same data $a' = 1.43a - 1713$ was obtained giving $a_0 = 3980$. I am unable to distinguish my choice of a data base from Libby's. It is just as appropriate for a creationists to cast out data as it is for a uniformitarian! A linear regression of the individual data yields again a slope of about 1.4 and an $a_0 \approx 3000$ yr.

The observed value of a_0 is particularly important since it simultaneously shows the qualitative correctness of our methods while pointing out the anti-biblical prejudice of the uniformitarian. Since there was reason to suspect a slope larger than 1.4, possibly as large as 5, then the assignment of the historical ages in Libby's data must be questioned.

Specifically, a_0 acts as a pivotal value above which historic ages have arbitrarily been assigned great values in

TABLE 1

Table 1. The historic ages a , and ages a' according to carbon 14, of some samples used by Libby.

Sample No.	a	a'	average
1	4650±75	3099±770	3979±350
		4234 600	
		3991 500	
12	4575±75	4721 500	4802 210
		4186 500	
		5548 500	
		4817 240	
267	2280	2190 450	2190 450
4	4700-5100	4803 260	4883 200
		4961 240	
810	≥5000	5744 300	5744 300
72	2625±50	2096 270	2531 150
		2648 270	
		2239 270	
819	~4700-5100	5317 300	5317 300
	1500-2700	1466 250	1449 200
		1452 290	
576	1950-2050	1917 200	1917 200
81	3750	3845 400	3621 180
		3407 500	
		3642 310	

order to accommodate evolutionary history and to contradict the ages in Genesis. Similarly, values of a less than a_0 have been diminished, again in agreement with secular historical research and to discredit as much biblical prophecy as possible by having prophecy given after the prophesied event took place.

According to this brief analysis the pivotal point is at $a_0 \approx 3000$ yr. (or about 1000 B. C.). And according to the Book of Proverbs, man's folly will reveal him and that Wisdom cries everywhere despite man's iniquity. Here, in this analysis, does the reader once again see man's perversion pointing to the biblical truth?

I fully expect that if historical ages were performed by a Bible believing Christian and if *only* biblically related samples were used, that a much larger slope, approaching five would be observed. I restrict consideration to only biblically related samples in the conviction that no other chronology than that in the Bible is valid, and that other chronologies have validity inasmuch that they can be related to scriptural events.

For additional examples of the straight line plot, and historic age distortions see the a' vs. a plots in Egyptian chronology chapters of Reference 9.

Global Radiocarbon

Before proceeding to a discussion of the global mechanisms for the production and transport of radiocarbon, a simple model treated by Cook¹³ will be examined. Let C be the C-14 concentration in the biosphere (or equivalently in an average unit of volume). Assume that k_1 is the constant rate of C-14 production (the specific productivity) and $-k_2C$ the rate of decay (the specific activity). Therefore

$$\frac{dC}{dt} = k_1 - k_2 C \quad (45)$$

Note that the maximum value of C occurs when $dC/dt = 0$ since, from observation $k_1 > k_2 C$. Hence

$$C_m = k_1/k_2 \quad (46)$$

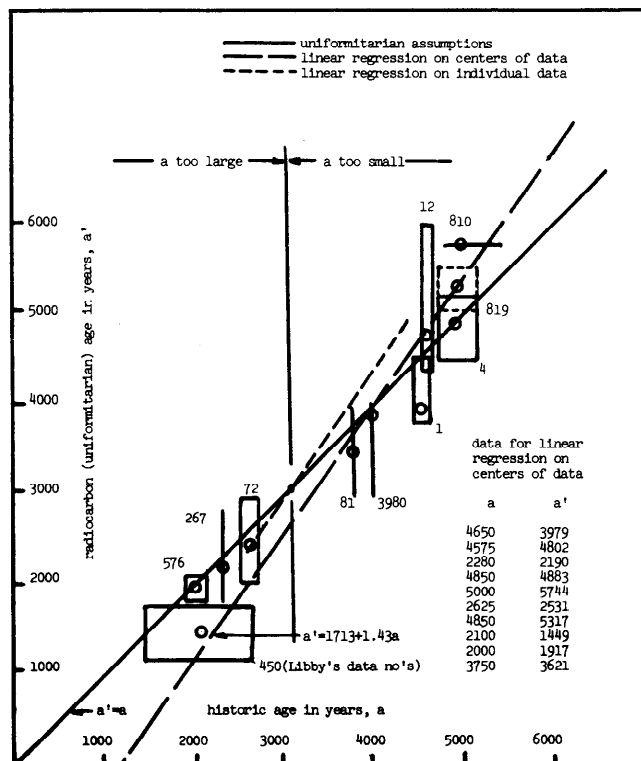


Figure 9. Here the data from Table 1, true and indicated ages, are plotted. The lines indicate several relations, to fit the data as well as possible, as is explained in more detail in the text.

Next define

$$Y = C/C_m = Ck_2/k_1 \quad (47)$$

and note that Y_p is the ratio of the specific activity to specific production at present,

$$Y_p = C_p k_2/k_1 \equiv R \quad (48)$$

Changing variables in our differential equation,

$$\frac{dY}{dt} = k_2(1 - Y), \quad Y(0) = Y_0 \quad (49)$$

from which

$$Y(t) = 1 - (1 - Y_0)e^{-k_2 t} \quad (50)$$

and

$$Y_p \equiv R = 1 - (1 - Y_0)e^{-k_2 t_p} \quad (51)$$

which on solving for Y_0 ,

$$Y_0 = 1 + (R - 1)e^{-k_2 t_p} \quad (52)$$

This relation is plotted in Figure 10.

It is reasonable to associate $t = 0$ with the time of the Flood and Y_0 with the activity/productivity ratio just after the Flood year. Various values for the specific activity and specific productivity have been computed since Libby's original work. For the moment let us adopt 12.4 and 18.8 counts per minute per gram from amongst values recently mentioned in the literature. Hence $Y_p = R = 12.4/18.8 = .66$ which from our graph gives $Y_0 = .42$ for $t_p = 4322$ as taken from Ozanne's chronology (Reference 11). Note that for $R = .66$ the maximum possible t_p is about 9000 years corresponding to an improbable $Y_0 = 0.0$. Furthermore, all feasible values for R yield values of t_p not more than several thousands of years.

If $Y = Y_0$ at the time of the Flood, then let $Y = Y_c$ at $t = t_c < 0$ at the time of creation (Fall),

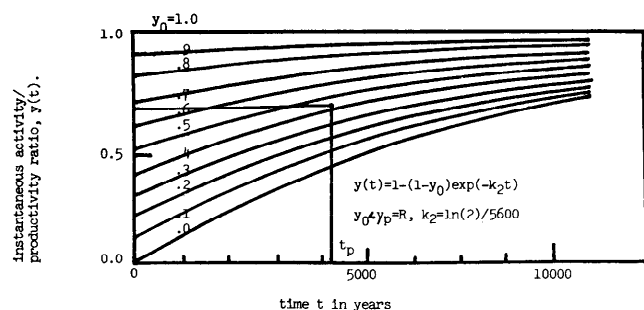


Figure 10. The ratio Y of the specific activity and specific productivity of carbon 14 at any time t , plotted vs. t . The various curves labelled with numbers are for the marked magnitudes of Y_0 , the magnitude of Y at time zero.

$$X_c = 1 - (1 - X_0)e^{-k_2 t_c} = \dots = 1 + (R - 1)e^{-k_2 (t_p + t_c)} \quad (53)$$

If $t_c = -1656$ then $X_c = .75$. Hence this would suggest that the specific activity was greater than the specific productivity in the pre-Flood world, which is not unexpected for a denser pre-Flood atmosphere capable of greatly attenuating the C-14 production-transport mechanism.

Toward a Creationist Model for Radiocarbon Dating

To the best of my knowledge nothing approaching a comprehensive mathematical model for radiocarbon data can be found in the literature. I am convinced that such a model would be of great value to Bible research, e.g. in the areas of chronology and Bible-lands geophysics and archeology.

This model must start with an accurate description of the boundary conditions. Specifically the trajectories of Bev range cosmic radiation in the earth's magnetic field must be analyzed in order to determine the fraction not reflected. Much attention¹⁴ has been given to the paths of captured particles, but little attention to the open paths. This analysis should provide for geographical dependence of radiocarbon ages.

The next step is the analysis of the atomic and molecular kinetics that produce fast (5-10 Mev) neutrons to thermal (4-1.6 Mev) neutrons to C-14 and other products. This part of the model is quite complicated but adequately explained in the literature (e.g. see various bibliographies in Reference 9). The exchange of molecular and atomic carbon (C-12, C-13, C-14) between the domains of the biosphere, ice, oceans, etc. is poorly modeled.

Existing models are designed to produce the desired uniformitarian result with little regard for the actual physical processes involved. For example, Rafter and O'Brien¹⁵ and Lingenfelter and Ramaty¹⁶ choose first order exchange models with no mention of the fact that the actual constitutive equations must be of the second order in order to represent the diffusion type transport problem.

For example, if $j = 1, 2, \dots$ is a domain index for the atmosphere, polar regions, ocean surface, etc. then we would expect equations for the concentration C_{ij} ($i = 1, 2, \dots$ is the index C12, C14, etc.) of the form,

$$\partial^2 C_{ij} / \partial h^2 = -k_{ij}(h, t) \partial C_{ij} / \partial t + A_{ij}(h, t) \quad (54)$$

where A_{ij} is the source function and k_{ij} is the diffusion strength. The solution of the exchange problem then supplies the initial conditions for the radiocarbon age equations.

Conclusions

Creationists are well aware of uses of science to unite man against God. Hence we are not surprised to note that the closing chapter of Olsson's book (Reference 9) is titled, "Radiocarbon as an Example of Unity of Science".

The above hueristics discredit the uniformitarian radiocarbon dating. When properly understood, radiocarbon dating corroborates the Bible in every case. In fact, despite efforts to the contrary, uniformitarians seem to be unable to present their basic data in a way that does not belie their intent and does not point to the Biblical record. A fine example of this is afforded in the article by Renfrew.¹⁷ His summarial plot shows that the greatest antiquity of bronze metallurgy lies in the very regions one would expect from the table of nations in Genesis 10. However I cannot accept Renfrew's ages, indicating the greatest ages of 6500 B. C. in the Hittite, Ararat and Ur regions.

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EVOLUTIONARY CONTRADICTIONS AND GEOLOGICAL FACTS†

R. W. MORRELL *

The sweeping claims made by many evolutionists stand in stark contrast with their specific admissions. They claim, in general terms, that evolution is well established. But when the question is that of the origin of some particular creature, doubts and vague speculations abound. Moreover, while they claim that there is abundant evidence for evolution, when pressed for details they have to admit that the fossils show gaps, not continuous variation. As for the other alleged evidence, it is evidence only to someone already determined to believe in evolution.

The primary importance of palaeontology in respect of the theory of evolution was recognized by Darwin in his *Origin of Species*. He knew that the fossil record did not support his speculations, but he was confident that subsequent research would fill the gaps.

Since Darwin first expressed his hopes in 1859 geologists have laboured to fulfill his expectation. Their efforts, however, have been a case of labor in vain, for the hoped-for evidence has not turned up.

In his contribution to *Darwin's Biological Work*, a book published by Cambridge University Press, in 1959 to celebrate the anniversary of the publication of *Origin of Species*, a distinguished geologist, John Challinor, late of the University College of Wales, admits that the fossil record only "partly supports evolution", but it also supports "separate and independent creation". He asks the question: "Is there any positive proof, from any part of the evidence, that evolution has, or has not, occurred?", and answers it negatively ("Palaeontology and Evolution" in *Darwin's Biological Work*, 1959. Republished, 1970, p. 53).

Here, then, we have a professional geologist clearly stating that the fossil record does not demonstrate evolution and in actual fact can be used to demonstrate creation. Dr. Challinor, though, is an evolutionist, despite what his research has revealed, but, aware of the significance of his admissions, goes on to speak of "near proof" being obtained "in some cases". This suggests that "we are justified in assuming that most probably it is universal and we must try to explain the general paucity of evidence as best we may". He then adds,

someone seriously combating the whole idea of evolution might well ask, in some exasperation, what evidence against evolution the evolutionary palaeontologist could not explain away to his own satisfaction.

In short, Dr. Challinor tells us rather bluntly that evolutionary palaeontologists argue around difficulties rather than answer them.

Continuity versus Gaps

It is a basic evolutionary postulate that continuity exists at all taxonomic levels, and in a review of the palaeontological evidence advanced for evolution, the British palaeontologist, Professor F. H. T. Rhodes, now of the University of Michigan, confidently asserts that it does and can be demonstrated. However, almost immediately after making the claim, he qualifies it by adding the words "only in a limited number of cases". (*The Course of Evolution, Proceedings of the Geological Association*, 1966, 77(1):16).

Presumably Professor Rhodes hoped that nobody would note the fact that he had contradicted himself; for either

continuity did exist and was demonstrable, or it did not. As a palaeontologist he is well aware that the chain of continuity for which he argues, is broken almost at the start with a gap between the Precambrian and the Cambrian.

An examination of the standard manual on fossil identification, (British Museum, Natural History, *British Palaeozoic Fossils*), will show that it does not describe or illustrate any Precambrian species, despite the fact that the era has strata ideal for the preservation of the remains of past life. This lack of fossils from the Precambrian has produced a crop of theories in explanation, and while they make for interesting, or entertaining, reading, they shed little if any light upon the problem.

Rhodes admits that the Cambrian abounds in fossils, stating it to have over 900 species representative of nine phyla. Many of these species are both complex and highly specialized and demand an evolutionary history if the theory is to get off the ground. However, neither Rhodes nor anyone else has provided them with one based upon hard facts.

Precambrian—Cambrian Boundary

The question of the boundary between the Cambrian and the Precambrian is of some interest; and has a direct bearing upon the claims made for some recent discoveries in Australia which have been placed in the late Precambrian. On an international basis, the boundary between the Precambrian and Cambrian is distinguished in terms of a discontinuity. Where found it is argued that the strata above is Cambrian and that below Precambrian. This discontinuity is not present in Britain, and even where it is present in other countries (and it is not always easy to see, or see at all) the actual rocks can tell us nothing about the supposed age difference between the two systems. Thus it can be argued that if a discontinuity can be observed, it simply represents a violent upheaval of short duration, certainly not one of a duration long enough to account for evolutionary change. There is in fact considerable difficulty in determining what is and what is not Precambrian and Cambrian, for comparison of rock samples can demonstrate nothing positive other than their composition. Challinor, in the work already cited, brings this out when he states that

when strata with a Lower Cambrian fauna are conformably underlain by a great thickness of unfossiliferous strata it must be somewhat uncertain whether these lower strata, particularly the lowest of them, should be classed as Cambrian or Precambrian (p. 70).

Rhodes notes that the method of deciding what belongs to what, is quite arbitrary. He writes:

The base of the Cambrian is not always a precise stratigraphic horizon. Stratigraphic correlation is *almost always a matter of faith*, done entirely on an intercontinental scale by matching similar faunas. In the case of the lowest Cambrian there is a distinct possibility that our correlation may be tenuous. This means, in short, that fossil material claimed as Pre-

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cambrian could just as well be ascribed to the Cambrian, and thus the break in continuity becomes not simply a gap but a yawning chasm. (Emphasis added)

Australian Fossils Considered

This brings us to the Australian fossils already mentioned. They were discovered at Ediacara in South Australia, and have been hailed as being one of the most important discoveries of Precambrian material yet made. Personal examination of some of these fossils gave me the impression that an inorganic explanation can be advanced for several.

However, it is clear that a great deal of the material is undoubtedly the remains of long dead creatures. Without exception all are complex, thus posing considerable problems for evolutionists. In appearance they are related to creatures found in formations dated by geologists much younger than the Cambrian, and so it is not without significance when we learn that initially they were ascribed to the Cambrian and not the Precambrian.

They were dropped into the late Precambrian out of stratigraphic considerations, which, as we have seen, both Challinor and Rhodes have pointed out, is a process that abounds in uncertainty and doubt. Thus fossils are claimed as being Precambrian, but which, as everyone well knows, could well be early, middle or even late Cambrian.

Attention to Transitional Links

Transitional links are essential to the theory of evolution, for making the continuity that Rhodes claims. In his paper he asserts that transitional forms exist to link amphibians with reptiles, and reptiles with mammals. The link claimed between amphibians and reptiles is to be found, according to Rhodes, among the Seymouriamorphs, *Seymouria* displaying both amphibian and reptilian characteristics. But is Rhodes correct in his contention?

In a work published only a few weeks before the Rhodes paper, W. E. Swinton, the international authority on fossil reptiles, flatly contradicts Rhodes, and denies that *Seymouria* can be a transitional form. He states that the degree of specialization displayed by it precludes *Seymouria* from the immediate line of reptilian ancestry (*Fossil Amphibians and Reptiles* 1965, pp. 25-27). Swinton also points out that *Seymouria*'s systematic position is open to question.

The transitional form between reptiles and the mammals is to be found, according to Rhodes, among the therapsids. Swinton does not agree, maintaining that all they do is to indicate the lines along which evolution took place. Rhodes omits any discussion of the difficulties involved in his claim; for example:

(1) how the reptilian jaw, which differs from that of a mammal in the number of bones present and the articulation with the skull, could have evolved without the transitional forms dying out through their inability to eat; or

(2) how the highly complex organ in the ears of mammals, termed the corti, which is completely lacking in reptiles, could have evolved, and from what.

Any creatures undergoing the changes involved in the evolutionary formation of such structures as the corti, or major anatomical variation in their jaw structure, would become extinct, because they could not have survived over the period demanded by evolutionists for such changes to have taken place. The late Sir Gavin de Beer recognized the difficulties involved in postulating mammalian evolution and hinted strongly that the essential transitional forms demanded by the theory of evolution will never be forthcoming, when he wrote that "fossils which might be re-

garded as ancestral to the existing mammals have not yet been found" (*Advancement of Science*, 1954, XI(42):167).

The American authority on dinosaurs, Professor E. H. Colbert, refers to the fact that "we can obtain no direct evidence on these changes (the establishment of constant body temperature, insulating coat of hair, reproductive organs, etc.) . . ." (*Scientific American Reprint*, The Ancestors of Mammals. March, 1949, p. 4). One assumes that evolutionists are aware of such difficulties, and so must know that, without the required evidence, his claims amount to wishful thinking as distinct from hard scientific fact.

Evolution and Structural Differences

The great bulk of the fossil evidence advanced for evolution consists of examples of structural differences. Thus fossil sea urchins are said to display evidence for evolution on the basis of changes seen in specimens collected in sequence. Changes in structure (body size, shape and size of beaks) is advanced as evidence of evolution among finches on the Galapagos Islands, and in a recent paper entitled Divergence and Evolution in Darwin's Finches (*Biological Journal of the Linnean Society*, 1973, 5, pp. 289-295), Ford, Parkin and Ewing present material on the differences displayed by various finches, and the advantages given to some by the shape of their beaks.

Yet such differences are not, as the authors assume, evidence for evolution anymore than are the reasons why they came about. Thus when they write of such differentiation as illustrating "the importance of these finches in the development of our knowledge or evolution" (p. 295), they simply display on their own part a confusion between evolution and development within the species. For, after all, the finches remain finches in the same manner that the differentiation in the sea urchins still leaves them as echinoderms.

I commenced with the observations of Dr. John Challinor expressed in a volume eulogistic of Darwin. His conclusions as to what evidence the various fossil groups display for the theory of evolution, contrast markedly with the assertions of Professor Rhodes, and are certainly deserving of careful consideration. He stated:

Foraminifera: "As the evidence stands, the morphological series shown do not always seem to have very strong claims to being evolutionary series" (p. 79).

Anthozoa: "Any suggestion is welcome in the attempt to find some evolutionary scheme into which the corals may be fitted" (p. 80).

Echinoidea: "Their number (the unanswered questions) is a measure of our ignorance" (Challinor is quoting another writer) (p. 81).

Brachiopoda: "Such is the imperfection of the geological record of evolution" (p. 82).

Mollusca: "No very coherent picture emerges when we trace the lammelibranchs and gastropods through the stratigraphical systems" (p. 82).

Trilobita: "The Cambrian record . . . reveals very little of the evolutionary paths they followed" (p. 86).

Graptolithina: "The links in the supposed evolutionary chains are not so secure as was thought" (p. 87).

Vertebrates: "The origin of the vertebrates is no more clearly revealed than the origin of any other phylum . . ." "The frailty of the palaeontological evidence" (pp. 88 & 89).

Plants: "... meagre evidence . . ." (p. 89).

Conclusions

In the light of such conclusions, the self-confident claims by Huxley and others of "the fact of evolution", take on a rather hollow ring. Yet, when we are regaled in the press or over TV and radio concerning evolution, the weakness of the case for it, as revealed by the quotations given above (which are just a few), is never mentioned.

Yet the facts are there for all to see, and indicate that due consideration should be given to alternative ideas; and scientists, who object to this, appear to be more concerned with upholding a particular dogma than seeking for the truth.

SINKING CONTINENTS

JAMES R. HONEYMAN*

Mt. Ararat is an extinct volcano, and there are signs that it erupted and built up under water. It seems possible that this happened at the time of the Flood, when the continents were below the sea level. At the present time the crust of the earth is depressed in the areas occupied by the northern and southern ice caps, as is learned by tracking artificial satellites. The weight of the two ice caps, it is suggested, would cause excessive internal pressure in the earth; and the ocean floors, being thinner than the continents, would rupture and then be uplifted. Displaced ocean water, added to the loads of ice, would cause the continents to sink, further uplifting the ocean floors. Magma from the rifts would heat the oceans, gradually melting the ice caps. Then, when the load of ice was mostly gone, equilibrium was restored.

The Problem Related to the Flood

Numerous mechanisms for the Flood have been advanced, but serious questions remain. The proposal offered here is an outline for study, not a conclusive answer. An attempt is made to suggest forces which are capable of producing two well established phenomena: (1) depressed areas of the crust, and (2) the mid-ocean rifts. That the rifts may have been caused by immense loads of ice on land has not previously been proposed, to the writer's knowledge.

Initial investigation of this possibility resulted from the geological study of Mt. Ararat by Burdick.¹ In a personal conversation, he stated that every piece of lava examined anywhere on the mountain had obviously hardened under water. Other indications that it had once been submerged consisted of some sedimentary rock and several examples of pillow lava. Since the peak reaches nearly 17,000 feet elevation and the base is 3,000 to 4,000 feet above sea level, here is powerful evidence that the entire area was at one time below sea level.

Moreover, working with Burdick, Read² demonstrated that lava samples from Ararat had only very small vesicles (gas pockets), or none at all. In this characteristic these samples matched lava samples dredged up from very deep water around the Hawaiian Islands. All magma contains gases, mostly steam, which usually expand and leave pockets as the lava hardens.

Apparently under the pressure of a great depth of water, vesicles are not able to form. Burdick and Read concluded that Ararat had erupted and had built up most of its height during the Flood. It is certainly not unusual for volcanoes to develop under water, as there are hundreds located on the ocean floors today.

Thickness of Crust

From consideration of very simple facts, it is commonly believed the continents are somewhat thicker than the sub-ocean strata. The crust of the earth "floats" on the plastic interior, according to the theory of isostasy. If a log floats on water, the major part is under the surface with only a few inches protruding. If the log is held upright however, several feet may be above water.

Following the analogy, geophysicists assume that the thickness of the continents must be somewhat greater than the under-ocean strata. Since great mountain ranges have no tendency to sink, it is further assumed that extensive "roots" must penetrate deep into the magma to maintain their elevation.

Extensive research by oceanographers using seismic shooting techniques provides measurements for the difference in thickness of the suboceanic crust and the continents. Ewing and Engel³ report:

These showed that the undersea crust in both the Atlantic and Pacific is only four to six kilometers thick, compared with the 25-to-40 kilometer thickness of the crust beneath the continents.

Of course, both ocean and continent are underlain by the mantle, which would add some tensile strength to each. The difference in this characteristic probably favors the continents by no more than a factor of two to one.

In *Physical Geology*, by Longwell, Knopf and Flint,⁴ the authors state another difference between continents and ocean floors:

Examination of the rocks that make up the Earth's crust has brought out a highly significant fact. Under the continents, rocks that approximate granite in their composition are predominant. In islands that rise from the floors of the oceans, however, the rocks characteristically have the composition of dark basalt

Volume for volume, granitic rock is about 10% lighter in weight than basaltic rock. Therefore, an obvious hypothesis is suggested: great blocks in the crust made of low-density rocks, if they are to rest in balance with adjacent blocks that have higher density, must have larger volume and hence will rise to greater height.

A rather simple experiment can be described here, with quite predictable results, which serves to illustrate the proposed theory. The purpose of the experiment is to show, on a small scale, what might happen if great loads of ice accumulated near both poles.

Simple Experiment Described

An ordinary cardboard globe may be used to represent the crust of the earth. Because the continents are thicker than the ocean floors, it would be desirable to reinforce all

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the area of the continents and the continental shelves. To simulate the ice caps, molded rubber cups, backed up by steel plates, might be used. The rubber cups should cover the area which equals the maximum extent of the ice caps. Those areas are as follows:

Location: If the maximum extent of the northern ice cap is plotted on a globe, it will inscribe a circle centered on the geomagnetic pole, which is located north of Baffin Bay, between Greenland and Canada, about 11.5° from the north pole. This is not the dip pole, which moves gradually, but the point where the greatest number of magnetic lines of force accumulate. The southern ice cap apparently centered on the southern geomagnetic pole, but there is less evidence about it.

Extent: One well known terminal moraine in Pennsylvania is located about 40 miles north of Pittsburgh. This is approximately 2,500 miles south of the geomagnetic pole. If these two points on a globe are used to set a divider and a circle is inscribed about the geomagnetic pole, it will enclose practically all of the areas believed to have been occupied by the Wisconsin ice cap.

Where mountain ranges were located close to this circle, additional areas were glaciated, apparently due to elevation. Most amazing is the fact that the extreme southwestern tip of Alaska, which is outside the circle, was not glaciated, according to geologists. If the glaciers were due only to snowfall, this would be one of the most likely places in the world for ice to have accumulated.

The final step in preparing the globe for the experiment would be to cut a hole, say near the north pole, and to fill the interior with sand, shaking it to fill it completely. The sand would represent the plastic interior of the earth, which tends to yield to large, long-term stress. If the globe with the rubber caps is placed in a hydraulic press and pressure gradually applied, the results are predictable. The globe will rupture probably near the equator. Since brittle materials tend to fail under stress near the middle of the thinnest sections, we would expect the first rupture to be near the middle of an ocean and across the equator.

Here is a fact which provides strong support for the present theory. Approximately one-half of the more than 40,000 miles of mid-ocean rift, is almost precisely centered between the continents. It is centered in the North and South Atlantic Oceans, also between Africa and the Antarctic, and between Australia and the Antarctic. It forms a great Y in the Indian Ocean, apparently under the influence of India and Sumatra on one side, and Africa and the Antarctic on the other two sides. (Engineers learned long ago that heavily loaded beams or large areas which are loaded equally, tend to fail near their center if they are relatively uniform in strength and thickness.)

Further Evidences of Rupture

The question then may be asked, do the ocean rifts show any other indication that something of this nature may have occurred? The answer is, yes, in several ways. Consider the rupture of the ocean floors. This is a subject seldom mentioned in the voluminous material published about the rifts, but powerful forces are necessary to fracture the crust.

Cook⁵ states that the strength of the crust is similar to granite, which has a tensile strength of about 1,000 lbs. per square inch. This indicates that a tensile force of about two billion tons per square mile is required for rupture. In view of the more than 40,000 miles of ocean rifting and the depth of the under-ocean strata, the forces required must have been gigantic.

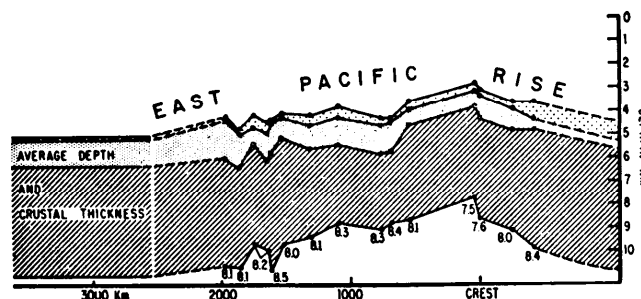


Figure 1. This shows a cross section of the East Pacific Rise. Note that the vertical and horizontal scales differ greatly. This map is taken from Menard's work, and is used here by permission.

Cross-sectional maps of the rifts made from seismological studies show the subocean strata are uplifted on both sides of the rifts. A map of the East Pacific Rise prepared by Menard, cited by Cook⁶ shows uplift from the abyssal depths commencing about 1,500 miles from the crest on the west side. The eastern slope appears steeper, possibly extending only 600 or 700 miles. The elevation of the crest is on the order of two miles. See Figure 1. This uplift of great areas of the ocean floor, which still exists today, is characteristic of all the mid-ocean rifts.

By far the strongest evidence of extensive uplift is found in the great number of fractures which are perpendicular to the rifts. These constitute one of the major features of the entire system. It is clear that if any substantial section of a globe is uplifted, it must become longer. However, the crust of the earth is not very elastic, so if it is stretched by uplift, it will eventually fracture.

It is not postulated that the ice caps would have done more than initiate the rifts. But two facts should be kept in mind: First, the crust under the ice caps could not have sunken until after rupture occurred. The plastic material under the crust is not very compressible. It could not remove from under any area until there was some place to move; i.e., until the integrity of the crust was compromised. Second, once the first rupture occurred, the stresses would concentrate at both ends, and the rift would propagate very rapidly.

The importance of the uplift of the ocean floors has been emphasized because the next stage then follows. Any uplift would have begun to displace ocean water, which would have had only one place to go—onto the continents. These, of course, were already starting to sink under ice loads in certain areas. The transfer of weight from ocean to continent could have taken place with frightening speed. The movement of water added to the load on the continents, but at the same time it unloaded the ocean floor. The major force which would be capable of creating more than 40,000 miles of rifts and even more miles of perpendicular fracture would be that caused by the continents, sinking under the combined load of water and ice.

Once an equilibrium in nature has been disturbed, it usually goes far beyond a new balance. Then forces begin to act to bring it back to normal. In this case, the magma flowing from—thousands of miles of rifts and fractures would have begun to heat the oceans. This would have been a heating element beyond comparison. Cook⁷ cited evidence from uniformitarian geologists indicating that the ice caps melted in no more than 100 years. Such speed is not surprising in view of the foregoing possibilities.

The fact that continents would tend to rise after being depressed is referred to in this comment in *Physical Geology*.⁸

Similarly, if the continental mass shown . . . could be forced down until its surface was below sea level, and then released, the familiar Archimedes' principle, or law of bouyancy, would cause slow deformation of the rocks beneath the continent until the surface arose to the proper height for equilibrium.

A Probable Sequence of Events

It is certainly difficult to assess a probable sequence of events. Here are some of the possibilities:

1. Many believe that the collapse of a water vapor canopy was one of the phenomena associated with the Flood. The collapse might have been initiated by the events which led to the rapid accumulation of ice. Volcanic material ejected into the atmosphere may have provided nuclei of condensation for the precipitation of some of the water vapor.

2. Magma flowing from depth contains great amounts of water in the form of steam. Also, as magma flowed out of the rifts and into the ocean water, vast additional quantities of steam would be generated. All this water, together with that from the canopy, could have caused enormous amounts of rain.

3. When ice began to build up into great ice caps, the first result would be extra pressure on the interior of the earth. Rifting would occur when the pressure caused forces exceeded the tensile strength of the thinnest section, the undersea crust. The area under the ice would have sunken slowly, just as a ship sinks as it is loaded, until a new equilibrium was established. Material displaced by the sinking crust would uplift the ocean floor, causing water to flow onto the continents.

4. The outer limits of the northern ice cap formed a circle about 5,000 miles in diameter. It is possible that the flooding of the continents occurred when the ice cap was no more than 3,000 miles in diameter. The Canadian Shield is nearly devoid of sediments for at least a radius of 1,500 miles from the geomagnetic pole.

If the ice had not advanced more than this, the ocean waters could have deposited sediments which were later modified by moving ice. Some of this growth of the ice caps may well have been due to the precipitation of great amounts of water vapor around the edges of the ice caps.

5. After the ice caps sank until the situation reached equilibrium, the flow of magma from the rifts would have been reduced, but heat stored in the oceans would have continued to melt the ice. The melting however, would require many years. So it could well be that a brief ice age followed the Flood. The ice may have actually advanced for many years after the flooding of the continents.

Depression of the Crust

Some arguments in this study have been based on the assumption that ice caps existed at one time which were capable of depressing the crust under them. Further evidence for this theory is found in ancient beaches which are far above sea level. It appears that large areas are still rising; so it is proposed that the mass of ice must formerly have been so great that it depressed the crust.

Longwell, Knopf and Flint⁹ state:

Evidence in Glaciated Regions. It is not idle speculation to suggest a force capable of bending a continental mass downward . . . Emerged shorelines, associated with beach deposits that contain marine shells and bones of dolphins and whales, are found in the region of Lake Champlain and Montreal several hun-

dred feet above present sea level. Similar evidence is found in Scandinavia and Finland . . . The inference is that the immense loads of glacial ice depressed the lands . . . Parts of Scandinavia are still rising at the rate of 2 or 3 feet in a century . . . and the Great Lakes region in North America is undergoing measureable tilting by continued uplift in Canada . . .

Figure 2 shows¹⁰ the amount of uplift which has taken place since the ice melted. It goes from zero at about the middle of Lake Michigan, to 900 feet of uplift at the eastern shore of Hudson Bay.

Studies by O'Keefe during the International Geophysical Year, cited by Wilson,¹¹ also are interpreted in terms of depression of the crust under both ice caps. These studies of the orbits of satellites show that they change altitude according to the gravity of the earth beneath them. The tracking of satellites is so precise that very small variations in gravity can be detected. Wilson's comment was that the earth was found to be slightly "pearshaped":

For the earth to depart from a spheroidal shape it must have been pressed inwards in Antarctica and in a ring through Europe, Siberia and Canada; these are precisely the places where great loads of glacial ice were placed on the earth during the recent ice age. These loads depressed the earth and caused its present shape. But the earth is now observed to be rising in those places, and I think that it is in the process of slowly flowing back to a spheroid shape. Rather than being permanently strong, the earth is weak and malleable.

The precision with which satellites may be tracked should make their evidence very valuable as to whether the numerous indications of the movement of ice were actually caused by ice or should be attributed to some other phenomenon such as flooding.

Rapid Accumulation of Ice

The ice caps have been ascribed to the slow accumulation of snow, but such a process would have taken many thousands of years. With a very powerful application of facts and logic, Patten¹² has argued that snow was not the major source of the ice, as follows:

First, the ice was apparently many thousands of feet deep near the center, thinning out toward the edges. If moisture-bearing wind had blown onto the ice cap, it would have been chilled and precipitated snow within probably no more than 100 or 200 miles. The greatest depth would then have accumulated around the periphery, which is contrary to the facts.

Second, if ice accumulated slowly, when it was deep enough to begin to move, it would have followed the path of least resistance. That is, it would have moved the most in the lowest elevations, eroding wide, smooth ice valleys as it went.

If it was deep enough to move over higher elevations, it would have rounded them off somewhat, but since more material would have been carried away from the valleys, it would have tended to exaggerate differences in elevation. In fact, it would have tended to corrugate the landscape as it moved. This is definitely not the effect the glaciers seem to have left. The glacial ice had a tremendous leveling effect, as shown in many midwestern states.

Third, Patten's most important point was that the ice must have moved as though it accumulated rapidly; that is, it moved outward from the center in a seemingly irresistible, radial pattern. If it had piled up rapidly near the geo-



Figure 2. On this map, the contours show the amount of uplift which has taken place, presumably since the melting of the ice. The contours are marked in feet.

magnetic pole until it was forced to move outward, it could not have followed the path of least resistance but would have moved straight out from the center. If this movement had radiated from the north pole, all of the ice would have moved south along the lines of longitude.

However, the center of the northern ice cap was between Greenland and Canada, so the movement was southward near the Ohio-Pennsylvania line. East of this, the ice had a slight easterly trend. Westward of this line, the ice had a westerly trend which increased across Canada until the ice in Alaska moved nearly southwest.

In all of this, the movement was directly outward from the geomagnetic pole except where prominent terrain features influenced local movement. The same radial pattern was found in Ireland and England. It was especially pronounced as the ice moved across the Scandinavian Peninsula. Flint¹³ cites a study by Hansen as follows:

The glacial deposits on the plains of Germany, Poland, and Russia contain "immense quantities" of rock of Scandinavian origin. It has been calculated that the volume of this drift is so great that were it removed it could be used to fill up the basin of the Baltic Sea and the basins of all the lakes in Scandinavia, and that enough would be left over to add a layer 25 meters thick to the surface of the Scandinavian Peninsula.

Flint admits that this may be exaggerated but it is a fact that it would require great ice movement to carry rock across the Baltic. It is also noteworthy that radial lines drawn on a globe, from the geomagnetic pole across Scandinavia, will fall upon Germany, Poland and Russia. Furthermore, if the drive outward from the center stopped when the ocean ice melted, part of the ice on the peninsula would then begin to move westward to the sea, no doubt deepening and widening the Norwegian fiords as it went.

The Historical Record

No proposed mechanism for the Flood is worth consideration if it does not agree with the facts of history as recorded in Scripture. Notice the implication of God's question to Job (Chapter 38:8): "Or who shut up the sea with doors, when it burst forth, as if it had issued from the womb?" Rainfall was an important phenomenon at the time of the Flood, but it does not cause the ocean to rush upon the continents.

No better descriptive phrase could be found than, "the same day were all the fountains of the great deep broken up", Gen. 7:11. The suddenness and violence of events is emphasized when this passage is taken with the question addressed to Job.

Possibly the most remarkable correlation is found in the second part of Genesis 8:1, "... and God made a wind to pass over the earth, and the water asswaged." If the ice accumulated rapidly at the beginning of the Flood period, then as soon as the storm was over, great winds would expected.

In equatorial regions the air would have been heated and would rise, but over the ice, it would have been chilled and would sink. This would be the start of the great southeasterlies which blew off the ice caps for many years. As the glaciers melted, dust and dirt were picked up and then deposited as windblown soil, or loess. These soils are found in great belts in central United States and in Europe, Russia and Siberia.¹⁴

What are the Problems?

Every theory which seems to help answer some problems invariably raises others. Patten struggled with the question, where did the ice come from? Despite an ingenious proposal, he was severely criticized. Unfortunately, there are no striations, drumlins or erratic boulders in the atmosphere to provide a record. But the evidence shows that the ice did not move as though it accumulated slowly, and it did move as though it accumulated rapidly.

Geologists have claimed for many years that all of the continents have been below sea level at one time or another and creationists agree. The enormous forces required to cause the rise and fall of continents have been largely ignored. Creationists have been reluctant to propose that they all sank at one time, probably because they would immediately be challenged to name the forces capable of accomplishing this. The evidence provided by the worldwide system of mid-ocean rifts was not even recognized until the International Geophysical Year in 1958.

The major problem with this theory is undoubtedly the matter of sedimentary deposits under the outer edges of the ice caps. There is no problem in much of northeastern Canada because there is a very large area where basement rock is close to the surface. Outside of that region, however, there are large areas which were covered with ice which have deep sedimentary strata.

If the ice descended very rapidly near the geomagnetic pole, considerable flooding and deposit of sediments may

have taken place before the ice reached its maximum extent. The question also arises as to whether the outer edges of the ice cap may have been lifted and floated for a time by the ocean waters.

Although this theory certainly raises questions, it also helps to answer others. Patten pointed out the necessity for very low temperatures to deep-freeze mammoths and cause extensive permafrost. A very moderate amount of cold, at greater distances from the ice caps, would also freeze the bird tracks, worm trails, ripples in sand and the many other delicate features preserved in sedimentary rock. Overnight temperatures no lower than 20° F. will freeze mud to rock-like hardness; then sedimentary deposits could form a contact line before thawing took place.

Summary

The purpose of this study was to determine what effect two great ice caps would have on the crust of the earth. In all probability, the effect would be precisely the same whether the buildup was slow or rapid. The validity of this theory is entirely dependent on the following assumption: the first effect of the accumulation of ice would be internal pressure.

If the interior of the earth was a strong, rigid mass, it would have easily supported the ice against the pull of gravity. However, if the part of the earth which is between the ice caps is more like a column which is not rigid, then under tremendous pressure, the center of this column will begin to fail.

As long as the crust of the earth provided support, like hoops around a barrel, the ice could be supported. When the pressure became excessive, the thinnest section would have ruptured and then been uplifted. Since the ocean floors show unmistakable evidence of uplift, the flooding of the continents and their subsequent sinking below sea level seem to be very reasonable consequences.

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DESCRIPTIONS OF PAST POPULATIONS

EDMOND W. HOLROYD, III*

Several creationist writers have discussed the growth of populations. Usually they have taken the growth to be geometric or exponential. Then, from known facts about present populations, they have tried to calculate back to the time of the Flood, or of creation.

*Here I shall comment mostly on Rodabaugh's work, since it appeared recently in the *Quarterly*, and had some refinements which were not found in other treatments.*

If the constants in the treatment are arranged to make the formulae fit the present populations, and some for ancient times, say in Jacob's day, the formulae give populations in intermediate times, say David's time or the beginning of the Christian era, which are too low by as much as five orders of magnitude. A more elaborate formula can fit the known figures for the Jewish population, for instance. But the result is of little use in proving the youth of the earth, or in finding the time of the Flood.

It is recommended, then, that, because of the discrepancies which may be introduced, that these arguments about populations not be used in popular public lectures.

Introduction

In two recent issues of the *Quarterly* Rodabaugh^{1,2} examined the growth of the world and Jewish populations. In the first article he fitted a simple exponential curve of the form

$$p = 2^n s, \text{ where } n = t/d \quad (1)$$

to recent and original populations of the Jewish people. He then used a more accurate population equation; his equation can be rewritten

$$p = s \exp(at) / (1 + ms(\exp(at) - 1)). \quad (2)$$

In these equations p is the population at some time t after an initial population s . The doubling period of the population is given by d ;

$$a = (1 \ln 2)/d. \quad (3)$$

The inverse of a limiting value to the population is m . A value of m was assumed and then Equation 2 was fitted several times to essentially two data points at the beginning and recent values of the Jewish population, the values of the data points changed slightly for each fit. Using the derived values of a , and a new assumed m for the world population, Equation 2 was then used to see how long it should take for the world population to nearly reach the limiting value.

In his second article Rodabaugh assumed different values of m and recalculated his a and other values, which showed only slight changes. He claimed in both articles that his curves are "reasonable" descriptions of the population. Rodabaugh also pointed out that a population equation by Morris is basically an exponential of the form of Equation 1 modified by probably slowly varying terms. The conclusions of the current article with regard to Equation 1 should therefore also apply to that equation by Morris.

It will be shown that the simple exponential Equation 1, and the more complicated Equation 2, when Rodabaugh's constants are used, give unreasonably small population values for the times between his two end data points.

Values of Time

The years mentioned in the Biblical books of Genesis, Exodus, Judges, Kings, and Chronicles were used to construct a time line on which to plot population values. Several commentaries were also used to convert Biblical years to the present calendar system. Key dates are 587 B. C. for the fall of Jerusalem and 722 or 721 B. C. for the fall of Samaria. Before these dates possible errors start to creep

in. Problems are possible in the interpretation of the lengths of reign of certain kings. These result in a 60 year spread of values for the date of the end of Solomon's reign as given by the several commentaries.

The length of the period of Judges also shows a diversity of opinion. This results in a spread of about two hundred sixty years for the date of the Exodus. Times before Joseph appear to add together without much difficulty, but the diversities of opinion of later years produce at least the same size error possibility in dating the early years according to our present calendar system. Such error bars are used in Figure 1.

Values of Population

Figure 1 is a ten-cycle semi-logarithmic graph of population with time. This form of graph was chosen because the plot of Equation 1 is a straight line, thus aiding in interpretation. Population values quoted by Rodabaugh are plotted. The recent Jewish values form a compact cluster at the upper right edge. The initial population of Jacob and his four wives is plotted at 1850 B. C. with a ± 150 year error bar. Some encyclopedia estimates of world population since 1650 A. D. are also shown, but with unknown errors.

Using a recent ratio of Jews to the total population and these world population estimates, some more Jewish data points were generated.

The average value of a for the initial population of 5 as given in the second article was found to be $a = 3.966 \times 10^{-3}$. Using Rodabaugh's limiting value of $1/m = 8.07 \times 10^7$ people, Equation 2 was fitted to the Jewish data points in Figure 1. The curve turns out to be a nearly straight line which starts to bend slightly only in recent times. The straight line fit of Equation 1 is also plotted for comparison. These lines are a close fit to the data points estimated for 1650 to 1850 A. D.

The same a was then used with Equation 1 to extrapolate the world population back to a small value from the 1922 value. As seen with the Jewish data, the line for Equation 1 is essentially the same as Equation 2 until the population gets close to the limiting value. It is seen that this line also is a good fit to the world population estimate for 1650 to 1922 A. D. Lowering of the death rate by modern technology is the usually quoted cause for the recent rapid increase in population that fails to fit this line.

Discussion of the Equation Values

Using Rodabaugh's constants Equation 2 indicates that only about 45 descendants of Jacob were available to leave Egypt in about 1300 B. C. during the Exodus. This compares unfavorably with the report of 70 people³ entering

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Egypt with Jacob a few 100 years earlier at the time of the seven-year famine. The equation indicates that there were only 145 descendants for David to rule over in about 1000 B. C. and fewer than 450 people in both Israel and Judah at the fall of Samaria in 722 B. C. It indicates about 8300 descendants of Jacob scattered around the world during the time when Jesus fed 5000 men,⁴ and their women and children in addition.

The parallel line showing the world population indicates only 50,000 people in the entire world at the time Sennacherib's army was destroyed leaving 185,000 dead.⁵ It shows that there were fewer than 20,000 people living in the world when David counted 1.3 million males in his kingdom⁶ who could contribute to his army. It shows that only about 700 people were living in the world at the time Joseph presided over food distribution in Egypt during the seven-year famine.

Clearly, both the Jewish population and world population curves by either Equation 1 or 2 do not fit estimated or reasonable populations between the time of Jacob and recent years. Estimated or known populations between the end points are consistently larger than the equations indicate. A simple exponential of the form of Equation 1, probably including one by Morris, cannot ever be adjusted to fit the points available. A curved line on this semi-logarithmic graph is needed, not a straight one.

Alternative Descriptions of Population

Equation 2 has the potential of being curved on a semi-logarithmic plot if different constants are used. Rather than assuming a value for m as Rodabaugh did, one can be calculated. Three data points will be used for the Jewish population: 5 at 1850 B. C., 2.7×10^6 at 1300 B. C. to represent the Exodus⁷, and 5×10^6 at 980 B. C. to represent David's kingdom⁶. (The latter two are crude extrapolations from the numbers of military age males counted in each census.)

The three unknowns of Equation 2, s , a , and m can be determined for any three data points. The first point easily give $s = 5$. The other two together yield $1/m = 5.001 \times 10^6$ people and $a = 2.541 \times 10^{-2}$.

Curve (2) with these constants is also plotted in Figure 1. It shows a steep rise (doubling period 27 years) during the time when the descendants of Jacob should have been prospering in Egypt due to their favored political status (Joseph was second in command, after Pharaoh, and in charge of the food). The curve's rise starts to slow when the Israelites in Egypt experienced their slavery. The curve's rise comes to a halt during the period of the Exodus, Conquest, and the Judges when the people lived a semi-nomadic life, were shepherds in hills, and suffered from wars and famines. The curve suggests that the Israelites were as numerous as the land could support around the time of David.

The present Jewish population has increased only by a factor of three since the time of David, showing the effects of population controls by wars, famines, three deportations and scatterings, apostasy and blending into the world population; and other factors. (It is a bonus of the fit that the new curve for the Jewish population also passes close to the data point for 70 people entering Egypt.)

A similar curve could be estimated which would rise from the eight people of Noah's time to well above the rise of David's kingdom and then level off towards modern population values. It, too, would show the population being held down by some limiting value which it may be supposed, increases with advances in technology. Letting m be

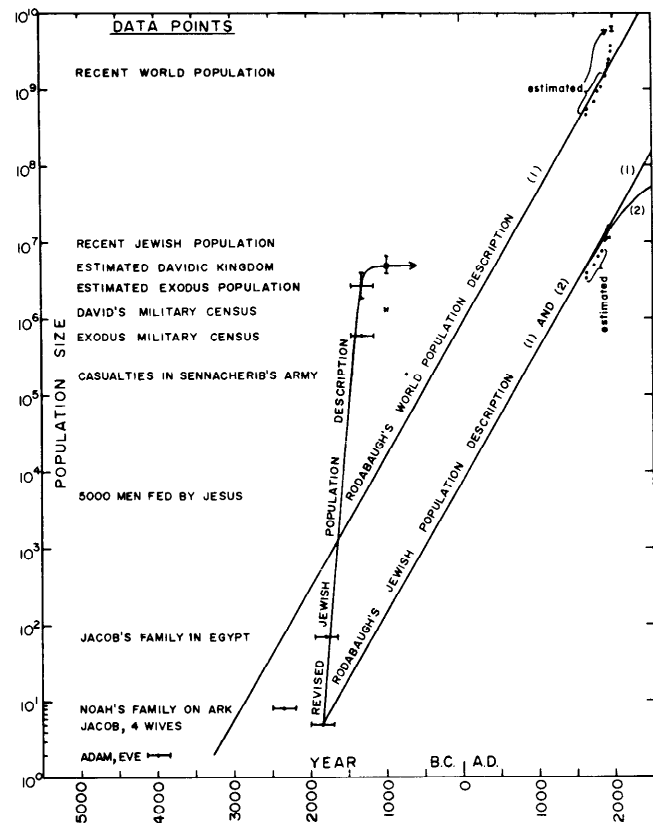


Figure 1. A semi-logarithmic graph of population with time. 10^0 is one, 10^3 is one thousand, 10^6 is one million, and 10^9 is one billion. A few known populations are plotted; some estimates have error bars included. Population descriptions by Rodabaugh for Jewish and world populations appear as nearly straight, parallel lines. A revised description for the Israelites rises steeply and then levels off. Any world population curve rising from the time of Noah must clear this hurdle of the Davidic kingdom population by at least a factor of a hundred before leveling to intersect modern population values. The rates of rise of the Israelite curve and one necessary after Noah's time are the same as for the present world population and are therefore reasonable.

a function of time would be more realistic than having it constant. The population has fluctuated in historic times as a result of wars and other crimes, food supply, disease, and social practices.

No form of a function $m(t)$ is being offered here; there are insufficient data to examine its shape. Many reasonable forms could be suggested. In fact by selecting a and an $m(t)$ either arbitrarily or with reason one could make a curve say nearly anything one likes about ancient populations.

A destruction of world population by the Flood and a rapid restoration afterwards to some limiting, slowly varying value is entirely possible to design into the equations. So is, however, a curve of the form (2) which assumes no Flood and lets the world population be limited through $m(t)$, since times even as great as those suggested by evolutionary theory. When t becomes large in (2), the equation reduces to its limiting value, $1/m$, whatever that may be.

Conclusions

The population descriptions by Rodabaugh were examined and found to introduce errors of up to five orders of magnitude if applied to intermediate times. It is therefore

recommended that, to save embarrassment, Rodabaugh's equations and constants *not* be used in popular lectures.

Equation 2 can still be used with proper constants to describe certain short term events. It should *not* be used to indicate that a Flood probably happened. The term *m* has apparently dominated the equation for the past 3000 years, much too long for giving an indication of when a population recovery occurred.

Whatever form of *m* is suggested to fit historical population data, and then used to extrapolate back towards the times of the Flood, another form of *m* could be suggested

giving reasonable values back to times unacceptable to creationists. Further efforts with this equation should therefore prove of little value in showing that a Flood occurred.

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- ⁷Numbers 1:46 (603,550 males of military age).

RESPONSE TO COMMENTS BY EDMOND W. HOLROYD, III

DAVID J. RODABAUGH *

I shall comment on Holroyd's article in terms of what I have written. It may be that much of what I have to say will apply to treatments of populations by others.

Israel, God's miracle people

To begin with, it is important to observe that Jewish population growth, as recorded in the scriptures, indeed does not fit with the equations generally given for population growth. To the Christian, this is evidence of the miraculous character of God's dealings with Israel.

One of Holroyd's concerns is that this fact could prove embarrassing in popular public lectures. This is not the case for several reasons. First, those who support the theory of evolution do not accept the statements of scripture mentioned in Holroyd's article. They do not admit Biblical data. In my article, information on Jewish population was purposely taken from liberal or secular sources. Evolutionists will admit that kind of data.

Population discussions apply only to long time spans and large populations

Second, to derive any meaningful information that compares one population to another, both should involve long time spans and large populations.

Everyone is aware of the fact that one man might have 20 children while another has none. This does not contra-

dict the population equations. It simply is not what they are intended to describe. The population must be large.

Population equations should also cover a number of generations. Numbers must be such that the population can be thought of as essentially a continuous function of time.

This requires a long time span. Jewish population actually dropped between 1939 and 1946; but this only conflicts with an improper use of the population equations.

Ad Hominem Argument

Third, the basic point in my articles was that the assumptions of the evolutionist lead to an absurdity.

In such a discussion, it is appropriate to allow certain presuppositions of evolutionists, and show in turn, conflict with their conclusions. This style of argument is valid and is even used in the scriptures (e.g., Matt. 12:26-27).

As mentioned above, the evolutionist will admit the data in my paper but will not accept the data of the scriptures.

Conclusion

For these reasons, it is quite proper (and effective) to use population figures in popular public lectures.

To be sure, those who believe the Bible know that God's miracle people—the Jews—did not conform to the normal population equations.

However, the evolutionist is such a committed uniformitarian that he would assert that the population equations are essentially valid. Such equations do contradict his system.

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MONUMENTAL ANACHRONISMS

Two more examples of the ease with which anachronisms may be built into monuments have been noted recently.

Galloway, Strome, in "Brave yesterdays, dints in their domes", *Legion Magazine*, 50 (4): 64 (published by the Royal Canadian Legion, September, 1975) remarked on monuments at St. Julien, France, to the Canadians in the second battle of Ypres, April 1915, and at Obourg railway station, outside Mons, to the Fourth Middlesex Regiment, which fought a notable battle there in 1914.

The point is that in both of these monuments the soldiers are shown wearing steel helmets. But the steel helmet

did not come into use *until 1916*.

It is true that these are anachronisms of only a year or two. But if a short anachronism can occur, so can a long one. So when information, or supposed information, from ancient monuments seems to conflict with Scripture, one should not suppose that the monuments are always right and Scripture is wrong. For that particular piece of supposed information could be an anachronism—or if anachronisms can appear in monuments, so could mistakes, or plain falsehoods.

—Editor Armstrong

PANORAMA OF SCIENCE

Optical Design in Creation

It is well known in optics that it is almost impossible to form a good image with one lens; there are spherical and chromatic aberration and other defects. These faults are corrected by using two or more lenses together, instead of one, to correct for each fault; the result is called a "doublet" (or "triplet", etc.). Naturally, it is more difficult to make such a combination; that is why good cameras or microscopes are expensive.

Now it has been found from fossils that certain trilobites, of the sub-order *Phacopina*, had such eye lenses long ago.¹ Their "schizochroal" eyes, as they have been called, actually have "doublet" lenses. It is stated that these lenses are "... designed to eliminate spherical aberration ..."; and that this design is "... in accord with constructions by Des Carte and Huygens and is dictated by a fundamental law of physics ...".

To make a doublet requires two materials, having different indices of refraction. The trilobite lenses accomplish that by being partly of calcite, partly of another material.

The authors hint at evolution, but really, how could such a thing have evolved? Surely the trilobites had little need of extra sharpness of detail. It is suggested, indeed, that the light-gathering power of the eyes was improved; but surely the difference would not affect survival much. Besides, the trilobites did not survive; other creatures, having much simpler eyes, did survive.

No, here is another example of the fact that when the Creator designs something He does not stint on it. He makes it adequate and more than adequate, some creatures in one way, some in another, as He sees fit.

Incidentally, human eyes, and those of many other creatures, are composed of different materials, in that the indices of refraction of the various humors and other things are somewhat different. Paley, in his *Natural Theology*, suggested that this arrangement helps to overcome chromatic aberration, the fault of a simple lens whereby different colours are focused slightly differently.²

In fact, Paley suggested that the notion of achromatic lenses, made from two kinds of glass to overcome chromatic aberration, had come from the design of the human eye. I have not been able to find much about this matter in more recent works. But it is abundantly plain that everywhere we turn we see evidences of design in Creation.

Exit Extraterrestrials

So often writings are seen in which the existence of living intelligent beings, usually assumed to be technically advanced, outside the Earth, is assumed, that it is surprising to see the existence of such extraterrestrials denied. But the author of an article in an astronomical journal has done just that.³

The author based his arguments on the fact that extraterrestrials, if there be any, have not visited the Earth. Not much is said in refutation of the claims, made by some, that there have been such visits; likely the author considered such claims too silly to call for serious refutation.

In the article the various explanations why the alleged beings from out there have not visited the earth were investigated. The proposed reasons are such as: "they are not interested in exploration", "the technical difficulties are too great even for them", "they have not got around to the earth yet", and so on. The author has shown that, if civilizations on other planets were anything like as common as

some have supposed, all of these explanations would be most unlikely. So the conclusion is that the reason why there have been no visits by extraterrestrials on earth is because there are none.

In fact, the author concluded that: "... the idea that thousands of advanced civilizations are scattered throughout the Galaxy is quite implausible ... an extensive search for radio messages from other civilizations is probably a waste of time and money ...".

It surely follows from these considerations, firstly, that the earth is unique; and secondly, that since random, chance happenings seem to have been unable to produce intelligent living beings elsewhere in the universe, neither can they have caused the intelligent life which is known on earth.

Pollen Provides Reliable Evidence

The writer of a recent item in *Nature* has mentioned "new confidence in ancient pollen data". "Ancient", in this case, means about 3,000 years old.⁴ When remains of ages such as this are studied, there is always the possibility of checking the results against information from history and archaeology; and the more things agree, the more confidence one can have in the results.

Readers of the *Quarterly* may have a special interest in pollen, because of the reports, which have been published from time to time, of pollen, apparently from modern plants, found in rocks commonly ascribed to Cambrian times, or even earlier. No doubt the situations are different in the two cases, the pollen mentioned in the present reference and that in the Cambrian and such rocks. Still, if the pollen is found to preserve an accurate record in the one case, one is inclined to feel confidence in it in the other.

Indeed, there is likely enough evidence for pollen in the supposedly very ancient rocks without any corroboration from the results cited here. Yet such corroboration can increase one's confidence that the rocks, commonly called Cambrian, etc., were actually laid down at times when plants of modern types were growing.

Signalling with Light Nothing New

Readers who have been Scouts may have practised at sending messages in Morse code with a flashing light. Others may have done it at sea. I practised at signalling thus in the army, some years ago, but never had an occasion to do it in action.

It appears, however, that, as we find so often, other creatures were ahead of us. Certain fireflies, such as the *Photuris*, use the method. The males, it appears, fly about flashing. But there is a pattern to the flashes, a code, a certain sequence of flashes. Females of their kind see the light, and answer with an appropriate signal. Thus the males can seek out the females.

The point of the title of the article cited is that in some cases females of one kind of firefly, upon seeing a male of another kind flash, may return the signal appropriate to the male. The male, thinking that all is well, approaches the female and is eaten for his pains.⁵

Is this not extraordinarily like the actions of the "wreckers" who used to put out false lights on rocky shores to lead ships onto the rocks?

The article author brings in the word "evolution". But how could this state of affairs have evolved? The usual objection, that the situation had to come into being full-grown, so to speak, applies here. Indeed, it applies also to

the very production of light by fireflies. So it applies doubly to such an extraordinary situation as this.

More recently another peculiarity of this behavior has been described.⁶ Apparently in some cases the females at first give the correct response for their own kind of firefly. Then, after they have mated, they switch to luring, and devouring, males of other kinds. How can such an extraordinary thing be explained in terms of evolution?

More on Light and Life

It seems to happen fairly often that ideas, originated by groups such as creationists, after initially meeting much opposition eventually become scientifically respectable. For instance, it is widely admitted now that ages found by radioactive carbon often need correction. Some of Velikovsky's suggestions have likewise been adopted by the scientific world in general.

Yet another group of investigators found, as was mentioned recently in this column, that light is not just a matter of seeing, of sun-tan, and of vitamin D. Rather, the light in the environment affects living things in many unexpected ways.

This very fact has now been discussed in an article in the *Scientific American*.⁷ Since that journal is circulated so widely, it will be enough here to note that these more subtle effects of light seem to come about in two ways, at least when higher animals are concerned. Some effects are produced by light on the body in general. Others have to do with light received by the eyes; but have nothing to do with seeing. Rather, in some way the reception of the light seems to affect the production of certain hormones.

It was pointed out earlier that such complicated relations between the environment and the things living in it point to their creation as an integrated system.

Is it possible that researchers will find (if it is not already known) that sound, quite apart from any meaning which might be taken from it, likewise has some subtle effects on human beings?

More Meteoritic Missiles?

More features of the earth's surface, which could be relics of ancient collisions of meteorites with the earth, have been reported recently. These are in Central Europe, mostly Germany and Czechoslovakia, and consist of hundreds of impact craters, spread out over a quite large area.⁸ It is said that the fall of meteorites took place 14.8 million years ago. How that time was estimated seems not to have been stated; there is a tendency to exaggerate such ages.

It is worthwhile for creationists to look into these matters, for the more that is known about the nature of the earth's surface, the more successful efforts will be in explaining it in terms of Creation.

There might be another possibility. Could it be that the explanation of these features in terms of the impact of objects from outside the earth is mistaken? After all, if lumps of iron and so on could exist outside the earth, presumably they could exist inside it; and if such things could fall down from above they could be forced up from beneath. Is it possible, for instance, that these features might be scars left by the breaking up of the great fountains of the deep?

Pleochroic Halos: Evidence for a Young Earth?

The phenomenon of pleochroic halos has been mentioned previously in the *Quarterly*. These halos are found in certain minerals, such as mica. A tiny bit of some radioactive material, such as an isotope of polonium, has become

embedded in the mineral. The radioactivity causes the mineral around the inclusion to become discolored. If the mineral is sectioned, the discoloration shows up as a ring; hence the name "halo".

It is possible, by inspecting the halo, to judge something about the kind of radioactive material which caused it. And here often appears evidence against any enormous ages of the minerals.

For presumably the radioactive material could become embedded in the mineral only when it was formed, or at least if it was still liquid. But the halos must have been formed when the minerals were solid; in molten minerals the halos would not keep their form.

But some of the radioactive materials which are identified have quite short half lives. So if the minerals were anything like as old as they should be according to the uniformitarian theory, the radioactivity would have been exhausted long before the mineral was solid.

Thus these halos are strong evidence for a young earth. It is interesting to notice that the halos are being discussed in journals which are, in general, committed to the uniformitarian viewpoint. In one such discussion, the existence of the halos was described as a "nuclear geophysical enigma".⁹

Acoustical Design in Porpoises

It has been known for a long time that certain porpoises have a region composed of a special kind of fat in the head. Sometimes this part has been called the "melon". More recently, it has appeared that the porpoises practice echolocation, emitting suitable sounds and apparently judging the situations of objects by the echoes coming back.

Now it appears that in some cases there is a connection between these two things.¹⁰ The fatty tissue of the melon is such that the speed of sound in it is different from that in the rest of the body. Consequently the melon acts as a sound lens, it focuses sound just as a glass lens focuses light. And this focusing seems to be of some use in connection with echolocation.

In the *Stenella graffmani*, for instance, the fatty tissue of the melon consists of special triacylglycerols and wax esters. Moreover, the speed of sound in this tissue depends on the composition; and apparently the composition is changed slightly to adjust for differences in the behaviour of sound in the surrounding water. The porpoise, so to speak, is able to focus or tune its sound lens.

There is also some evidence that the composition may vary from place to place in the melon. This technique is occasionally used in optical lenses, or other optical elements, the index of refraction of the glass being graded from place to place to get results which would be impossible with uniform glass. The porpoises, it appears, were ahead of the optical designers in applying such techniques.

Is it necessary to point out that such a situation could never have evolved by chance, that it points, rather, to design of the most skillful and ingenious kind?

Another Carbon 14 Date Too Old

The book *Gears from the Greeks*, about an ancient astronomical device found in an ancient wreck off the Greek Island of Antikithera early in this century, has provided a piece of information which may be of some interest to creationists.¹¹ During additional investigation recently, wood from the wreck was dated by radioactive carbon in the usual way. The result was an indicated date of about 220 B. C. But on archaeological grounds, the date of the wreck has been set at about 80 B. C.

An Unexpected Magnetic Effect

An investigator has noticed recently that fracture of materials may cause magnetic effects.¹²

Samples of low-carbon iron were broken in the usual way in which samples of metal are tested. It was found that magnetic fields of about 1,000 gauss appeared at the instant of fracture. The fields were detected by the electromotive force which they induced, and were displayed on an oscilloscope. It is reported that subsequently the field was retained for about 15 days, at least in large specimens; then it decayed about exponentially.

The reason that this phenomenon, on which more experimenting needs to be done, is mentioned here is that it might have a bearing on the magnetization of rocks. Perhaps the magnetization could have been caused by the stresses, fractures, etc., which the rocks have undergone. This might help to show what should be made of the supposed magnetic reversals.

A possible experiment, along these lines, would be to see whether there is any difference in the remnant magnetization (either in magnitude or in direction) of samples of the same kind of rock taken from the two sides of a fault.

Apparently shock, in general, can cause magnetic effects, at least in some cases. An author has described remnant magnetization, in rocks around Lake Superior, as shock-induced.¹³

Also, the authors of a recent article have suggested that magnetization on the moon might be due to the impacts of comets.¹⁴ The ionization around the comet, it was suggested, might have helped. Such impacts, the authors also remarked, might have produced some effects on the earth.

—Contributions by Harold L. Armstrong

How Some Beetles Keep Warm or Cool

In a recent item in *Science* the author mentioned yet another mechanism for thermoregulation.¹⁵ Flightless beetles (*Onymacris plana*) from the Manib Desert in South-West Africa regulate their body temperature by a combination of thermoregulatory behavior and a selectively reflecting and absorbing surface, especially in the elytra.

The elytra absorb about 95% of the radiation in the visible, and shorter wavelengths; but in the longer wavelengths, infra-red for instance, absorb only about 20% at most and let the rest through.

This feature is adaptive, in the following way. In the early morning, when the desert is cool, the greater proportion of the incident radiation is in the longer wavelengths. This passes through the elytra, and is absorbed by the beetle's body, helping to keep it warm.

Around noon, on the other hand, more of the incident radiation is in the visible and shorter wavelengths. This is absorbed by the elytra, which act as a sunshade for the rest of the body. The heat caused in the elytra is dissipated by convection. Thus the beetle can keep cooler. Under extreme conditions of heat the beetles seek the shade, or go into burrows.

So once again it is impossible to say that either of the homeotherms ("warm blooded" animals, such as birds and mammals), or ectotherms ("cold blooded", including insects) is, in this respect, more "advanced" than the other. Rather, the available evidence shows (as does God's Word) that all animals were created equally well adapted to their particular environment. "And God saw everything that He had made, and behold, it was very good". (Genesis 1:31)

—Contributed by E. Norbert Smith

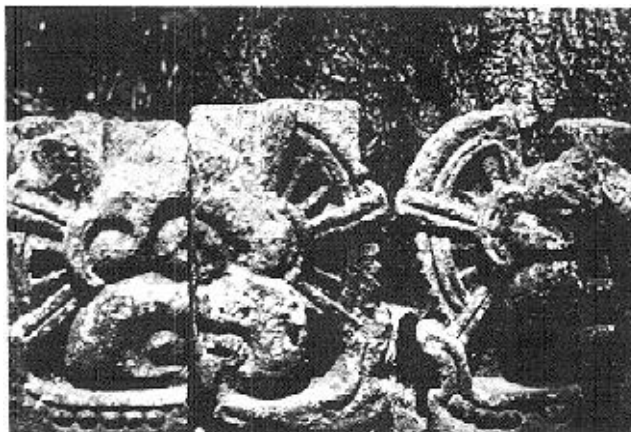


Figure 1. These carvings, on the Copan Mayan Indian ruins in Honduras, look amazingly like gears with spoked wheels and housings.

Gears in the New World Long Ago?

The accompanying illustration (Figure 1) is a photograph of carvings on the Copan Mayan Indian ruins in Honduras. It has been suggested that it looks very much like gears, with spoked wheels and housing.

Before anyone objects that wheels of any kind, let alone gears, were unknown in the New World until Columbus' time, let it be noticed that there is now evidence that that is not so. There is evidence of the use, in what is now Peru, of the potter's wheel, and of some kind of lathe, around the fifth century A. D.¹⁶

Also, Heyerdahl has reported that wheels were used even earlier in Mexico.¹⁷ He wrote:

... small ceramic dogs, running on real wheels just like modern toys, are found in Olmec graves from pre-Christian times ... (the common belief) until that discovery was made was that the Old World wheel was unknown in America before Columbus. It was indeed known ... at least by those who founded the earliest Mexican civilization. Why it was lost before being put to practical use is another matter ...¹⁸

Incidentally, the Olmecs are always providing surprises. An archaeologist has found what seems to be a magnetic compass, in Olmec remains, dating from round 1,000 B. C., in San Lorenzo Vera Cruz, made of lodestone but artificially shaped. He has suggested that it perhaps was used, not in navigation, but for orienting ceremonial structures. Apparently that was the first use of the compass in China.¹⁹

To return to the wheels, it is perhaps not incredible that they were gears. The book *Gears from the Greeks*, about the device found in the wrecked ship off Antikithera early in this century, has shown that it was a mechanism of much greater complexity than anyone had supposed was possible in antiquity.¹¹

To what is this surprising technical advancement, on the part of many ancient peoples in different parts of the world, to be ascribed? Does it not come from the dispersion of a highly advanced people from Babel, a dispersion which did not, for a while anyway, destroy their technological abilities?

—Contributed by Harry V. Wiant, Jr.

In a recent issue of the *Yale Alumni Magazine* (Dec. 1975), Arthur W. Galston, professor of botany, discussed the ability of trees to "tell time". In Connecticut, trees start to shed their leaves, produce winter buds, and cease their growth in September. This may seem strange when

the first killing frost will probably not occur for another six to eight weeks, and much additional photosynthesis could be accomplished if the leaves were functional longer.

The tree, "wisely", plays it safe by dropping its leaves at some reasonable interval before freezing injury or death would occur. To do this, however, requires a "knowledge" of the exact date and a "sense" of the probable date of the year's first frost. Both of these are measured within the tree by chemical timers.

A remarkable pigment, called phytochrome, measures the relative amount of light and dark in a 24-hour cycle. In light, phytochrome is converted into active forms, in darkness into inactive form. By this means, the tree can keep track of the date within two minutes accuracy.

The status of the phytochrome helps determine growth rate, onset of dormancy, beginning of flowering, seed germination, and other processes, although how the pigment status is "understood" by the plant is not exactly known. Even more amazing, because chemical reactions are very sensitive to temperature fluctuations, a temperature-correction process is included. Surely, the complexity of life is the best evidence of a Creator.

— Contributed by Harry V. Wiant, Jr.

Mind over Brain?

This is a sequel to the item, "Quantum Psycho-Physics", in this section (p. 215f) of the *Quarterly* for March 1976.

Independently of Dr. Evan H. Walker, qualitative conclusions generally similar to his sharp quantitative conclusions had previously been reached by at least one eminent biochemist and two pre-eminent brain-physiology medical scientists.

This is not surprising, for Dalton reached many correct conclusions about the atomic nature of matter prior to detailed confirmation by research in microphysics, and Mendel reached many correct conclusions about genetics and heredity prior to detailed confirmation by the discovery of chromosomes, cistrons, and the DNA code.

Physical chemist, biochemist, authority on chemical reaction theory and the quantum statistics of matter, Dr. Henry Eyring, a recipient of the National Medal of Science and past president of both the American Chemical Society and the American Association for the Advancement of Science, in 1967 said the following.

More recently, we have been obliged to give up the old determinism of classical mechanics as well as the idea of indestructibility of matter. Mechanical determinism meant that if one were given the state of the universe at any instant of time, a sufficiently expert mathematician could calculate the state of things at all times to come. This left no place for the great principle of free will. Then quantum mechanics brought with it the uncertainty principle. This principle eliminates the possibility of predicting the future exactly,† and tends to confirm that fundamental Christian tenet that man enjoys free agency as a divine gift.²⁰

Roger W. Sperry, Ph.D., is Hixon Professor Psycho-biology at the California Institute of Technology. In 1973 he received the 29th annual Passano Award for medical science. He is an authority on the left-brain/right-brain phenomenon, the development of consciousness, the mind-brain relationship, and many technical aspects of brain research.

†Presumably this is intended to refer to mechanical or mathematical prediction, and not to deny the possibility of supernatural or divine prophecy. — Editor

In the early 1950's Dr. Sperry described consciousness as a functional or operational derivative of brain activity. In an interview he noted that by 1965 he had come to appreciate that conscious effects must work *into* brain activity as well as being derived *from* it. He said:

Accepting that conclusion forces a change in one's whole philosophy. . . . Mental events are seen to control the course of subsidiary neural action . . . volitional behavior is seen to be determined at a mental as well as at the molecular and physiological levels of causation. . . . Science has not previously had an acceptable explanatory concept for psycho-physical interaction. In fact, for decades it has been denounced on principle. The new brain model provides support for a science of mind. . . . On these new terms the world view of science is not interpreted merely in terms of its elements and what is quantifiable and measureable.²¹

Wilder Penfield, M.D., F.R.S. in the early 1930's and since has experimented with direct electrical stimulation of the brains of more than 1,000 patients (thereby pioneering new treatments for epilepsy), and made the epochal finding that at certain sites in the temporal lobe stimulation produced a dream-like "flashback" in which the patient re-experienced the stream of consciousness of an earlier time as though watching a movie. This experience was mechanical and repeatable, but the re-activation of the past never confused the patient or made him believe he was actually in the past.

Penfield realized that in no instance did this phenomenon seem to involve any of the functions of the mind (that element that feels, perceives, thinks, reasons, and wills). This forced Penfield to reconsider his earlier struggles to prove that the brain accounts for the mind. In the words of UCLA neuropsychologist Marjorie Schuman reviewing Penfield's latest book, Penfield concluded, "The mind . . . stands above the content of consciousness at any moment. It is an independent entity."²² "The mind directs and the brain mechanism executes", he decided. "The brain is messenger to consciousness." Penfield wrote in his book:

Do brain mechanisms account for mind? . . . [In] death . . . the mind seems to vanish, as in sleep. I said "seems". . . . If, however, during life, when brain and mind are awake, direct communication is sometimes established with the minds of other men or with the mind of God, then it is clear that energy from without can reach a man's mind. In that case it is not unreasonable for him to hope that after death the mind may waken to another source of energy.²³

— Contributed by Robert W. Bass

Time and Lysenko's Unsung Critic

A recent article with this title, by Daniil Granin deals primarily with Alexander Lyubishchev's mastery of the economical use of time, but also stresses his criticism of Lysenko's work and his anti-Darwinist concepts.²⁴

Regarding time it seems he kept a daily account of how much time he spent at various activities. At the end of each month he summed up the work spent on basic scientific work, on books, meetings and relaxation. He could thus see where the gaps were and correct them.

These monthly accounts were summed up at the end of the year and on the basis of these he planned his time, making a self-analysis of how his productivity was changing, what he had failed to do and why.

Granin says such a system calls for considerable courage. Not everyone can face up to how poorly, irrationally, criminally and disastrously he spends the one and only life he has.

Though his system would seem to reduce one to a machine, actually Lyubishchev was able to read more than most, traveled a great deal, especially to the countryside collecting insects for his entomological work, loved music, had many friends and was often surrounded by young people.

His main reason for being so anxious to make the most of his time was to develop an organic system based on mathematics and biology. In particular he wished to make a mathematical study of the curves of the structure of organisms that have no direct functional significance.

There are many such in plants and animals. Thus the elegant curves of the rose bud, open flower petals, and even the ripened hip or seed pod have no relation to function or survival under natural conditions. For this reason Lyubishchev was an anti-Darwinist and tried to prove that evolution was not connected with natural selection, using arguments based on biometrical analysis.

Also he published over 1000 pages of detailed criticisms of Lysenko's policies covering areas from vernalization to intra-varietal crossing of plants from self-fertilized seeds.

It would be very worth while if his writings could be translated and made available to creationists.

— Contributed by Walter E. Lammerts

Future in the Past

Most laymen are under the impression that plant breeders are continually improving the quality and survival ability of various crop plants such as wheat, rice or tomatoes. Actually, as Eleanor Lawrence points out in an article with the above title²⁵ agriculture in highly developed countries now depends on comparatively few varieties of the major crops. These are bred mostly for high yield, early maturity, and resistance to specific diseases occurring in the area of high-est production.

As a result there is a great danger of losing the more primitive or wild relatives of the present crops cultivated on a large scale. These have been selected by peasant farmers for reliability rather than high performance on the basis that in a bad year a small but dependable yield is better than no yield at all.

They are genetically mixed strains and accordingly new variations arise periodically by chance cross breeding. Some of these may be better adapted to local areas and so are selected by the farmers.

Actually these crops were brought into existence thousands of years ago and have gradually spread out from their original centers of cultivation, diversifying into many genetically distinct local varieties.

The resulting reservoir of genetic variation has been of great value to the plant breeder. Resistance to pests, diseases, cold and drought tolerance, and climatic adaptation have gradually accumulated in these older strains.

Since there is great danger of losing these strains, the Crop Ecology and Genetics Unit, a special unit of the Food and Agriculture Organization of the United Nations, was set up to gather and store seeds of the older varieties. The program is coordinated by the International Board for Plant Genetic Resources. In making these collections the varieties are described botanically in such a way that the plant breeder can easily identify material which might be useful to him.

The interest of this article cited from the creationist's viewpoint lies in the fact that the very existence of the IBPGR, financed by \$730,000.00 in 1975, with a proposed budget of \$1.3 million for 1976 is a recognition of original created diversity.

For as Lawrence points out in her opening sentence, "Most of the stable crops grown today were first brought into cultivation thousands of years ago." The diversification into localized varieties must have been the result of either original created heterozygosity or mutation.

Now mutations have been shown to have little or no climatic, disease, or pest resistant value. Some such as dwarf habit in rice, so useful in the breeding work of the International Rice Institute in the Philippines, may have originally resulted from a mutation. Actually it was found in a "primitive" variety in Taiwan. So it might have been from an original created diversity also.

— Contributed by Walter E. Lammerts

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BOOK REVIEWS

Gears from the Greeks† by Derek De Solla Price. 1975. Science History Publications, 156 Fifth Avenue, New York, N. Y. 10010, 70 pages. Price \$8.50.

Reviewed by Philip G. Hill*

In the year 1900 a small ship carrying a party of sponge divers sheltered from a storm in the lee of Antikythera Island, near Crete. Exploring the sea bed near their anchorage the divers found the remains of an ancient ship which yielded many objects of archaeological interest. Specimens of Greek and Roman pottery, amphorae, etc. were happily accepted by the Greek Archaeological Museum, and were found to date to 80-5 B. C.

But the most interesting object of all lay unnoticed for months. It consisted of some pieces of corroded bronze with "clear traces of gear wheels". Early conjecture that this was merely an astrolabe, was refuted by the obvious complexity of the gearing.

Professor Price writes a fascinating account of painstaking detective work spanning over 70 years, which has led to clear identification of the form and function of this mechanism.

The great break-through in the investigation was the result of gamma radiography in 1971, which showed the gear teeth sufficiently clearly that gear ratios could be associated with astronomical and calendrical parameters. The relic has been shown to be a calendrical sun and moon computing mechanism.

The astonishing feature of the mechanism is a quite sophisticated differential gear assembly, demonstrating an idea previously thought to date back no earlier than the 16th century. (Apparently it is nowhere mentioned by Leonardo da Vinci.) Before this discovery, there appeared to be little if any evidence that the Greeks had developed scientific instruments of any degree of complexity.

Price concludes that "this singular artifact, the oldest living relic of scientific technology, and the only complicated mechanical device we have from antiquity, quite changes our ideas about the Greeks and makes visible a more continuous historical evolution of one of the most important main lines that lead to our modern civilization."



PROVIDENCE LOST—A Critique of Darwinism by Richard Spilsbury. 1974. Oxford University Press, Ely House, London W1. 133 pages. £3.50 UK

Reviewed by the Rev. T. Robert Ingram**

This is a difficult book to discuss. The title suggests the author might prize an understanding of God's providence and show how Darwinism (and Neo-Darwinism) is incompatible with it.

There are some parts of the book which present a penetrating analysis of certain aspects of life which cannot be accounted for by any Darwinian or Neo-Darwinian postu-

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†This book is mentioned in the "Panorama of Science" section in this *Quarterly* especially for the evidence which it contains for the high development of ancient technology. It would seem that this development may be ascribed, in part at least, to the dispersion from Babel of an already high civilization. —Editor

**Rev. T. Robert Ingram, D.D., is Rector of St. Thomas' Episcopal Church and School, P.O. Box 35096, Houston, Texas 77035.

lation of purely materialistic evolution. Unfortunately, while the author seems to expose the fallacies of Darwinian thinking one after another, it is clear that he never questions the assumption that evolution has taken place. One is constantly looking for the suggestion that evolution is God-directed; if the suggestion is there, however, it is so veiled as to be almost undetectable.

If the author presents any integrating thesis at all to tie together his speculations and examinations, it would seem to be one of definite agnosticism, as in such statements as, "Belief in Total Explanations places an absurd over-confidence in the powers of human thinking and wise selection of 'authorities,' in the case of derived dogmas."

It is hard to understand how a mind which ranges so widely would simply be uninformed about the traditional recognition of the finiteness of the human mind which renders it incapable of comprehending the infinite without the necessity of denying the existence of that which it cannot comprehend.

The statement, "The eternal inadequacy of human understanding rules out the possibility of total explanations," betrays an ignorance of the meaning of eternity and puts an arbitrary and unsupported limitation on the realm of possibility. Throughout the book the case for purpose in connection with such things as speech, language, values and love is presented, but so watered down as to fail as a real critique of the inadequacy of Darwinism. Perhaps it is simply impossible to assume that evolution is true and still shoot it full of holes.

The chapter on Language is outstanding and might well be worth the price of the book.

The logical absurdity of the agnostic position, however, that nothing is certain but uncertainty, is most unsatisfying.



Remember Thy Creator by G. Richard Culp. 1975. Baker Book House, Grand Rapids, Michigan, 207 pp. Paperback, \$3.95.

Reviewed by John N. Moore*

Dr. Richard Culp remembers some of the stumbling blocks in the path he followed from belief in evolution as a non-Christian to spokesman for belief in the creation account of *first* origins and full Christian commitment. He wrote this book to present clearly his reasons why Christians should not be unsettled by evolution and need not try to seek some compromise position such as theistic evolution.

The main parts of the book appear under the headings, "General Refutation of Evolution" and "Technical Refutation of Evolution". Both sections are valuable and Dr. Culp used the introductory part, "Evidence for Divine Creation", to stimulate the reader's inquisitive nature by reminding us all of the unique and "just right" nature of the inanimate aspects of the earth's atmosphere, water, the solar system; and of animate aspects of bird nests and migration, fish migrations, the human eye, homeostasis, and certain vital organs. Surely the reader encounters some real problems as far as trying to explain the first appearance of these features of the natural environment by any naturalistic means.

Thus, in his general refutation of evolution, which so many have turned to in place of acceptance of the unchang-

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ing answers on first origins found in God's Word, the author reviews the "classical evidences" so commonly used. Comparative anatomy, comparative embryology, vestigial organs, geology, the fossil record, anthropology, and genetics are each considered carefully in separate chapters.

Of particular import in these chapters were discussions of "living fossils" (p. 85f); so-called prehistoric men (p. 94ff), including a chart of comparison of ape with man; and "re-capture" of evidently extinct stages of domestic cattle and horses. Pictures of the ancient auroch and wild tarpan are used to illustrate the author's position that modern domestic animals did not evolve but were artificially bred.

Chapter 12, "Evolutionists' Weaknesses", may prove to be a most important chapter for many readers wherein the author incorporated numerous personal experiences at Purdue University, University of Michigan, and Michigan State University as firsthand information about evolutionists' disunity, fluctuation of ideas, closed-mindedness, fallibility, credulity, inhibition of dissent, philosophical orientation, dogmatism, intolerance, and actual dishonesty.

The following chapter, "Theistic Evolution", is well done and this reviewer was particularly pleased to see the chart of comparison of theistic evolution and Genesis, which exposes the sheer superficiality of any similarity; and also discussion of outstanding Christian men in the physical and biological sciences, who have "testified without embarrassment of their faith in God". In addition to Faraday, Virchow, Linnaeus, Pasteur, Cuvier, Agassiz, Morse, Hovey and Bartram, the author could have added mention of Kepler, Newton, Boyle, Kelvin, Clerk-Maxwell, Steinmetz, Ray, and Mendel.

In the second main part, discussion of radiometric dating methods, comparative blood tests, and creation-evolutionism is rather standard and somewhat brief. However he does include most pointed attention to publications of and positions taken by members of the American Scientific Affiliation organization. In his conclusion Dr. Culp offers the reader a useful "Christian's Focus", and provides, thus, a culmination of his repeated and faithful inclusion in section after section, and chapter after chapter, of relevant Scriptural texts.

Through personal correspondence with Dr. Culp I have learned that he would like to make changes. He would like to improve some of the line drawings, expand the Index, and include a bibliography beyond the footnoted references that now appear at the bottom of pages.

I recommend this book highly. It is an excellent addition to everyman's library whether casual reader or subject matter specialist. Dr. Culp shows that he has studied to be approved of God with respect to evolution as an unnecessary stumbling block to a person's faith in Jesus Christ.

Readers are positively encouraged to use *Remember Thy Creator* in arming their loved ones to meet the worldly ideas of evolutionists so that even theistic evolution will not be a philosophy of deceit (Col. 2:8) to attract them away from Christ, the Creator.



The Troubled Waters of Evolution† by Henry M. Morris, Ph.D. Creation-Life Publishers, San Diego, Cal., 1975, 217 pages, \$2.95 paperback.

Reviewed by Theodore P. Aufdemberge*

Dr. Henry Morris is well known to readers of the *Quarterly* since he was one of the founders and a former president of the Creation Research Society. His mission is well known by those who have read any of his previous books.

The book reviewed here could only have been written by one who whole heartedly believes that the theory of evolution is contrary to Biblical revelation, unscientific and on top of that, so inadequately matches, explains, or predicts the facts that it must be considered untrue and therefore unworthy of the general acceptance unfortunately given it. Morris, true to form, sets out in this book to refute the theory of evolution mainly on the last two points and to defend his belief that creationism, while also not a scientific theory, is worthy of more general acceptance because it adequately matches, explains, and predicts the facts observed by modern scientists.

The first chapter, "Up With Creation," indicates that the belief in the creation "theory" of the earth's origin is not dead but has a growing number of adherents in the scientific community. Secondly, Morris claims that the theory of evolution has many problems which are ignored, considered of little account, or unknown to the teachers of the evolutionary "theory".

Chapter two, "Troubled Waters Everywhere," shows how evolutionary thinking has infiltrated almost every area of thought and life. In it Morris attempts also to show how totalitarian ideologies, racism, and pollution are direct outgrowths of the teaching and conscious or unconscious acceptance of the evolutionary theory of origins.

Chapter three, "A Long, Long Trail A'Winding," traces the history of the evolutionary theory from the present to the Greek philosopher Thales of Miletus or perhaps even farther back to Nimrod, the Tower of Babel, and ultimately to Satan himself. Morris does say, however, that "solid evidence for the latter is admittedly tenuous."

Chapters four and five, "In Scientific Circles," and "Can Water Run Uphill," define both evolution and creation in terms of scientific models. Morris quotes several definitions of evolution from well-known evolutionists. Briefly, the evolutionary model that he contends is inadequate can be stated in two premises:

1. Matter and energy are eternal and conserved.
2. Complex things found in the universe today evolved from pre-existing but less complex things by the natural processes at work today, e.g., chance mutations and the survival of the fittest.

Dr. Morris's scientific creation model is stated on page 106, in the form of three premises:

1. An initial period of special creation, in which all the basic entities (astronomical systems, structure of matter and energy, the forces and laws of nature, the distinctive kinds of plants and animals, and man) were brought into existence by processes of supernatural creation which no longer operate in the natural world.

2. The present period in which the basic laws and processes of nature are essentially uniform. In particular, these processes are functioning within a framework of quantitative conservation and qualitative deterioration. Nothing is being created, since this was finished in the special creation period in the past, but neither is anything passing out of existence. And yet, though nothing is lost, things do appear to be running down. Individual organisms, and even entire species, may die out, but life goes on, and always in the same basic distinctive forms as originally created.

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†A short review of this book has already appeared in the *Quarterly*. However, a second review, from a somewhat different viewpoint, of a work of so much interest to creationists, is worth while.

3. One or more periods of cataclysm in the past, when the entire world was affected by destructive processes of tremendous scope and intensity.

After setting forth these two models Dr. Morris proceeds to compare both models with the scale of reality and like Belshazzar, the evolutionary model is found wanting.

Chapter six, "Boil and Bubble," is quite polemic. Here Dr. Morris returns to and drives home the theme that thinking in terms of the concept of evolution is the cause of all things hateful to God and man and perhaps a few other frightening things as well, e.g., the population explosion and abortion, the energy crisis and pollution, racism, the sexual revolution, etc.

I found the first three chapters to be informative and thought provoking. Chapters 4 and 5 however, seemed tedious and repetitious to me. The concise statement of the creation model quoted above and how it better fits the observed facts of science was good, however, the latter was done on two or three occasions.

I was thankful to Dr. Morris for his treatment of the second law of thermodynamics from the viewpoint of classical mechanics, statistical thermodynamics, and informational thermodynamics. That evolution and the second law of thermodynamics are contradictory is true and must be emphasized, but I got a bit tired of reading that it was. I was hoping Dr. Morris could come up with additional arguments because most defenders of evolution have heard this before and are satisfied with the open system reply.

Chapter 6, while containing many good thoughts gave me mixed feelings. After reading this chapter I'm sure that Dr. Morris did not write this book for the professional scientist. I think it, the title, and chapter headings indicate an attempt to popularize the book and to sell his idea to as many people as possible.

As a result he occasionally appeals to the emotions rather than to reason and the book, especially chapter six, becomes quite polemic. Evolution is cited as the cause of things which I personally abhor. As a result, I found myself cheering him on. But after more thought, I realized that I had not been reading critically. Let me give two examples.

While arguing for a young earth, Dr. Morris uses an argument which I myself have used to discredit the uniformitarian argument for an old earth. He first applied the con-

cept of uniformitarianism to current population data and then extrapolated backwards. According to the result, Adam and Eve would have lived 1075 years ago. Thus the uniformitarian treatment is discredited.

But then, Dr. Morris lowers the annual population growth rate from 2% to 1/3 per cent and calculates that Adam and Eve lived a bit over 6,000 years ago. Is not the 1/3% rather like a "fudge factor", chosen to give the desired result? The method fails for the same reason as that for which radiometric dating fails: some of the assumptions have been shown to be invalid. It is true that the argument does show that there is nothing unreasonable, as far as population data go, about a young earth, but this is not proof of a young earth.

Secondly, I cannot believe that the acceptance of evolution is a cause of racism, communism, etc. These evils would be with us even if Darwin's *Origin of Species* had never been written; neither, if evolution were totally abandoned tomorrow would these things necessarily disappear. Is the truth not that all of these things have a common cause: the faultiness of human nature?

Perhaps the foregoing explains my mixed feelings about chapter six. I believe that judicious editing could have improved this chapter. In spite of these criticisms one has to judge the entire volume by what I believe was Dr. Morris's reason for writing it.

I believe he was appealing to those preachers and teachers who believe that the universe was created by the Triune God, people who are looking for arguments to use when confronted by others brainwashed into believing that evolution is the only scientifically acceptable explanation for the origins of life and the universe. This book contains excellent advice for these persons on pages 173-179. The advice is too long to quote here but well worth the price of this book.

Secondly, this book was written for those students who were taught to believe that God created the world and now find their faith severely tested by their teachers and textbooks. This book will help them see that although many accept the evolutionary "theory" of origins as fact, it is neither the only nor best explanation for the origin of the universe. I recommend that this book be used for these purposes.

LETTERS TO THE EDITOR

More Observations of Potholes

On a recent visit to Ontario, I spent some time in discussion with my son, Douglas Cox, on the subject of potholes.¹ As I was to visit Yosemite valley after leaving Ontario, Douglas asked me to report on any potholes which I might discover. I am now passing on my observations, in the hope that they may be of some interest to readers of the *Quarterly*.

Let me say also that I have never studied geology in any academic way. Nor, until my visit, did I know anything about potholes—except the ones to be avoided in driving a car.

I visited Yosemite in September 1975, toward the end of a long dry spell. Yosemite Falls was "bone-dry". Vernal and Nevada Falls were not quite dry, but they could well have been at an all-time low. Thus it was possible to examine two potholes which otherwise would not have been seen.

The first was at Vernal Falls, within a few feet of the edge of the precipice and right in the center of the stream. I did not take any measurements, but should say that the specimen at Vernal Falls was the smaller of the two, perhaps a little more than two feet across. It was cone-shaped inside, and partially filled with pebbles.

But what struck me was that the down-stream edge of the lip was worn away, giving the hole a slightly elongated appearance. This gave the distinct impression that the pothole was there before the water; that the water, far from having caused the pothole, was doing its best to destroy it.

The other pothole was just above the bridge on the track leading to Nevada Falls. The river here was confined to a narrow rock channel with a smooth rock surface on either side. On the right-hand edge of the channel was a partly submerged pothole, slightly bigger than the first, cone-shaped, with pebbles on the bottom, and the lower edge worn away exactly as at Vernal Falls. A child of six stood in the hole up to her thighs in water.

In each case the water was running over the holes; but there was no indication of a circular or swirling action inside, nor was there any movement of the pebbles.

Reference

¹Cox, Douglas E. 1975. On the interpretation of potholes, *Creation Research Society Quarterly*, 12(1):25-31.

Yours,
G. W. Cox
9 Hornsey Avenue,
Launceston,
Tasmania,
Australia

Dr. Earl Hallonquist: Creationist Crusader

Many creationists, particularly those in the United States, are unaware of the tremendous personal contribution Dr. Earl Hallonquist, a Canadian scientist, has made to the creationist cause, both as a scientist and through his efforts to make available to the public the scientific case for creation. Dr. Hallonquist, until his retirement, was director of Wood Products Research for MacMillan Bloedel Ltd. of Vancouver, a position he held, along with other administrative positions, for 22 years. He received his Ph.D. with a major in Industrial and Cellular Chemistry from McGill University. Dr. Hallonquist and his wife, Grace, reside in New Westminster, a suburb of Vancouver, B.C.

Dr. Hallonquist has been for some years National Director of the Bible-Science Association of Canada and First Vice-president of the Bible-Science Association of Caldwell, Idaho. He is the author of several booklets and pamphlets containing scientific evidence against evolution, and has directed several creationist lecture tours across Canada and the United States.

It has been my privilege to co-labor with Dr. Hallonquist in an eleven-day cross-Canada lecture tour, as well as to participate in several lectures and seminars in Canada planned and directed by Dr. Hallonquist. In addition to similar activities of this kind, Dr. Hallonquist has participated in numerous tours throughout Canada and the United States to show the film, *Footprints in Stone*. These activities have often been made at considerable personal financial sacrifice to Dr. Hallonquist.

This talented, modest, choice servant of the Lord has recently been forced into inactivity while recovering from a stroke. We trust that the Lord will restore him sufficiently that he can once again resume his activities in behalf of scientific creationism.

Sincerely,
Duane T. Gish,
Associate Director
Inst. for Creation Research
San Diego, California 92116

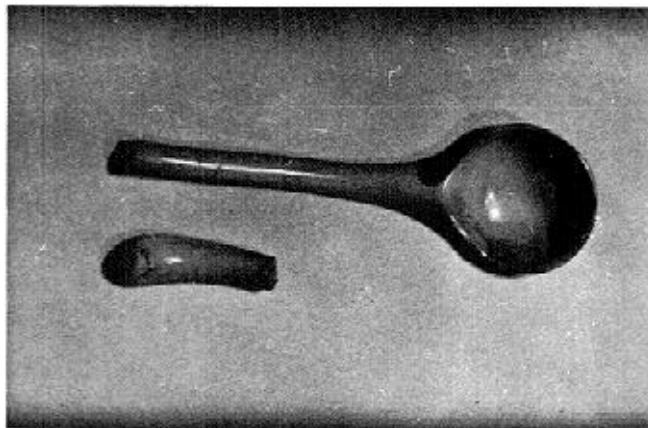


Figure 1. A spoon found in Pennsylvania soft coal. Approximate length, 6 inches.

A Curiosity From Coal

I recently published a photograph of a stone carving at the Copan Mayan Indian ruins in Honduras which appeared to represent gears with spoked wheels and housing.^{1,2} In response, Mrs. Myrna R. Burdick³ wrote to me and mentioned a spoon she and her mother found in soft Pennsylvania coal in 1937. Through further correspondence I obtained a photograph (Figure 1) and details of the find.

The spoon was found in a mass of off-brown colored ash which remained after burning a large piece of coal. The ashes, when disturbed, fell apart, revealing the spoon.

It was intact when first found, but was broken later, perhaps while being examined at the Smithsonian Institute. The Institute personnel, of course, rejected the idea that such an item could be found in coal.

This might well be a relic from the antediluvian world.

References

¹Grit, 22 June 1975, page 4.

²See Figure 1 in the "Panorama of Science" in this issue of the *Quarterly*.

³Address: 1534 Kearney St., Casper, Wyoming 82601.

Sincerely,
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An *abstract* of from 100 to 200 words should be included with the manuscript. The abstract should contain a summary of the entire article, briefly giving representative coverage to such possible areas as data presented, concepts discussed, conclusions established, etc. Letters, book reviews, or articles less than one journal page need not contain an abstract.

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Two or more consecutively numbered references in the body of the article to the same source can be handled in the reference list by use of *Ibid.*, with new pages given. Later references to that same work (not in direct sequence) should be designated by Author, *Op. cit.*, and new pages cited.

By this system bibliographic material is not injected into the text, but is localized in the reference list at the end. A complete citation for interested readers is also guaranteed. Several typical forms follow by way of example:

References

¹Smith, G. M. 1950. The fresh-water algae of the United States. Second Edition. McGraw-Hill Book Co. Inc., N. Y., p. 434.

²*Ibid.*, p. 436.

³*Ibid.*, p. 307.

⁴Ris, H., and R. N. Singh 1961. Electron microscope studies on blue-green algae, *Journal of Biophysical and Biochemical Cytology*, 9:63-80.

⁵Smith, G. M. *Op. cit.*, p. 482.

⁶Corner, E. J. H. 1961. Evolution (in) Contemporary botanical thought. Edited by Anna M. MacLeod and L. S. Copley. Quadrangle Books, Chicago, Ill. p. 417.

⁷A "clone" of plants is a group of adult plants originally derived from one parent plant by means of vegetative reproduction.

⁸Ris, H., and R. N. Singh *Op. cit.*, p. 69.

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