

Creation Research Society Quarterly

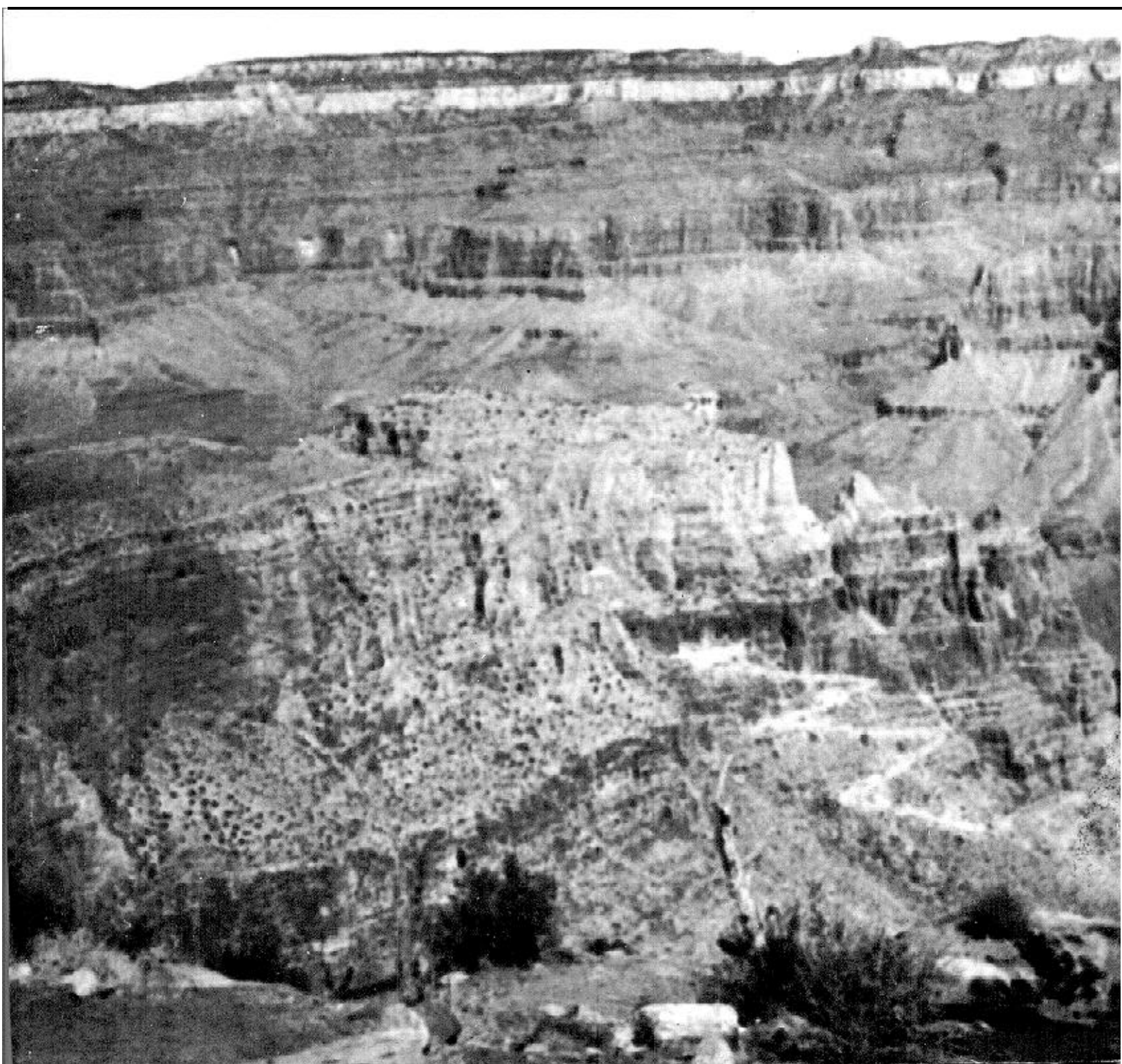
Haec credimus:

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

VOLUME 22

JUNE 1985

NUMBER 1



CREATION RESEARCH SOCIETY QUARTERLY

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VOLUME 22

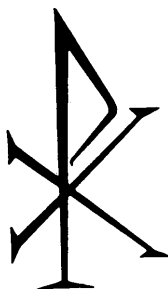
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NUMBER 1

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QUOTE

When Origen and Plotinus, who tried a philosophical refutation of Gnosticism had themselves partly succumbed to it, Augustine succeeded brilliantly, helped above all by the notion of *creatio ex nihilo*, creation out of nothingness. Things created out of nothing lack the unlimited existence of God; they are, characteristically, "mutable." *Mutabilitas*, in this context, included the meaning of turning bad, a tendency to nothingness. Hence their need to "preserve such being as they have received."

Niemeyer, Gerhart. 1984. Augustine's political philosophy? in *The Christian vision: man in society*, Lynne Morris, editor. The Hillsdale College Press, Hillsdale, MI. p. 58.

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COVER ILLUSTRATION

A portion of the Grand Canyon as viewed along the South Kaibab Trail. The Canyon is a natural laboratory for Creationists. — Photo by Emmett L. Williams

APPLICATION FORM FOR THE CREATION RESEARCH SOCIETY

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DEDICATION TO RICHARD G. KORTHALS

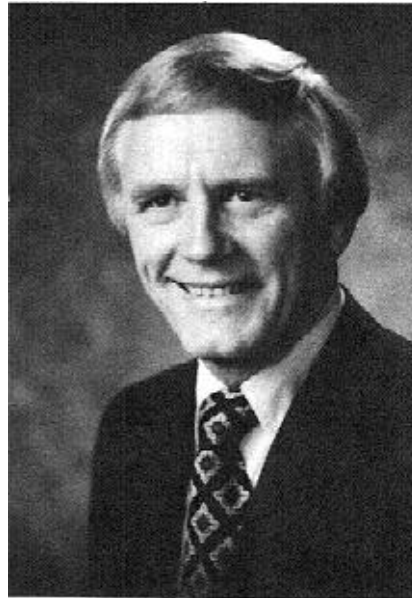
Many men will spend a lifetime in one career, retiring honorably after a long period of service. However, it is not given to many men to retire from one career, then embark on another, retire from that, and then retire from still another. However, Prof. (Lt. Col. ret.) Richard G. Korthals, our hard working treasurer of the Creation Research Society is just such a person.

Born in 1922 in Lacrosse, Wisconsin, Dick attended Central High School in Lacrosse, graduating in 1940. He then enlisted in the United States Air Force as a pilot, ending his career as pilot in the rank of Captain after 5½ years. He then attended Lacrosse Teachers College, the University of Minnesota and the University of Denver. Returning to the Air Force, he enrolled in the Air Force Institute of Technology at Wright Patterson AFB in Ohio and received a B.S. in Aeronautical Engineering from this school in 1954. In 1961 he received his M.S. in Astronautical Engineering from the same school.

Dick Korthals' professional career began when he served as the Commanding Officer of the U.S. Air Force Base at Green Bay, Wisconsin from 1950-52. This was followed by serving as Project Engineer on the BOMARC missile system with the Air Defense Command at Colorado Springs, Colorado from 1954-59. He then served on the faculty at the Air Force Academy in Colorado Springs from 1961 to 1965. During this time he rose from Instructor to Professor and Acting Head of Aeronautics. At the end of that time, he retired from the Air Force.

Dick Korthals began another career by joining the faculty of Concordia College, Ann Arbor, Michigan, in 1965. Here he served as Assistant Professor of Physics. After promotion to Associate Professor, he served until June 1972. He changed careers again by embarking on two years of service in the field for the Michigan District of the Lutheran Church-Missouri Synod. Dick returned to college service, when in 1974, he accepted the position of Dean of Students at Concordia College, River Forest, Illinois. Then, finally in 1981, he once more retired from an academic position. However, Dick is not going into idleness, since he plans to devote his remaining active years to writing.

In 1945, Captain Korthals married Irene Limmer who was serving as a nurse, also in the Pacific war



zone. Their union has been blessed with three daughters and a son.

For several decades, Dick Korthals has also served the cause of Creation. During his years at the Air Force Academy, he delivered a number of lectures on the subject of Creation and evolution in various parts of the country. He also has written a chapter, first published in CRSQ 2(2):6-14, in *Creation, Evolution and God's Word*, edited by Paul Zimmerman. In 1965, he was elected to the board of directors of CRS and in 1968 he was elected treasurer. In that position he has devoted a good deal of time and energy to his task. Now he is also laying down that burden in 1985. Those of us on the CRS board, who have had the privilege of working with Dick value him for his quiet advice and good sense with which he has always served the CRS. In retrospect, at this time we can only say of Dick Korthals, "Well done, thou good and faithful servant."

Wilbert H. Rusch, Sr.

QUOTE

If Transcendentalism rescued the Deism of Jefferson and his compatriots of 1776 from obscurity, it also gave to it a new form and a new direction. Both systems commonly denied many evangelical doctrines, but there were also very great differences between them which made it virtually impossible for the Unitarianism of the earlier era to retain its original form and outlook. The rationalism of Lord Herbert of Cherbury, and the empiricism of Locke, gave way to the intuitionism of the romantic era; the vast distances which the Newtonian world view placed between God and his creation were replaced by the warm glow of a pantheistic conception of the universe: the universe in its totality is God. . . .

Singer, G. Gregg. 1981. *A theological interpretation of American history* (revised ed.). Presbyterian and Reformed Publishing Co., Phillipsburg, NJ, p. 49.

EDITORIAL COMMENTS

Harold Armstrong, a CRS Board Member from 1967 to the present and editor of the Quarterly from 1974 to 1984 suffered a massive heart attack on February 8 and died on February 14. Harold was one of the hardest working men for Creation I knew. Always a gentleman with a keen wit, he will be missed by all of us. More will be said about him in a later Quarterly.

This issue is dedicated to Richard Korthals who for many years served as treasurer of the Society. As the Society grew, so did the treasurer's job. Dick performed his tasks in a business-like and kind manner helping the Board with his sensible advice.

Dr. Eugene F. Chaffin continues his discussion of the Oklo natural reactor from past Quarterlies. Several young earth implications are suggested concerning this interesting phenomenon. George Howe and Dennis Englin offer some Creationist interpretations on eclipses in their invited article.

John Moore continues his educational column centering on naturalistic origin of life speculations. This very weak link in modern thinking is carefully explored in the usual thorough Moore style. In conjunction with this article I have selected several past writings on chemical evolution that have appeared in the Quarterly and listed them below.

1. Zimmerman, Paul A. 1964. The spontaneous generation of life *CRSQ* 1(1):13-17.
2. Gish, Duane T. 1964. Critique of biochemical evolution *CRSQ* 1(2):10-12.
3. Williams, Emmett L. 1967. The evolution of complex organic compounds from simpler chemical compounds: is it thermodynamically and kinetically possible? *CRSQ* 4:30-35.
4. Frair, Wayne F. 1968. Life in a test tube *CRSQ* 5:34-41.
5. Gish, Duane T. 1970. The nature of speculations concerning the origin of life *CRSQ* 7:42-45, 83.
6. Parker, Gary E. 1970. The origin of life on Earth, *CRSQ* 7:97-103.
7. Trop, M. and A. Shaki. 1974. Is molecular evolution of proteins possible? *CRSQ* 11:28-29.
8. Helmick, Larry S. 1975. Origin and maintenance of optical activity *CRSQ* 12:156-64.
9. Sharp, Douglas B. 1977. Interdependence in macromolecule synthesis: evidence for design *CRSQ* 14:54-61.
10. Trop, M. 1979. Polyamino acid-the missing link *CRSQ* 15:205-9.

The 21 volumes of *CRSQ* contain a rich heritage of Creationist scientific thought. It is sad that more Creationist authors do not reference or even know of the existence of this material. Several libraries in Christian colleges have been designated as repositories for the Quarterly. These libraries will send copies of the Quarterly to a local library in your area on inter-library loan. The repositories are Bob Jones University Library, Greenville, SC, Christian Heritage College Library, El Cajon, CA, Concordia College Library, Ann Arbor, MI, Los Angeles Baptist College Library, Newhall, CA, and The King's College Library, Briarcliff Manor, NY.

The articles by Vaninger and Seaver deal with Biblical chronology. Vaninger approaches his subject archaeologically whereas Seaver offers some statistical models on post-Flood lifespans. Norbert Smith continues his solid research work for the Society. The Director of the Grasslands Experiment Station discusses the mechanism of natural selection and its lack of effect on flatworms.

Gerald Heyes points out the little-understood dangers of extrapolation of scientific data. Using engineering examples, he illustrates the foolishness of much of naturalistic extrapolation into the past.

Emmett L. Williams, Editor

INSTRUCTIONS TO AUTHORS

1. Manuscripts shall be typed and double spaced.
2. An original plus two copies shall be submitted to the editor of the Quarterly.
3. All submitted articles will be reviewed by at least two technical referees. The editor may or may not follow the advice of these advisors. Also, the prospective author may defend his position against referee opinion.
4. The editor reserves the right to improve the style of the submitted article. If the revisions of the editor and referees are extensive, the changes will be sent to the author. If the changes are not suitable to the prospective author, he may withdraw his request for publication.
5. Due to the expense involved, manuscripts will not be returned to authors.
6. All references (bibliography) must be presented in the style shown in the Quarterly. If a prospective author is not familiar with the CRS format, the editor will furnish an example reference page.
7. All figures and drawings must be prepared professionally. No sloppy hand drawings or freehand lettering will be accepted. The editor reserves the right to approve submitted figures. Unacceptable illustrations will result in rejection of the manuscript for publication.
8. Any manuscript containing more than 25 pages is discouraged. If a topic cannot be covered to the author's satisfaction in this length of pages, the author *must* divide his material into separate papers that can be serialized in the Quarterly.
9. The Quarterly is a journal of original writings. Only under unusual circumstances will I reprint previously published manuscripts. Never submit an article to two or three journals, including ours, hoping all of them will publish your work. I consider this practice unethical. When submitting an article, please state if the material has been published previously or has been submitted to other journals.

INVITED PAPER

AN ANNULAR SOLAR ECLIPSE

DENNIS ENGLIN* AND GEORGE F. HOWE**

Received 16 July 1984; Revised 25 October 1984

Abstract

The annular eclipse of May 30, 1984 provided an opportunity to study the unusual phenomenon.

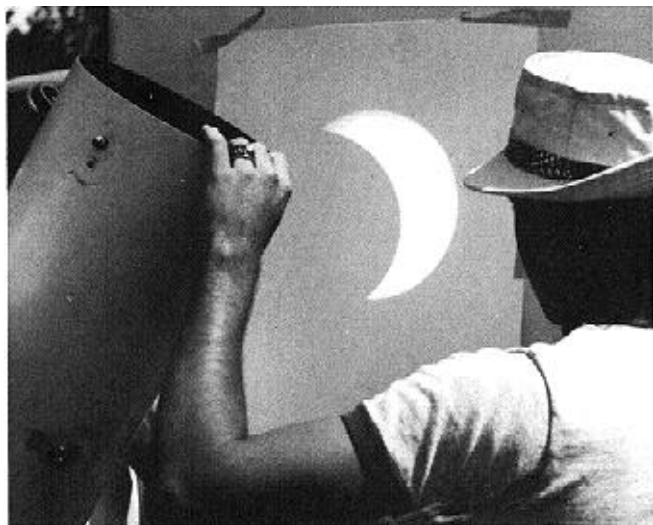


Figure 1. Members of the astronomy club from a nearby high school set up a screen and cardboard for viewing the reflected image of the eclipse, shown here at about 40 minutes before the actual event. Photo by G. Howe.

Observing an annular eclipse of the sun is a rare and striking experience. On May 30, 1984, however, the opportunity to do just such a thing presented itself to people along a certain narrow band across Louisiana, Mississippi, and some other southeastern states. The path of this particular eclipse was scheduled to move right over the town of Wiggins, Mississippi.

A local roadside rest park along the main highway at Wiggins was anything but restful on that day. People had come early from as far as California and Texas to set up telescopes and view the amazing event. Some of those present had reflecting devices whereby the image from their telescopes could be projected onto cardboard (Figure 1). One member of a Houston, Texas astronomy club was graciously passing out small pieces of mylar with which to view the eclipse without harm.

Long before the eclipse was at its peak, the image of the moon began blocking out a sector of the sun (Figure 2). During this time the pine-studded landscape nearby was becoming progressively darker. At one point, a few minutes before the peak of the annular eclipse, automatic switches turned on the lights in the buildings and along the access road. One viewer called our attention to the fact that nearby birds were no longer singing and had evidently begun to roost.

At 11:08 a.m., when the eclipse at this locality was at its maximum, a gentleman allowed others to take

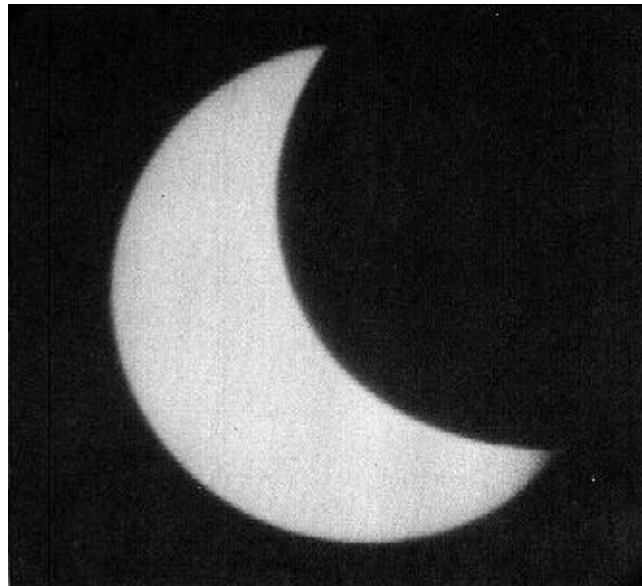


Figure 2. Ralph Phillips of Houston, Texas, permitted others to view and photograph eclipse through his telescope which he said was operating at about 30 power. This picture was taken through his equipment about 40 minutes before the maximum blackout and one can observe the image of the moon encroaching on the sun. Note sunspot also. Photo by G. Howe.

pictures of the reflected image using his equipment. At the instant of maximum eclipse (see Figure 3), he spoke out in clear and audible voice to the large crowd clustered at his telescope, "Now, who can say that there isn't any God?" Surely this was a beautiful view and as such, a tribute to the Creator. But is there another way in which a Creationist can see evidence for design in such an event as this?

A solar eclipse occurs whenever the Moon comes between the Sun and the Earth. This can only occur during the eclipse season because the orbit of the Earth Moon system is tilted at 5.2° to the plane of the Earth's orbit around the Sun. See Figure 4.



**George F. Howe, Ph.D., is Professor and Chairman, Division of Natural Sciences and Mathematics, Los Angeles Baptist College and Director, Grand Canyon Experiment Station, Creation Research Society.

*Dennis Englin, Ed.D., is Associate Professor of Biology at Los Angeles Baptist College and he teaches an astronomy course.

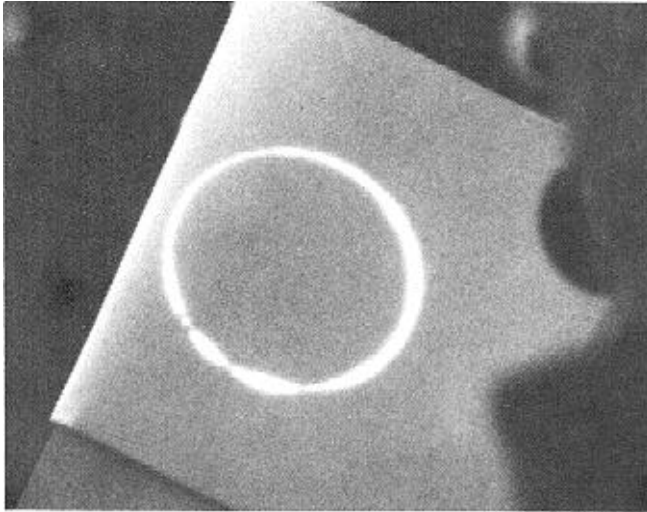


Figure 3. Another astronomer permitted photographs of the reflected image at the instant of maximum eclipse, 11:08 a.m., Central Daylight Time, May 30, 1984. The halo of the sun is seen here as the moon shields the sun itself. The little dark bands seen at about 6, 7, and 8 o'clock in this view are Bailey's Beads. Photo by G. Howe

At points A and B the Moon crosses the plane of the Earth's orbit and could potentially come between the Sun and the Earth during a New Moon.

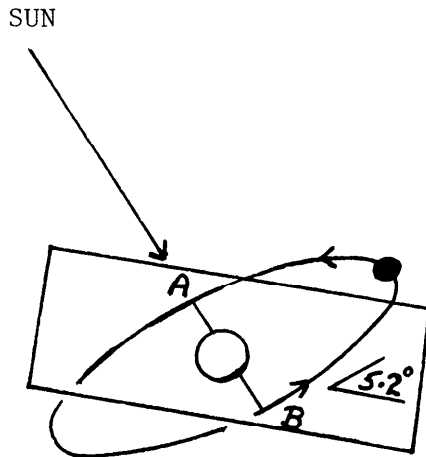


Figure 4. The plane of the Earth-Moon system revolving about a common center of mass is tilted at about 5.2° to the plane of revolution of the Earth about the Sun.

Figure 5 shows that during certain times of the year solar and lunar eclipses are more likely to occur. An eclipse season occurs about every six months. A lunar eclipse can occur only at a Full Moon and a solar eclipse can only occur at a New Moon. At least two solar eclipses occur every year, and never more than five. A cyclic pattern of solar and lunar eclipses repeats itself every 18 years 11 days and 8 hours. This is called the Saros cycle.¹

In Figure 6, the Moon casts a partial shadow (penumbra) and a total shadow (umbra) upon the Earth. Anyone outside of the path of totality will observe a partial eclipse (perhaps only a half or a third of the

Sun will be covered). Professional and amateur astronomers travel great distances to view the total eclipse in the path of totality.

A "remarkable coincidence" occurs during a total eclipse. The observed size or apparent size (also called the angular size) of the Moon is the same as that of the Sun.

On page 17 of the popular text, *Discovering Astronomy*, by Jeffreys and Robbins, the authors state that:

This remarkable coincidence between the angular sizes of the Sun and Moon means that when the Moon happens to pass directly between the Earth and Sun, a total eclipse of the Sun can take place. At such a time, the bright disc of the Sun will be just covered by the Moon, and the faint tenuous outer atmosphere of the Sun, called the *corona*, can be seen. The corona is only one-millionth as bright as the Sun's disc and therefore is usually lost in the glare of the Sun. Only at the time of a total eclipse can it be seen. For this reason, astronomers often go on long and arduous eclipse expeditions to out-of-the-way parts of the globe to study the corona.

The Sun and Moon both have an angular size of 0.5° during a total eclipse. This is a combination of their distances from the Earth and their respective radii. This is not an accident or a combination of cause and effect phenomena that can be explained by complementary tidal effects or similar physical interactions. This is, rather, a beautiful example of the design of a gracious Creator.

The eclipse observed on May 30, 1984, was an annular eclipse. Figure 7 shows the difference between an annular and a total eclipse. In the annular eclipse, the umbra of the Moon comes to a focus before it reaches the Earth.

Because of the intensity of light that is still allowed to pass around the Moon, the corona and daytime stars around the celestial sphere region of the Sun are not appreciably visible during an annular eclipse. Nevertheless, it was a spectacular event showing Bailey's Beads (see Figure 4) caused by the higher mountain ranges and craters of the Moon that project above its surface.

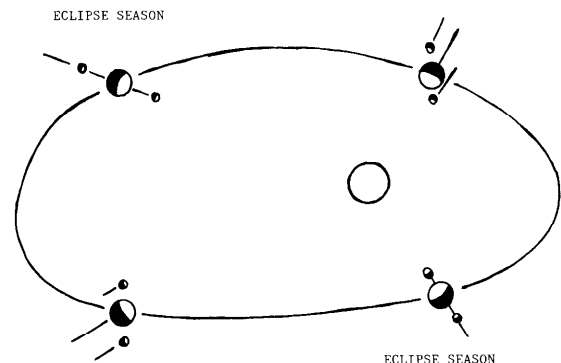


Figure 5. The eclipse seasons only occur at about six month intervals because of the alignment of the Sun, Moon and Earth.

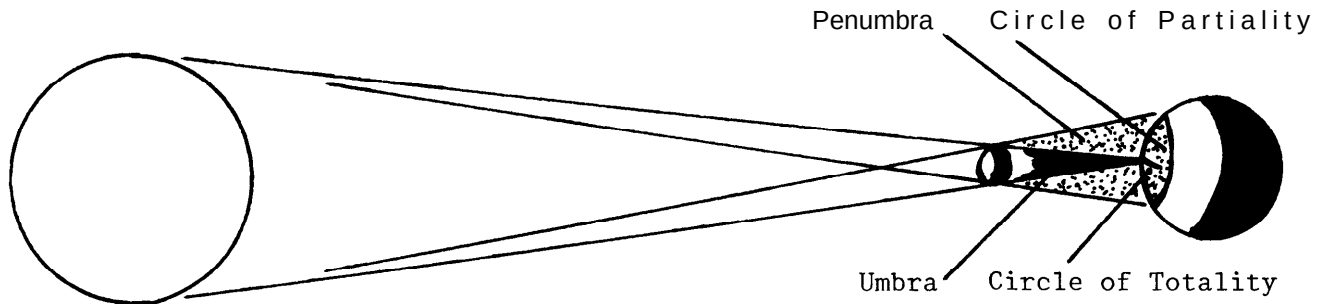


Figure 6. The total eclipse results when the umbra of the Moon falls upon the Earth.

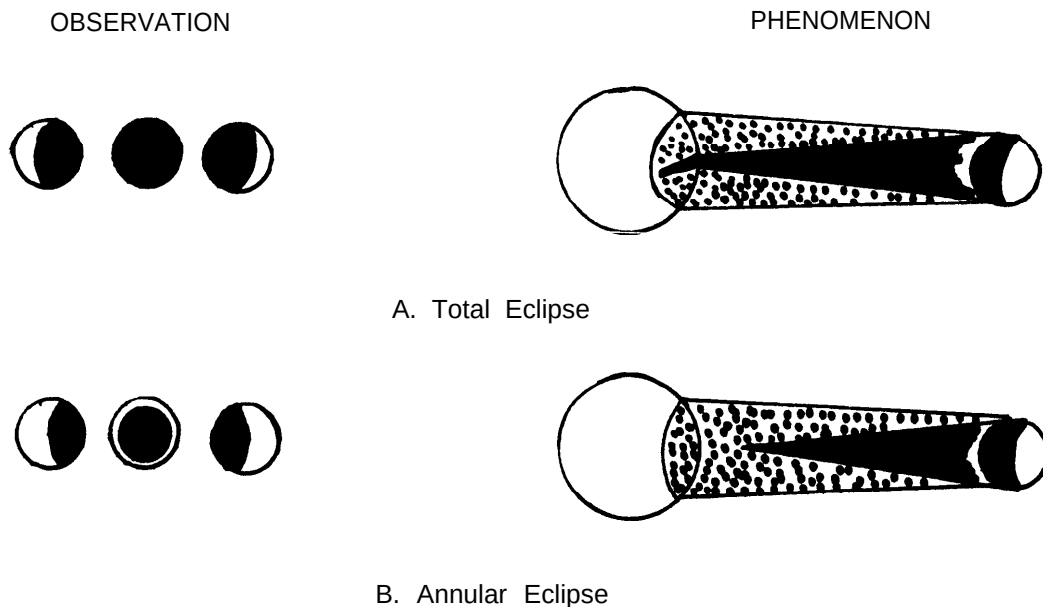


Figure 7. A total eclipse occurs when the umbra falls upon the Earth. An annular eclipse occurs when the umbra focuses to a point before it reaches the Earth resulting in a "ringed" Sun rather than a "totaled" Sun.

Another total solar eclipse occurred in New Guinea on November 22, 1984 and lasted for 2.0 minutes of the total phases. Later, on March 18 of 1988 a total eclipse will occur in Indonesia and the Philippines that will have a total phase of 3.8 minutes.

The eclipse is one of God's fingerprints in the universe to remind us of who He is—the great I AM.

References

1. Duffett-Smith, Peter. 1981. Practical astronomy with your calculator, second edition. Cambridge University Press, New York, pp. 154 and 155.
2. Jeffreys, William H. and R. Robert Robbins. 1981. Discovering astronomy. John Wiley, New York, p. 17.

QUOTE

What specially attracts liberal arts students to naturalism is its emergence in the form of humanism, a philosophic system that adds to the naturalistic agenda a program of social ethics. Humanism emphasizes not only man's duties to his fellow man and to nature, but also certain expectations from his fellow man and from nature. Human beings ought to champion social justice, promote human rights and racial equality and be concerned, we are told, about poverty; they ought, moreover, to preserve natural resources and avoid polluting the cosmos. Humanism emphasizes also certain human expectations from nature, which is assumed somehow to uphold personal worth and security. Although most secularists abandon any expectation of individual immortality, some have assigned their bodies to deep freeze at death in the hope that science in the next century will be able to retrieve them for endless life on earth.

Henry, Carl F. H. 1984. The crisis of modern learning in *The Christian vision: man in society*. Lynne Morris, editor. The Hillsdale College Press, Hillsdale, MI, p. 7.

THE OKLO NATURAL URANIUM REACTOR: EVIDENCE FOR A YOUNG EARTH

EUGENE F. CHAFFIN*

Received 1 August 1984; Revised 16 October 1984

Abstract

A fossil nuclear reactor is believed to have been discovered at Oklo in Gabon, Africa. The author has previously considered the scientific data from the viewpoint of a creationist. In this work further studies of concentrations of uranium and of reactor by-products are presented and discussed as they relate to determining the age of the reactor. The data still seem to be consistent with the young earth view.

Introduction

In an earlier article,¹ hereafter referred to as A, data from the Oklo natural fission reactor in Gabon, Africa were examined to demonstrate their consistency with the young earth model of creationists. To review briefly the history involved, it was discovered by some French scientists in 1972 that a body of uranium ore at Oklo in Gabon contained several zones which had once been natural reactors. Subsequent researchers concluded that the self-sustaining nuclear reactions must have occurred about 1.9 billion years ago.^{2,3} In A, the author considered various aspects of the available data, including the relationship between neodymium (Nd) isotope concentrations and uranium (U) fuel depletion as well as the effective multiplication factor (k_{eff}) for the neutron population. It was concluded that the data were consistent with an interpretation in terms of an earth as young as 6000 years or so. One of the crucial arguments involved the diffusion of the isotopes of neodymium. It was crucial since a self-consistent model of the Oklo phenomena must match the production rates of fission products and the duration and age of the reactors with the observed amounts of fission products which have survived at Oklo. In this article the mechanism of neodymium diffusion will be discussed, the evidence provided by some other fission products will be considered, a more detailed consideration of the fast fission factor involved in the calculation of the effective multiplication factor will be given, and a possible alternative model involving variable decay constants will be introduced. This alternative model also seems to be able to explain the data from Oklo in terms of a young earth, and the author has not come to any definite conclusions as to which model is better.

Neodymium Isotope Concentration and Fuel Depletion

In A, data were considered which gave the concentrations of the various stable isotopes of the rare earth element neodymium (Nd) as a function of position through the reactor zones. Neodymium has seven stable isotopes: Nd-142, Nd-143, Nd-144, Nd-145, Nd-146, Nd-148, and Nd-150; and only one of them, Nd-142, is not formed as a result of fission.⁴⁻⁶ Cowan et al.⁷ used the Nd-142 concentrations as a means of determining the amount of the neodymium already present at the various positions in the reactor zone, before the Oklo fission reactions took place (the "primordial" neody-

mium). In A, it was pointed out that Cowan et al.'s arguments for a 1.9 billion year age for the reactor were invalidated, if the Nd-142 isotope concentration had changed due to Nd-142 diffusion. A graph was shown of Nd-142 concentration versus position, which gave strong evidence for Nd-142 diffusion, and hence showed that other age estimates of the Oklo ore may be supported by the data, including ages as small as 6000 years or so. The young earth interpretation is only possible, however, within this framework of assumptions, if Nd-142 diffuses at a faster rate than the other neodymium isotopes. In this article possible mechanisms of diffusion will be discussed, and evidence presented which shows that Nd-142 should definitely diffuse at a different rate than the other Nd isotopes.

Neodymium is normally 27.2 percent Nd-142, while the percentages of Nd-143, Nd-144, Nd-145, Nd-146, Nd-148, and Nd-150 are 12.2, 23.9, 8.3, 17.2, 5.7, and 5.6, respectively.⁸ These are the percentages that have been found in samples containing neodymium and apparently are the same no matter where the sample was collected, although a slight but notable variation has been discovered in the Allende meteorite.^{9,10} Cowan et al. used these percentages, plus the measured concentrations of Nd-142, to calculate the presumed amounts of primordial neodymium isotopes present at each position in the reactor zone. These "primordial amounts" were then subtracted from the measured amounts of the various neodymium isotopes at the same positions, to obtain the presumed amounts formed as a result of fission. Cowan et al. compared the results of these calculations to the amounts of fuel depletion, and concluded that the two results did not compare favorably unless the fission reactions occurred about 1.9 billion years ago. U-235 and U-238 have half lives of 704 million and 4.47 billion years,¹¹ and hence 1.9 billion years ago the percentage of uranium that is U-235 would have been larger. See Figures 1 and 2. This point, according to Cowan et al.'s assumptions, would mean a larger amount of fission would be required to explain present U-235 concentrations if the reactions occurred 1.9 billion years ago as opposed to more recently. The larger amount of fission of U-235 is consistent with the large amount of neodymium which has to be interpreted as fission product neodymium in Cowan et al.'s model.

In order to upset the above arguments, we need only to note the Nd-142 had to diffuse out at a different rate than the other neodymium isotopes. If the neodymium isotopes all diffuse out at the same rate, then

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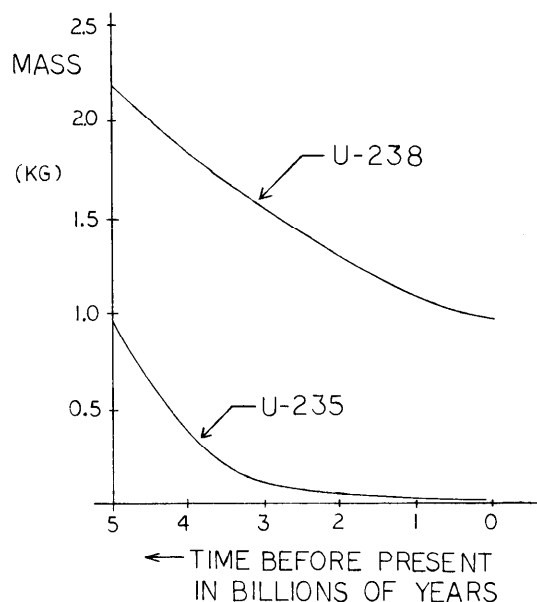


Figure 1. The amounts of U-235 and U-238 that would have been present, at various times in the past, if one kilogram of natural uranium survives at the present epoch, according to extrapolation of the law of radioactive decay. The "conventional" model of the Oklo reactors relies on the increased proportion of the uranium that would have been U-235 a couple of billion years ago in order to explain the Oklo data.

the Nd-142 concentration would give a true measure of the amount of primordial Nd *still present*. The amount of the fission product isotopes Nd-143, Nd-144, etc. still present at a location could be calculated. This amount of presumed fission product neodymium still present is too large to be explained by the young earth model by a factor of about 4.5 to 6.5, according to simple calculations.

However, evidence can be found, and will now be presented, which shows that Nd-142 could have diffused at a larger rate than the other neodymium isotopes. Nd-142 is special compared to the other Nd isotopes in that it has a closed neutron shell nucleus. The neutron number $N = 142 - 60 = 82$, one of the so-called "magic numbers" in nuclear shell theory.¹² Interestingly, this is related to the diffusion probability through the recoil caused by neutron scattering. Through the recoil probability involved in neutron scattering, if a neutron of sufficient kinetic energy (greater than about 0.7 keV) collides with a neodymium nucleus and scatters, the nucleus will recoil with enough kinetic energy to leave a lattice site or to break a molecular bond.¹³

For elastic scattering, the maximum change in neutron kinetic energy is given by¹⁴

$$\Delta KE = KE_i \frac{4A}{(A+1)^2} \quad (1)$$

where A is the mass number of the target nucleus and KE_i is the initial neutron kinetic energy. This kinetic energy lost by the neutron will be gained by the recoiling nucleus during the scattering. Thus if the bond energy is about 20 eV, and A is of the order of 142 to 150, then the initial neutron kinetic energy must be at least about 0.7 keV in order for the nuclear recoil to

be enough to knock the nucleus free. If the bond energy is 25 eV (or 5 eV), the required neutron kinetic energy changes, but remains the same order of magnitude as 0.7 keV.

Now the neutron flux per unit energy interval is inversely proportional to the kinetic energy. Hence, although fission neutrons are born at nearly 2.0 MeV of kinetic energy, most of the neutrons which cause neodymium nuclei to be knocked free will have kinetic energies just above 0.7 keV. The values of the scattering cross sections from 0.7 keV to about 30 keV are given in reference 15. Hence, a measure of the relative probability of the various neodymium isotopes being knocked free is given approximately by the integral of this cross section divided by the kinetic energy, from 0.7 keV to 30 keV. A complication is the fact that Nd-143 and Nd-145 have large neutron capture probabilities. Thus comparisons of the present day concentrations with the cross section data need to be done by combining the results for Nd-143 with Nd-144 and the results for Nd-145 with Nd-146. Only these combinations can be considered in a way that is nearly independent of neutron fluence and hence model independent (Neutron fluence is the integral of neutron flux over time). The combination must be performed by using the isotopic percent abundances as well as an estimate of how these will change with time in the reactor. The results, shown in Table I, indicate that Nd-142 should have a smaller probability of being knocked free than any of the other isotopes or isotopic combinations. This might at first seem to imply that Nd-142 should diffuse *less* than the other isotopes, which would be the opposite conclusion to which the creation model has led us. However, a neodymium ion which has been knocked free from its position does not necessarily diffuse out of the reactor zone at a faster rate than the neodymium atoms that have not

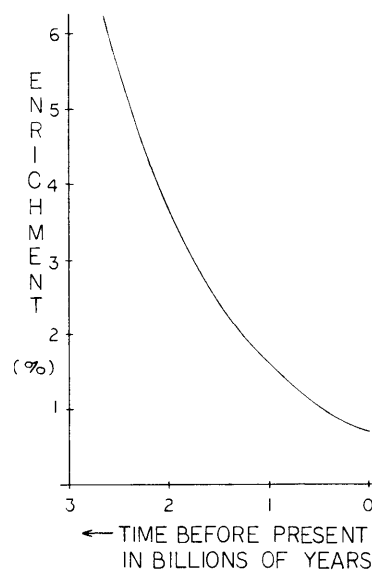


Figure 2. The enrichment, that is, the percentage of the uranium that is U-235, versus time, zero representing the present epoch. The curve is obtained by extrapolating the law of radioactive decay into the past, using the results of Figure 1. About 1.9 billion years ago, the enrichment would have been just over 3 percent. Presently, natural uranium normally has an enrichment of 0.72 percent.

been "knocked free." This also depends on the probable types of chemical recombination in the minerals in the reactor zone, and the diffusion rates (say, by water transport) of these "types."

Now the minerals and rock material found in the Oklo zones included uranite, quartzite, amorphous carbon, pelite, and others.¹⁶ Pelite is a term meaning "mudstone," indicating that clay minerals were present. The 2P'traverse mentioned in reference 3 crosses a 3 cm thick clay filled fault near sample 1182. This fault may have served as a conduit for water percolation. The ability of the diverse array of mineral phases at Oklo to retain neodymium thus seems to be a complex problem. It may be said, however, that mineral phases undoubtedly exist which are better able to retain neodymium than others. By "retain" neodymium we mean to keep it localized in the mineral, resisting any tendency for it to dissolve in any water percolating through the ore. The neodymium could nevertheless be transferred from one mineral to another by recoil following neutron scattering. Thus, when the Oklo chain reactions started, the neutrons produced may have served to knock Nd-143, Nd-144, etc. out of position more often than Nd-142, thus providing a mechanism by which Nd-142 would be left predominantly in a different mineral phase than the other neodymium isotopes. We hypothesize that the mineral phase in which Nd-142 was predominantly found was then more susceptible to water action. Diffusion over long distances then took place by water action, not by recoil following collisions with neutrons.

As an oversimplified example of a set of mineral phases capable of supporting the above diffusion mechanism, consider a solid solution of Nd³⁺ ions in mixed crystals of UO₂, UO₃, Ce₂O₃, and CeO₂. By a "solid solution" it is meant that the neodymium ions occasionally replace the uranium and cerium ions in the lattice structure, or are present at interstitial sites. Now the UO₃ and CeO₂ are more water soluble in basic solutions than UO₂ and Ce₂O₃, as explained in references 17 and 18. Hence, under the right conditions the neodymium present in the UO₃ and CeO₂ phases would be more susceptible to water transport than that in the UO₂ and Ce₂O₃. Therefore the nuclear recoil caused by neutron scattering could be responsible for a higher isotopic percentage of Nd-142 being present in one phase than in the other, and hence in Nd-142 diffusing more than the other neodymium isotopes.

In this connection, it might be mentioned that a similar recoil mechanism was resorted to by Lugmair et al.,¹⁹ and further studied by Clayton²⁰ and Kappeler et al.²¹ to explain the anomalous Nd-143 concentrations found in the acid insoluble residues from the Allende meteorite. In this case, the recoil was that following the alpha decay of Sm-147.

Nd-142 has a lesser "knockout" probability than any of the other neodymium isotopes or isotopic combinations (see Table I). If it had an intermediate value, the model presently being considered would be implausible. But the lesser value for Nd-142 lends credence to our model, which can be strengthened by the following numerical arguments (see column 3 of Table I).

Table I. A Measure of the "Knockout" Probability for ND Isotopes or Isotopic Combinations and Corresponding Fractions which Diffused Outward.

Isotope or Isotopic Combination	$\int_{.7 \text{ keV}}^{30 \text{ keV}} \sigma_5(E) \frac{dE}{E}$ (barns)	Fraction Which Diffused Out
Nd - 142	17.0	$r' = 0.67$
Nd - 150	20.4	$.453 < r < .459$
Nd - 148	29.7	$.15 < r < .16$
Nd - 145 & Nd - 146	28.8	$.19 < r < .20$
Nd - 143 & Nd - 144	39.6	$.11 < r < .12$

We consider the total concentrations of the isotopic combinations Nd-143 plus Nd-144, Nd-145 plus Nd-146, Nd-148 alone, and Nd-150 alone for each position in the reactor zone, and define for each the following:

- x = the initial concentration before any fission took place,
- r = the fraction of the initial concentration x that has been lost by diffusion,
- s = the fraction of the isotopic combination produced from fission that was subsequently lost by diffusion.

We also define:

- r' = the fraction of the original Nd-142 concentration that has been lost by diffusion.

Next, knowing the percent abundances of the different neodymium isotopes, we hypothesize that:

i) The initial Nd-142 concentration may be found by multiplying the value of x by the appropriate ratio of percent abundances. For example, when x represents the isotopic combination Nd-143 plus Nd-144, then the initial Nd-142 concentration is:

$$\frac{27.1}{36.1} x \quad (2)$$

since the percent abundances of Nd-142, Nd-143, and Nd-144 are 27.1, 12.2, and 23.9 percent respectively, and $12.2 + 23.9 = 36.1$ percent.

ii) The final Nd-142 concentration may be found by multiplying the result of i) by $(1 - r)$. The quantity $1 - r$ would be of course the fraction of the original Nd-142 concentration that has *not* been lost by diffusion. For example, when x represents the isotopic combination Nd-143 plus Nd-144, then the final Nd-142 concentration is:

$$(1 - r') \frac{27.1}{36.1} x \quad (3)$$

These two hypotheses, plus the above definitions are enough to place bounds on the possible values of x, r, s, and r'. For example, the final concentration of Nd-143 plus Nd-144 must be:

$$(1 - r)x + (1 - s)(\gamma^{143} + \gamma^{144}) \frac{\sigma_f^{25}}{\sigma_a^{25}} (N_i^{25} - N_f^{25}). \quad (4)$$

Here γ^{143} and γ^{144} are the fission yield coefficients of Nd-143 and Nd-144 (see reference 22), σ_f^{25} and σ_a^{25} are the respective fission and absorption cross sections of U-235, and N_i^{25} , N_f^{25} are the initial and final U-235 concentrations.

By considering equations (3) and (4) simultaneously and using the data for sample point 1402/2 given by Cowan et al.,²³ it is easy to show that the fraction r' must be between 0.626 and 1.0 if s is indeed a fraction (between 0 and 1). Taking arbitrarily the sample value $r' = 2/3$, we then find the value of r (the fraction of the original concentration that has been lost by diffusion) to be as given in the third column of Table I. Since the fraction of Nd-142 lost by diffusion, r' is bigger than any of the allowed values of r , and furthermore there seems to be a correlation between columns 2 and 3 of Table I, these numerical studies show that the amount of diffusion that must have occurred for each isotopic combination was determined by the "knock-out" probability caused by neutron scatterings.

To conclude, numerical studies, summarized here, give strong evidence that Nd-142 diffused out of the reactor zones at Oklo at a rate faster than the other neodymium isotopes. This in turn enables the Oklo data involving neodymium and uranium concentrations to be explained in terms of a young-earth model.

If experimental determinations of the diffusion rates of neodymium could be done, it might be possible to rule out the conventional 1.9 billion year old view of the reactor. The experiment might involve placing samples of Oklo minerals inside a cavity in a reactor, while simultaneously subjecting the sample to a flow of water over its surface. Ion microprobe and other techniques, used before and after the reactor exposure, could then reveal the extent to which Nd-142 concentration changed as compared to other neodymium isotopes. Since the author is a theoretician, this is offered as a suggestion for those with expertise in this type of experiment.

It should be mentioned that ion microprobe studies, notably those of Havette,²⁴ give data on the change in concentration of various products with position in the grains of ore. Some have concluded on the basis of these data that the neodymium fission products essentially stay in place with the uranium.^{25,26} However, the loss of a finite fraction of the *primordial* neodymium is also consistent with these data. The ion microprobe data imply that s is near zero but make no claim about r and r' , where s , r , and r' are the quantities defined in this paper. In other words, we are claiming that the predominate primordial chemical species containing neodymium were apt to allow neodymium migration, whereas the forms of neodymium produced from fission were not as apt to migrate. Also, the smaller neutron scattering cross section of Nd-142 would mean that it would tend to remain in the primordial chemical combination, and hence not recombine with the less mobile chemical species. Hence Nd-142 would diffuse out at a faster rate.

As corroborative evidence, it might be mentioned that Cowan et al.²⁷ data for SC-23, a sample taken two meters from reactor zone one, has 27.35 percent Nd-142, whereas natural neodymium is supposed to be only 27.11 percent Nd-142. This is exactly what our model would predict. Also, Maeck et al.²⁸ state: "...

U and Nd data from the SC-36 core samples at the edge of the rich U lens are highly discordant and indicate fission product and/or U redistribution."

Consideration of Other Reactor By-products

Besides neodymium, other fission products such as rubidium, strontium, xenon, and samarium could be studied. The author will discuss some of the results involving these other fission products as well as the reactor by-product Pu-239.

Lancelot et al.²⁹ and Hageman et al.³⁰ studied Rb-85, Rb-87, Sr-86, Sr-87, and Sr-88. Rb-85, Rb-87 and Sr-88 are fission products while Sr-86 and Sr-87 are not. Also, none of these five isotopes has an appreciable neutron capture cross section. Rb-87 is radioactive with a half life of 5.2×10^{10} years, decaying into Sr-87. It should be possible to distinguish between the young earth and conventional models using data on these isotopes. However, the experiments show that only traces of fission product Rb-85, Rb-87, and Sr-88 are present, and it is concluded that they must have leached out. Less of these products would have been produced if the young earth model is correct, but in either model the amount that should have been present, if no leaching had occurred, is more than the actual traces detected. We can gauge the amount of primordial strontium and rubidium by calculating ratios of the measured concentrations and comparing with ratios based on the known percent abundances of the different isotopes and also the known fission yields. The result is that almost zero percent is due to fission, i.e., only traces are "detected." Hence we conclude that, since Rb and Sr are water soluble, the fission product Rb and Sr were produced in a form that was leached away by ground water, whereas the Rb and Sr that were "primordial" were present in mineral combinations that were not so water soluble. Hence primordial Rb and Sr remain but very little, if any, of the fission product Rb and Sr are present.

Thus the rubidium and strontium data are inadequate to decide between the young earth model and the conventional model.

Xe-135 and Sm-149 are important fission product poisons. They will be produced as a result of fission, and have large neutron capture cross sections. Thus, after a reactor has been operating long enough, their concentrations build up to a point where there will be many neutrons captured, and these neutrons will not be able to cause fission, hence the name "poisons." If the young earth model is correct, the Oklo reactor would only just be able to maintain a self sustaining reaction. The buildup of Xe-135 and Sm-149 might thus cause the reactor to shut down. However, Xe-135 is radioactive with a half life of 9.2 hours, and it decays into an isotope which does not have an appreciable neutron capture probability. Hence, even if Xe-135 poisoning were a problem, the Oklo reactor could have operated in spurts, with a matter of hours between these "spurts." The Sm-149, on the other hand, is not radioactive and would remain even if the reactor shut down. However, the maximum reactivity contributed is only about 0.04, since of course Sm-149 is removed by neutron capture during reactor operation.³¹ Thus Xe-135 and Sm-149 do not present a serious threat to the young earth model.

Pu-239 is bred" in nuclear reactors as a result of neutron capture by U-238, followed by two beta-minus decays. Walton and Cowan³² quoted ionic probe analyses as evidence that U-235 and U-238 occur in exactly the same positions. They concluded: "This would not be the case if Pu-239, during its half life of 24,400 years, had moved more than a few microns." This conclusion rests on the fact Pu-239 decays by alpha emission, becoming U-235. In the conventional model, with its longer duration of the reactions than the young earth model, large amounts of Pu-239 would have been bred and subsequently decayed into U-235 during the 1.9 billion years. Hence, if Pu-239 had migrated more than a few microns, Walton and Cowan claim that anomalies would be noted in the percentage of uranium that is U-235. Now the percentage of uranium ore that is U-235 is less than normal in the reactor zones, and this is one reason why we know a nuclear reactor existed. However, if Pu-239 had migrated, samples near the edge of the zone (or possibly even near the edges of mineral grains) might show anomalously high percentages of U-235.

Now in the present young earth model, very little decay of Pu-239 could have occurred in the approximately 6000 year history of the earth, and we are free to conclude that there may have been more migration of plutonium and uranium than Walton and Cowan must conclude in their model. It would be interesting, therefore to have data on plutonium concentrations in and near the Oklo reactor zones. Pu-239 is occasionally detected in trace amounts on earth, and are usually blamed on chance neutron irradiations rather than natural reactors.

The possibility of uranium migration no doubt also plays a role in explaining the Oklo data. Maeck et al.³³ stated: "Some redistribution and possibly migration of U may have occurred, especially at the edges of the ore zone." They go on to state that assuming water transport is not unreasonable. In the *Cambridge Encyclopedia of Earth Sciences*³⁴ we find the statement: "Extremely mobile elements such as uranium have often been leached away from rocks which appear fresh and unaltered." Also, it states:

... although uranium is extremely mobile under oxidizing conditions, it quickly becomes insoluble and drops out of solution when conditions become more reducing.

I conclude that studies of the variation of plutonium and uranium concentration do not disprove the young earth model.

The Fast Fission Factor and the Neutron Population

In A, it was argued that the Oklo reactor could have maintained a self sustaining nuclear reaction even if the ore had an enrichment of only 0.72 percent. This enrichment is the value to be expected on the basis of the young earth model, A weak point in the argument was the statement that the fast fission factor, ϵ , could have been as much as 1.2. Some who are accustomed to working with nuclear power reactors where ϵ is closer to 1.0 may doubt the validity of this value. The author would like to give a theoretical treatment of this matter showing that 1.2 is not an unreasonable value of ϵ for the Oklo reactors.

We begin by defining the fast fission factor as the number of neutrons produced by all fissions divided by the number of neutrons produced by thermal fissions. It is then given by:

$$\epsilon = \frac{\nu_2 \int_0^{E_{th}} N^{25} \sigma_f^{25} \phi(E) dE + \nu_1 \int_{E_{th}}^{\infty} N^{25} \sigma_f^{25} \phi(E) dE + \nu_0 \int_{E_{th}}^{\infty} N^{28} \sigma_f^{28} \phi(E) dE}{\nu_2 \int_0^{E_{th}} N^{25} \sigma_f^{25} \phi(E) dE} \quad (5)$$

where:

- ϵ = fast fission factor
- ν_2 = number of neutrons produced in an average thermal fission of U-235
- ν_1 = number of neutrons produced in an average non-thermal fission of U-235
- ν_0 = number of neutrons produced in an average fission of U-238
- N^{25} = number of U-235 atoms per unit volume
- σ_f^{25} = microscopic fission cross section of U-235
- $\phi(E)$ = average neutron flux per unit energy interval
- N^{28} = number of U-238 atoms per unit volume
- σ_f^{28} = microscopic fission cross section of U-238
- E_{th} = the break between "thermal" neutron energies and non-thermal energies.

In the approximation of infinite dilution of the uranium fuel in the moderator this becomes:

$$\epsilon = 1 + \epsilon \frac{\nu_1 N^{25}}{\xi N^{MOD} \sigma_s^{MOD}} \int_{E_{th}}^{\infty} \sigma_f^{25} \frac{dE}{E} + \epsilon \frac{\nu_0 N^{28}}{\xi N^{MOD} \sigma_s^{MOD}} \int_{E_{th}}^{\infty} \sigma_f^{28} \frac{dE}{E} \quad (6)$$

where:

- ξ = logarithmic energy decrement
- N^{MOD} = number of water (moderator) molecules per unit volume
- σ_s^{MOD} = microscopic scattering cross section in water.

Solving for ϵ , this gives:

$$\epsilon = \frac{1}{1 - \frac{\nu_1 N^{25}}{\xi N^{MOD} \sigma_s^{MOD}} \int_{E_{th}}^{\infty} \sigma_f^{25} \frac{dE}{E} - \frac{\nu_0 N^{28}}{\xi N^{MOD} \sigma_s^{MOD}} \int_{E_{th}}^{\infty} \sigma_f^{28} \frac{dE}{E}} \quad (7)$$

To derive this, I have assumed that the neutron flux per unit energy interval $\phi(E)$ is proportional to $1/E$. Now, above one Mev, this is not a good approximation because E is then near the source energy E_0 . A treatment by Placzek³⁵ divides the considerations into neutrons below αE_0 and neutrons above αE_0 , where

$$\alpha = \left(\frac{A-1}{A+1} \right)^2 \quad (8)$$

For U-238, the mass number A is 238, and α is near 1.0. Below αE_0 it is a good approximation to put $\phi(E)$ as being proportional to $1/E$, while above αE_0 it is not. With these modifications, the equation for the fast fission factor becomes:

$$\epsilon = \frac{1}{1 - \frac{\nu_1 N^{25}}{\xi N^{MOD} \sigma_s^{MOD}} \int_{E_{th}}^{\infty} \sigma_f^{25} \frac{dE}{E} - \frac{\nu_0 N^{28}}{\xi N^{MOD} \sigma_s^{MOD}} \int_{E_{th}}^{\alpha E_0} \sigma_f^{28} \frac{dE}{E} - \frac{\nu_0 N^{28} \sigma_f^{28}(E_0)}{N^{MOD} \sigma_s^{MOD}(E_0)}} \quad (9)$$

As an example, using this equation, and assuming 10 percent water and 56 percent uranium by weight, the fast fission factor comes out as $\epsilon = 1.16$. Thus the assumption of paper A that $\epsilon = 1.2$ was reasonable. To check whether the use of equation (9) is a reliable model, one might evaluate it for the case of a natural uranium, graphite moderated reactor. In that case the ratio of moderator concentration to uranium concentration is much larger. Weinberg and Wigner³⁶ give it as 452 as opposed to a value of about 2.4 for the Oklo reactors. The above equation then results in a fast fission factor of about 1.02 for the graphite case, in agreement with experimental results for graphite reactors. Thus this equation seems to be reliable, and since it gives a fast fission factor of 1.16 for conditions simulating the Oklo reactor zones, the assumptions of paper A are vindicated. Thus the young earth model here proposed has satisfactorily explained all the data, thus far.

Variable Decay Constant Models

As was recently pointed out by Morton, Slusher, Bartman, and Barnes,³⁷ models which allow radioactive decay constants to increase indefinitely as we approach creation have a problem i.e., the large decay rates would have produced too much heat, ultimately enough heat to vaporize the earth. Hence, a more reasonable variable decay "constant" model might be as shown in Figure 3. I suppose that the decay constant, λ , rose to a large value at a time, t_1 , perhaps when the Flood occurred, and then it decreased rapidly to its current value.

Gentry³⁸ has pointed out that for alpha decay, if the kinetic energies, E , of the emitted alpha particles are constant, whereas the nuclear radius, R , does change, then there could be a change in the decay constant, λ , without a change in radioactive halo radii. A model consistent with these conditions might be a model in which there was a variation in the k of Coulomb's law.³⁹

How do these models relate to the Oklo reactors? One possibility is that they might allow a recent creation interpretation of the Oklo data even if experimental study of neodymium diffusion shows that it does not occur as the author has proposed in this paper. Alternatively, it may be that a combination of these effects gives a better explanation of the numerical data at Oklo.

In particular, if the Coulomb force were stronger in the past than now, and the nuclear force remained the same, then the fission mass yield curve would shift.⁴⁰ The increase in Coulomb repulsion during the rise in decay constant episode would mean an increased production of nuclei with mass numbers just above $A = 140$. This would mean an increased production of the neodymium isotopes $A = 143$ to 150. This increased production might make explanation of the Oklo data possible even without resorting to neodymium diffusion.

Summary

It is possible to explain the Oklo reactor as a recent phenomenon, having occurred only several thousand years ago. The study of the properties of the neodymium isotopes shows that Nd-142 has a smaller proba-

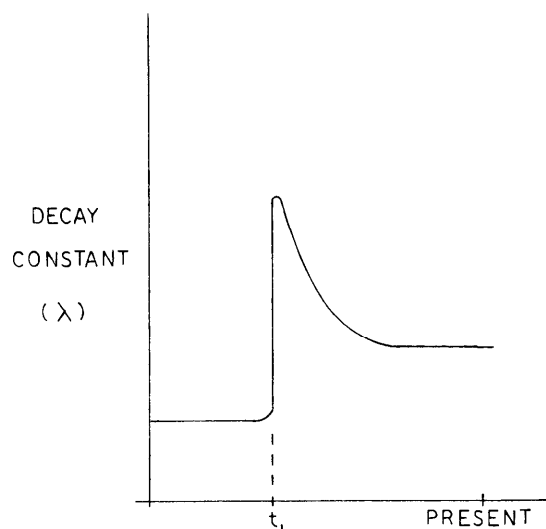


Figure 3. A hypothetical decay constant "episode." No scale is placed on the vertical axis since the scale would be different for each radioactive nuclide. The time t_1 could possibly be the time of the Flood. In order to possibly explain the polonium halos of Gentry,³⁸ the decay constant is shown as a smaller value before t_1 than after t_1 .

bility of being knocked out of position by a neutron scattering. This means that the other neodymium isotopes would have a larger probability of recombination into less mobile forms. Hence diffusion of Nd-142 at a faster rate seems possible, and the confirmation of this by experimental study is encouraged. This would show that the Oklo data could be interpreted as a recent phenomenon. The study of rubidium, strontium, xenon, samarium, plutonium, uranium, and other fission related substances at Oklo does not present any significant difficulties for the recent creation model. The study of neutron multiplication also indicates that the Oklo reactions could have occurred in recent times. A possible alternative explanation in terms of an episodic increase in radioactive decay constant was also considered, and seems to be a viable model, at least as far as the investigation has proceeded.

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EXPERIMENTAL RESULTS OF CROWDING ON THE RATE OF ASEXUAL REPRODUCTION OF THE PLANARIAN DUGESIA DOROTOCEPHALA

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Abstract

Natural selection is central to evolution and is thought to provide the mechanism for the development of new species. Pressure exerted by natural selection is thought to play a major role in the regulation of animal populations. If it could be demonstrated that natural selection is not needed for the maintenance of populations or that the harvest of prey species by predators is random, then evolution would be without a mechanism. Experimental evidence is presented indicating the freshwater planarian, Dugesia dorotocephala, regulates its own population density at healthy levels without need for starvation, disease or predation. Data also indicate worm density is a more important determining factor of reproduction rate than food under certain conditions. Additional work is needed with other species and under natural conditions.

Introduction

If the Creation/evolution controversy is ever to be resolved, I believe it will be done at the level of population ecology. Fossil evidence from Darwin's time to the present day overwhelmingly supports the Creation model and has little correlation with evolution, but most life scientists ignore the fossil evidence. Philosophical arguments are interesting, but offer no testable data or predictions. Few areas in science have expanded as rapidly in recent years as population ecology and evolution is central to the discipline. Indeed population ecology might be more appropriately called applied evolution. In spite of the upsurge in interest and federal support, the most basic of all population

ecology questions remains unanswered: that of how the population of animals in the natural environment is regulated.

Darwin and others rightly observed that, without human intervention or environmental catastrophe, the population density of most animal species remains nearly constant from year to year. This is amazing when one considers annual differences in rainfall, growing season, temperature, wind and other environmental factors. Population stability is also striking when one considers the reproductive ability of most organisms. Darwin was impressed with the reproductive potential of animals which is seldom achieved under natural conditions; certainly not for long. It is this very point that gave Darwin the mechanism for evolution. He assumed animals reproduce at their maximum physiological potential and these excess ani-

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mals provide the raw material for species "improvement" by natural selection. Modern evolutionists go so far as to suggest that the ability to leave reproducing offspring is the only thing that natural selection ultimately favors.¹ Darwin insisted as do most modern population ecologists that population is regulated by negative outside forces such as starvation, disease, predation, and intraspecific and interspecific competition for resources. It seems unlikely that animals could maintain the highest sustainable yield from their resources without some internal limit. In order to avoid overfishing, man has established fishing limits. Increased fishing effort increases the fish caught but would soon result in over exploitation and diminished returns. Animals too regulate "harvest" of natural resources in part by parcelling out living space into territories. Unlimited reproduction by individuals as postulated by Darwin and modern population ecologists would lead to over exploitation and habitat destruction.

For evolution to be a plausible explanation for the origin and diversity of life, it must have a mechanism. Natural selection is still thought by many evolutionists to be that mechanism. If natural selection can be shown to be inoperative, unnecessary, or nonselective, then evolution would be without a rational mechanism. In contrast, the Creation model has no need for a selective mechanism for "species improvement." Invalidation of natural selection would therefore weaken the argument for evolution, while having no effect on the credibility of Creation as a rational explanation for the origin and diversity of life.

There are two straightforward ways to falsify the concept of selection. If it could be shown that natural selection lacked selectivity, i.e., it was random, then it could have no directive influence. We have long been told that predators are necessary for removal of the weak, diseased, and old prey individuals. There are few scientific data supporting such a "Wild Kingdom" or "Walt Disney" mentality. Indeed, limited observational data seem to indicate mountain lions select the strong, fast and healthy deer over the weak, sick or diseased. If that is the case, then natural selection would be mal-adaptive for the prey species by leaving the inferior as breeding stock.² Many fateful predator-prey encounters appear to be random, again negating the selective aspects of "natural selection."

A second way to falsify natural selection as the directive force in evolution would be to demonstrate that natural animal populations are self regulating; that is, that it is recruitment and not negative outside forces that maintain population equilibrium. Wynne-Edwards³ and others have amassed a large data base suggesting that it is recruitment, not losses, that are regulated! Such an interpretation appears more in line with a Creationist view and has been discussed previously.⁴

The common freshwater arrow headed planarian or flatworm *Dugesia dorotocephala*, provides an excellent model for evaluating population regulation. They are nocturnal free living omnivores found in streams throughout much of North America. Reproduction is sexual and asexual. Sexual reproduction occurs in hermaphroditic adults. Fertilization is internal and stalked eggs are attached to the substrate. Asexual re-

production occurs by fissioning. The posterior end of the worm clings to the substrates while the anterior end crawls away. A tug-of-war ensues with the tail piece finally breaking off. Both pieces regenerate missing parts. No fracture plane has been described. Fissioning is thought to be under control of the brain and was found to occur in inverse proportion to population density.^{6,5} Since planaria reproduce asexually, (only growth by mitosis is involved) clonal cultures can be established to reduce genetic variability.

The purpose of this study was to elucidate factors limiting asexual reproduction in planaria, *Dugesia dorotocephala*. A clonal colony was established in order to reduce variability of the data and sufficient experimental replicates were tested to obtain statistical validity. Several factors vary with population density that might alter reproduction. Such factors include worm meeting worm encounters, slime build-up on the substrate, availability of oxygen, or metabolic products such as carbon dioxide or ammonia or possibly some other population density factor. Several types of experiments were conducted in an attempt to isolate and quantify various density dependent factors.

Experimental Methods

On May 1, 1982, a single flatworm was collected from Red Rock State Park, Hinton, Oklahoma (Caddo County). This is the same population previously studied.⁷ A clonal colony was established with a population of several hundred worms by October, 1982, when experiments were begun. As over 2,000 flatworms were tested, experiments were conducted throughout the remainder of 1982 and all of 1983. Stock culture and all experimental animals were maintained in non-aerated, non-chlorinated well water with a 12-hour photoperiod. Duration of each experiment was at least 60 days. The first two weeks data were discarded to allow acclimation to experimental conditions. Data are presented as days per fragment per worm. It was calculated as:

$$\text{Days/fragment/worm} = \frac{\text{Total days}}{(\text{Total fragments / number of worms})}$$

Means were compared by Student's t-test and considered different if $P < 0.01$. Semilogarithmic regression equations of the form $Y = A^{Bx}$ were calculated by the method of least square. Standard errors were calculated for A and B.

Experiment 1. This experiment was designed to determine the asexual reproduction (fissioning) rate of flatworms as a function of density. Planaria were maintained in 10 ml of water in 25 ml glass vials. Worms were fed three times a week (MWF, 2.33 days) (days fed, feeding interval). Following feeding, the fragments (if present) were counted and removed to the stock culture. Water was decanted, the vial rinsed once, then refilled with 10 ml water. Worms were tested at densities of 1, 2, 4, 6, and 8 worms per 10 ml of water. Eight replicate experiments were used. Surface area for gas exchange was 4.52 cm^2 . Surface area or "crawl space" was 21.1 cm^2 .

Experiment 2. This experiment is similar to experiment 1 except worms were fed and fragments counted and removed twice a week (MF, 3.5 days). Worms

were tested at densities of 1, 2, 4, 6, and 8. Thirty-four replicate experiments were performed.

Experiment 3. A similar experiment was done except animals were fed once a week on Monday. Feeding interval was seven days. Worms were tested at the same densities with 23 replicates.

Experiment 4. A similar experiment was done except feeding was once every other week (feeding interval 14 days). Twenty replicate experiments were conducted.

Experiment 5. This experiment is similar to the previous ones except the water volume was doubled to 20 ml. Densities tested were 1, 2, 4, and 8 worms in each vial. Worms were fed three times a week (MWF, 2.33 days). Surface area for gas exchange was still 4.52 cm^2 , however surface area increased to 37.7 cm^2 . Eight replicates were performed.

Experiment 6. An attempt was made to determine the relative importance of substrate or water in regulating reproduction. Worms were fed twice a week (3.5 day intervals) and maintained in glass vials as in the previous experiments. Three vials were used in each replicate as follows. Six worms were placed in a clean vial. At each feeding day one test worm was in each of two other vials. Single worms in the two vials were fed and the water discarded. Next, water from the vial with six worms was placed in a clean vial and the "water test" worm transferred into it. The six worms were then transferred into a new clean vial and fed. The "old" vial in which the six worms had been living was refilled with fresh water and the "substrate test" worm transferred into it. Fragments were counted and removed at each feeding. If something on the substrate (such as slime) inhibited reproduction one would expect the single worm moving into the vial lived in by six worms would show reduced fissioning. If, on the other hand, something in the water inhibits fissioning the worm moving into the vial with water lived in by the six worms would show reduced reproduction. Five replicates were tested.

Experiment 7. An attempt was made to determine the natural limits of the planaria under the experimental conditions of this study. Single worms were placed in 10 ml water in glass vials and fragments counted but allowed to remain in each vial. Five replicates in each group were used and four groups tested at feeding intervals of 2.33, 3.5, 7, and 14 days. Population equilibrium required approximately 90 days.

Experiment 8. An attempt was made to determine the effect of substrate or living space on reproduction. Worms were housed in small plastic boxes made for mailing microscope slides. The boxes measured $3.0 \times 7.5 \times 1.5 \text{ cm}$. Worms were placed in the boxes in 15 ml of water. Two worm densities of 2 and 8 worms per 15 ml were used. One set of slide boxes had no slides in them, the other set contained a slide. The addition of the slide increased substrate area (crawl space) from 40.8 to 61.8 cm^2 (an increase of 51 percent). Surface area in both cases was 2.4 cm^2 . Five replicates of each condition were tested.

Results

Increased population density reduced the rate of reproduction in each group tested. Less frequent feeding also reduced reproduction. Results of Experiments 1-4 are summarized in Figure 1 and Table 1. Data with each experiment were highly correlated (correlation coefficient > 0.99). Table 2 contains regression equations. Intercepts (a) were significantly different, but slopes (b) were all similar. The results of Experiment 5 (see Table 2) were not significantly different from the results of Experiment 1 even though twice the water volume was used.

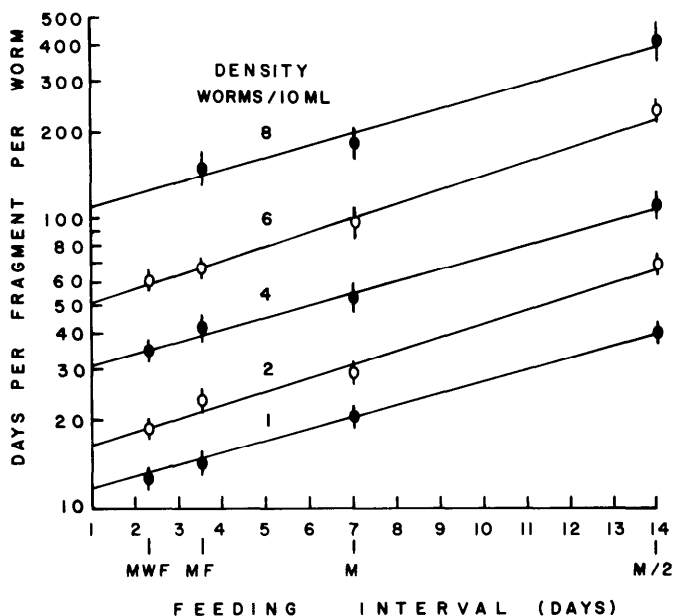


Figure 1. Semilogarithmic relation between feeding interval and rate of reproduction. Circles indicate means and vertical lines represent two standard errors of the mean. Best fit lines were calculated by the method of least squares.

The "substrate test" group of Experiment 6 produced a fragment every 23.0 ± 2.2 days while the "water test" group yielded fragments every 23.6 ± 1.7 days. Results were not significantly different.

Results of Experiment 7 after population equilibration was 7.8 ± 1.6 , 11.6 ± 2.1 , 7.5 ± 2.2 , and 1.5 ± 3.0 respectively for animals fed MWF, MF, M and M/2.

Experiment 8 yielded the following number of days per fragment per worm.

Density/15 ml	40.8 cm^2 Substrate	61.8 cm^2 Substrate
2	40.3 ± 2.4	27.4 ± 3.0
8	90.5 ± 5.5	49.8 ± 2.0

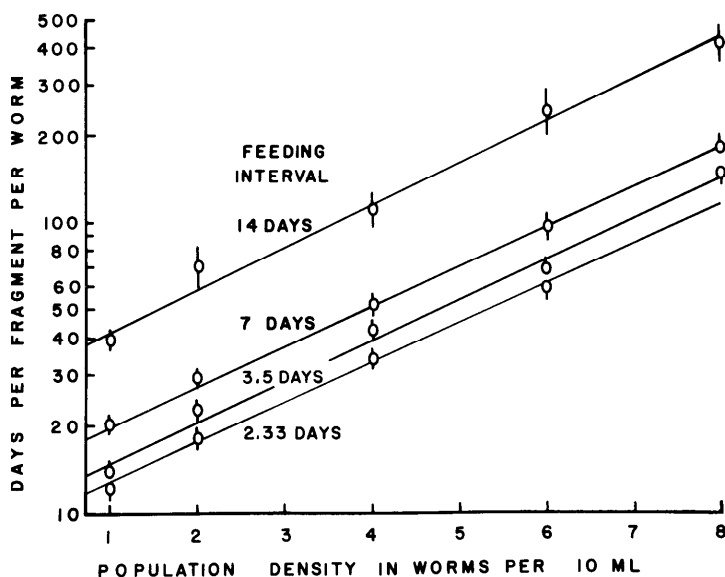
Discussion

In each experimental group, increasing worm density reduced the rate of asexual reproduction. Experiments 1-4 (Figure 1, Table 1) clearly show the effects of density and feeding frequency. Reproduction appears to be more closely linked with density than with feeding frequency. For example, consider a density of 2 worms/10 ml fed twice weekly. If feeding is reduced to once a week, reproduction drops from one

Table I. Results of worm density and feeding frequency on asexual reproduction in flatworms, *Dugesia dorotocephala*. See text for experimental conditions. Units are day/(worm fragment/worm).

Experiment	Feeding	1	2	4	6	8
1	MWF	12.8 ± 0.7	18.8 ± 0.05	35.1 ± 2.7	61.5 ± 2.7	—
2	MF	14.5 ± 0.8	23.3 ± 1.5	42.9 ± 4.4	68.5 ± 3.8	150.2 ± 22.7
3	M	21.2 ± 1.3	29.5 ± 1.8	54.3 ± 4.2	98.6 ± 9.1	188.7 ± 19.7
4	M/2	40.7 ± 4.2	70.9 ± 8.4	115.9 ± 9.8	224.0 ± 41.4	432.0 ± 50.9
5	MWF	13.1 ± 0.6	18.8 ± 1.3	35.4 ± 0.7	93.7 ± 2.6	—

fragment every 23.3 days to one every 29.5 days — a difference of 6.2 days. If instead, one moves from 2 worms/10 ml fed twice a week to 4 worms/10 ml fed twice a week, reproduction is reduced to a fragment every 42.9 days or a change of 19.6 days. The same data (from Experiments 1-4) were replotted in Figure 2 showing the relation between feeding frequency and reproduction. Again, the effect of crowding is dramatically illustrated.

**Figure 2. Semilogarithmic relation between population density and rate of reproduction. Symbols and calculations the same as in Figure 1.**

The results of Experiment 5 help to isolate what factor of density is most important in reducing reproduction. In this experiment, 20 ml of water instead of 10 ml was used. Any inhibiting factor was therefore reduced by the additional water volume and the worms had more substrate (crawl space). Fissioning however was not changed significantly (Table 2). Area for gas exchange remained the same suggesting it may

be some diffusible component such as O₂, CO₂, or NH₃ that limits reproduction. Following feeding, worms were often observed near the surface or actually clinging to the water surface. This was especially common in high density vials. One would expect oxygen consumption (as well as carbon dioxide production) to be highest immediately after feeding.

Experiment 6 further suggests neither substrate nor something in the water inhibit reproduction as neither "used water" nor pre-slimes substrate reduced reproduction; this was interesting as slime had been postulated as inhibiting reproduction by previous workers.⁸

Experiment 7 clearly shows that flatworms are capable of regulating their own population density without negative outside forces such as predation, starvation, disease. In three of the four feeding schedules, population densities were maintained independent of feeding frequency. Such regulation strongly suggests internal control involving feedback and some census or measure of the population as has been postulated by Wynne-Edwards.⁹ It is also significant that worms maintained a healthy density with no obvious detrimental crowding effects.

Experiment 8 seems to suggest a substrate or crawl space component. Increasing crawl space and thus reducing worm/worm encounter increased the rate of reproduction.

Conclusions

Data from these experiments clearly indicate that the planarian, *Dugesia dorotocephala*, can regulate its population density apart from the so-called Darwinian checks. Negative outside forces such as starvation, predation or disease were not necessary for population homeostasis. Worm density could also be regulated independent of feeding frequency. Such data strongly suggest the role of natural selection has been over emphasized both as a factor in population control and more importantly as a mechanism for evolution. Implications of internal population regulation weaken the entire evolution scenario. Animals are not reproducing at their physiological limit, but are merely replacing losses. Natural selection, as defined by the

Table II. Experiment summary and regression equations of the form $Y = A^{BX}$ where X is the worm density and Y is the number of days per worm fragment per worm (see text).

Experiment	Feeding	Volume	A	B	Correlation
1	MWF	10	9.76 ± 0.46	0.31 ± 0.013	0.998
2	MF	10	11.36 ± 0.96	0.32 ± 0.017	0.995
3	M	10	15.67 ± 0.31	0.31 ± 0.003	0.999
4	M/2	10	32.30 ± 2.86	0.33 ± 0.02	0.995
5	MWF	20	10.59 ± 0.81	0.28 ± 0.02	0.996

evolutionist is not natural. An even grander design than evolution is evident. Animals were designed with the ability to avoid over-exploitation of their habitat without the need for disease, predation or starvation. Only recently is man learning to limit the harvest of renewable resources to assure the highest sustainable yields. Design in nature implies a Designer. "And God saw all that he had made and behold it was very good." (Genesis 1:31a).

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EDUCATIONAL COLUMN

TEACHING ABOUT ORIGIN QUESTIONS: ORIGIN OF LIFE ON EARTH

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Abstract

In the first article (CRSQ 21:115-19) in this four-part series the author stated the validity of two fundamentally contrasting viewpoints about origins; and in doing so, he provided objective, scientific data for (1) Total Creationism (based upon belief in Eternal, Personal Creator God who created all things), and (2) Total Evolutionism (based upon the belief that all things derived from some Eternal, Impersonal Matter-Energy condition.). By emphasizing limitations of proper, orderly scientific endeavor, he delineated that scientists deal with two kinds of inquiries: (a) inquiries to explain "present" natural phenomena (leading to the science of cosmology, for example), and (b) inquiries to explain unobservable origins of aspects of the "present" natural environment (leading to "Historical" Theories, such as cosmogonies). In a second article (CRSQ 21:189-94) he concentrated upon differences between the methods of cosmologists and cosmogonists, and presented itemization of circumstantial evidence for an Evolution Model and Creation Model about the origin of the universe. This article contains discussion of specific examples and illustrations of the above as applied to teaching about the origin of life on the earth.

Introduction

Science, as a proper and orderly profession, entails specifically the direct and/or indirect, *repeatable* observation(s) of *natural* objects and/or events that occur or exist in the physical environment.

Total Creationism (based upon belief in Eternal, Personal Creator God Who created all things), and Total Evolutionism (based upon the belief that all things derived from some Eternal, Impersonal Matter-Energy condition) involve unnatural objects and/or events (singularities). Thus these viewpoints cannot possibly be submitted to scientific study. Nevertheless, professionally qualified scientists of the majority do present objective, scientific facts in support of Total Evolutionism; and, also, professionally qualified scientists of the minority do present objective, scientific facts in support of Total Creationism, as listed in a previous article (CRSQ 21:115-19) in this series.

Whereas changing descriptions of the structure of the universe can be handled collectively under the term "cosmology," and ideas of scientists about the origination and generation of the universe can be subsumed under the term "cosmogony," there are at least two main ideas of scientists about the origin of life on

the earth in addition to the majority position. Many, many modern biologists and biochemists accept the "conventional wisdom" about some sub-microscopic origin of life on the earth, but other scientists favor the idea that life came to earth from outer space; yet, a minority of scientists opt for the traditional, theistic view of origin of life on the earth (more on these latter concepts in other sections of this article).

Again, modern scientific endeavor is focused on the "present." Although developments regarding gene manipulations and synthesis and transfer of genes are "frontier" aspects of modern biology, nevertheless the ultimate origin of life on the earth is beyond application of scientific methodology. Biologists are not able to study scientifically the origin of life on the earth, as has been admitted by Bernal, Dixon, Mora, and other scientists. In short the principles of experimental science do not apply to discussions about the origin of life on the earth.

Modern Majority Position Evaluated

But what is the present position of the majority of biologists? According to their mechanistic, materialistic view of the universe, all reality came into existence through "evolution." Thus proponents of this view insist that life arose on the earth (or somewhere in the universe) from inanimate matter through chemical and physical processes still operating today. (A brief summary of this "chemical evolution"—sometimes called "molecular evolution"—is provided in Table I.) However, in order to protect the integrity of proper,

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Table I. Evolution Model for the Origin of Life on the Earth.

According to the evolution model, the story of life on the earth began some five billion years ago and gradually unfolded through a series of five stages:

Stage 1

Evolutionists have imagined that the atmosphere of the early earth was quite different from the present atmosphere. In contrast to the present *oxidizing* atmosphere, which contains 21% free oxygen (O_2), 78% nitrogen (N_2), and 1% of other gases, supposedly the early earth was surrounded by a *reducing* atmosphere made up mostly of methane (CH_4), ammonia (NH_3), hydrogen (H_2), and water vapor (H_2O).

Stage 2

Because of ultraviolet light, electric discharge, and high-energy particle bombardment of molecules in a reducing atmosphere, stage 2 came about with the formation of small organic molecules such as sugars, amino acids, and nucleotides.

Stage 3

Presuming all of this happened billions of years ago in a reducing atmosphere, then stage 3 is imagined during which combinations of various small stage 2 molecules resulted in formation of large polymers such as starches, proteins, and nucleic acids (DNA).

Stage 4

These large molecules supposedly joined together into gel-like globs called coacervates or microspheres. Possibly these coacervates attracted smaller molecules so that new structures, called proto-cells, might have formed.

Stage 5

Evolutionists believe that, finally at least one of these globs absorbed the right molecules so that complex molecules could be duplicated within new units called living cells. These first cells consumed molecules left over from earlier states, but eventually photosynthesis appeared in cells, in some way, and oxygen was released into the atmosphere. As the percentage of oxygen in the early atmosphere increased, most of the known forms of life on the earth today began to appear. Because of the presence of oxygen, these early life forms destroyed all the molecules from earlier stages, and no more chemical evolution was possible.

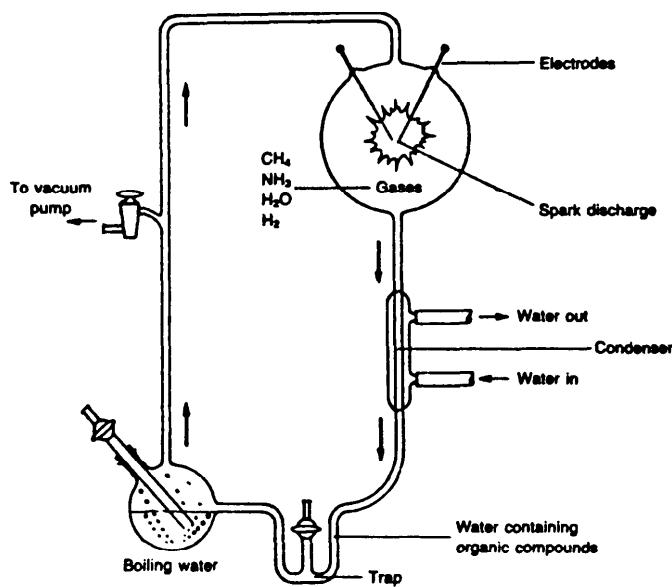
orderly scientific endeavor, modern science teachers should present students with candid evaluation of this mechanistic, materialistic view in the following manner.

For *Stage 1* biologists who speculate on the origin of life on the earth require a primitive earth model that includes tolerant conditions in which postulated chemical reactions leading to the origin of life could occur. Such "historical" theories are forced to postulate a primitive earth atmosphere very different from the present atmosphere, that is, an unnatural atmosphere.

Evolutionists are forced to imagine, *a priori*, that the primitive earth atmosphere contained no oxygen, that is, it was *not* an *oxidizing* atmosphere. Rather, most modern biologists insist that the primitive earth atmosphere was a *reducing* atmosphere. But such an atmosphere is an unnatural condition; and furthermore, Abelson and other scientists insist that no geochemical evidence can be found for a primitive methane-ammonia atmosphere. Noteworthy is the fact that the lowest sedimentary layers do not contain unusually large amounts of carbon or organic chemicals, as might be expected if some kind of reducing atmosphere of the earth ever existed.

Unnatural Conditions Required

Of course good circumstantial evidence exists for the formation of simple organic compounds in *Stage 2* as found in the outstanding work of Dr. Stanley Miller

**Figure 1. The Miller Apparatus.**

and Dr. Sidney Fox. (See Figure 1.) However a vital part of these experiments on *synthesis* (not creation) of amino acids and a few other simple organic compounds under assumed primitive earth conditions was a cold trap (natural?) where synthesized products were collected. (More on the "cold trap" later.) Significant, also, is the natural tendency for biological molecules to go from the complex and well-ordered to the less complex and disordered state at temperatures at which life processes commonly occur. The success of all experimenters, then, is due to special conditions to minimize instability of organic compounds and maximize accumulation of quantities of simple organic compounds.

And most noteworthy is the fact that *both* "left-handed" and "right-handed" amino acids are formed in these experiments. However, *only "left-handed" forms of amino acids are found in living organisms.* This condition is a "mystery" for modern biologists, according to Dr. Francis Crick; and a "very puzzling fact," according to Dr. Linus Pauling.

Also very important is the fact that the simple molecules produced in the laboratory are *not living* substance. Synthesized organic compounds are not the same as the complex, large molecules of *Stage 3*, such as enzymes (which are chains of amino acids), so importantly characteristic of the *organization* and *coordination* that make living systems different from non-living matter. Enzymes are very special kinds of ordered proteins and so far modern biologists have only produced protein material more or less randomly. According to Dr. Fox, large and complex proteins formed on the earth in warm water ponds near the edge of volcanoes, but his scheme would require a unique series of events and unnatural conditions with questionable probability.

Evolutionary biologists believe that if large polymers, such as starch, proteins, and nucleic acids (DNA) could form on the primitive earth, then it would be possible (in *Stage 4*) for gel-like globs called coacer-

vates, or microspheres, to form. Oparin believes that coacervates might have been intermediate between loose molecules and stable living systems. However, it can be shown that necessary processes are not selective; and they are not stable, nor the basis of organization that would be duplicated.

Living Cells versus Coacervates

With regard to *Stage 5*, the significant differences between living cells and coacervates are organization and coordination that make living systems distinct from non-living matter. In all living systems the most fundamental example of coordination is the manner in which DNA codes for protein formation. DNA is the complex molecule of heredity, and proteins are the macromolecules of structure (organization) and function (coordination).

Most notable is the fact that many specific enzymes, which are proteins, are necessary for proper functioning of the DNA code during protein synthesis. Also, formation and selection of each amino acid in proteins depends upon several RNA molecules. In fact, the whole process of protein synthesis is a very complex system. (See Table II.)

According to the popular materialistic, mechanistic view of the origin of life, enzymes are special kinds of proteins that resulted from time, chance and unknown, supposed natural chemical processes. According to the accepted materialistic, mechanistic view of the origin of life, the complex relationship between DNA and proteins found in living cells also resulted from time, chance and unknown, supposed natural processes. Yet the dilemma of the appearance of the first cell according to this viewpoint has not been solved, and seems to be the final insurmountable barrier to the origin of life on the earth.

Table II. Weaknesses of Origin of Stable Metabolic Systems.

1. Vast quantities of macromolecules would have to be present in primeval seas at some saturation point where complex coacervates or protenoid microspheres would precipitate out of solution.
2. Such globular products are unstable and would easily disintegrate because there is not a natural tendency for more complex systems to form spontaneously from less complex systems.
3. Even if some catalytic ability did appear it would have been useless and plainly destructive.

Science Textbooks

This very brief critique of essential ideas of internationally famous biologists is given so that the science teacher might better evaluate some of the concepts involved. Thus the science teacher can be prepared to meet the tremendous promotion of the Thermal Model put forth by Fox, and the incredibly persuasive presentations of Oparin's ideas on the possible stages of formation of the first living cell on the earth.

Too often authors of high school and college science textbooks have accepted quite uncritically the ideas of evolutionary biologists. Textbook authors, of course, have been encouraged to write as they have because of the almost unilateral acceptance of the ideas of Fox and Oparin, and the lack of critical analysis of Miller's experiment, by leaders of scientific organizations and by editors of scientific journals and magazines.

Such wide acceptance of the mechanistic, materialistic viewpoint confirms the bias and really unscientific attitudes that dominate the educational and scientific establishments with regard to questions of origin of life on the earth. The science teacher should realize and be prepared to show students that not all written material that incorporates the evolutionary outlook is necessarily acceptable as scientific when gauged against criteria of proper, orderly scientific endeavor. (Also see Table III of special conditions required by complexity of life.)

Table III. Four Special Conditions Required by Complexity of Life.

- The complexity of life requires at least four special conditions:
1. An open system of chemical change (which is characteristic of a green plant).
 2. An adequate energy supply (which basically is the sun in this solar system).
 3. An energy conversion system.
 4. A control system for the whole complexity of the life processes (even in the single-celled life forms, which can never properly be called simple since all life forms are complex).

The fact that living organisms require *all four* of these conditions is quite a sufficient basis for students to realize that the passage of time alone could never result in the appearance of independent, stable, duplicating cells, as structural and functional units of the complexity of life.

Life-Death Continuum

As an aid to teaching strategies that augment further objective, candid analysis of ideas involved in the majority position, the accompanying Life-Death Continuum can be very helpful as a frame of reference. (See Table IV.) This classroom-tested chart can be used effectively to focus attention upon the *synthesis* of amino acids versus the concept of original *Creation* of life.

In Creation/evolution discussions about the origin of life on the earth particular attention should be given to the entries shown as part of the "past" in the Life-Death Continuum. Over the centuries there have been repeated "outbursts" of debate about the origin of life on the earth. It is almost as if a debate question had been formulated in ancient times; and human beings had been taking "pro" and "con" positions on a question such as, "Resolved: Life on the earth came from some inorganic source." (See Table V of ideas on the origin of life.) Actually many scientists in the past, and modern proponents of sub-microscopic origin of life, have turned away from the century-old belief that the Creator God was the ultimate origin of life on the earth. In simplest terms the debate comes right down to the choice between some sub-microscopic combinations of sub-molecular units of matter as a result of time, chance and unknown, supposed natural chemical processes *versus* the origin of life on the earth from the Creator God, the First Cause of all things.

(The third position that life came to the earth from outer space involves the fallacy of "begging the question." No evidence of life, as biologists know it today, has been identified by way of any experiments in space. Even if some strong positive indications of life, or life supporting conditions, were found on Mars or another planet in the solar system, no answer would really have been gained regarding the basic question

Table IV. Life-Death Continuum

Past	Present					Future
	Events resulting in alteration, termination, extension, modification of continuum—					
	Artificial organs (Instrumentation)					Eternal life Immortality
	Organ transplants					Resurrection
	Eugenics Euthanasia Genetic disorders					
ORIGIN	Life (Birth)	Miscarriage	Birth controls	Abortion	Death	Transfiguration
Cosmos	1. Movement	Natural disasters	Suicide	Murder	(Loss of co-enzymes results in tissue death)	Reincarnation
	2. Metabolism					
	3. Chemical composition	Starvation	Diseases	Medicines (drugs)		
	4. Cell structure					
	5. Minimum size					
	6. Optical activity					
Spontaneous	7. Isotopic fractionation	Accidents		Hypothermy		THE END
Generation	8. Reproduction (size, no.)					

Vertical lines are "boundaries" which enclose essentially those concepts in the "present" that are amenable to scientific research. The events above the horizontal line might be discussed in science classes because of social significance; whereas those below the line might be mentioned only, since full attention in social studies, sociology, medicine, or related courses can be assumed. Scientists are generally agreed that they do not have any proper scientific means for studying the "future." It is important, then, for students to face the logical question: Can investigators scientifically study the "past"?

of the ultimate origin of life. The logical question would still be, what was the origin of life on Mars, or elsewhere?)

Now biology teachers should explain the move of many modern biologists away from belief in God as the ultimate origin of life on the earth, which belief was held by Pasteur and many other leading scientists who were founders of the biological sciences. Science teachers should make clear that the reason many biologists have turned away from the centuries-old belief in God as the ultimate origin of life on the earth is identified in their frame of mind of wanting to accept only a presumed naturalistic origin of life.

Critique of Naturalistic Ideas

Yet these scientists know of *no* naturalistic origin of the first life on the earth. When reductionist biochemists, like Oparin, Fox, and Ponnampertuma, imagine some five-stage origin of life as itemized already, they rely upon completely unnatural, that is, *supra* - natural ideas (those beyond the natural). That many modern scientists, who follow Oparin, Fox, and Ponnampertuma, do *not* stay within restrictions of their supposed naturalistic outlook or philosophy is manifest initially in their imagined belief that a *reducing* atmosphere once surrounded the early earth. A reducing atmosphere is *not* a naturally occurring phenomenon. It is *only imagined*.

Actually any belief in some spontaneous combinations of sub-molecular units of matter to form living substance is a direct contradiction of the Law of Biogenesis: Life comes from pre-existing life. Careful empirical findings have been basic to development of the Law of Biogenesis; and no evidence contrary to that law of nature (or natural law) has ever been identified from scientific study of objects and/or events in the natural environment, which is the "venue" of proper, orderly scientific endeavor.

The Cold Trap Problem

And there is a further unnatural aspect of the work of scientists who have expended a great deal of effort attempting to *simulate* early conditions of an imagined reducing atmosphere. Science teachers should make very explicit for students the unnatural conditions associated with the cold trap referred to already in Stage 2 of the imagined "chemical evolution" of life.

Several scientists have successfully synthesized amino acids and a few other simple organic compounds under assumed primitive earth conditions. But such experiments have involved use of a special trap to isolate the products gained from the interaction of the mixture in the apparatus and the energy source used for the synthesis. In other words students should understand clearly that successful production of amino acids in the laboratory was achieved as a consequence of very special conditions imposed by research scientists-conditions *not known* to have existed on the primitive earth.

The science teacher leading Creation/evolution discussions of the origin of life on the earth must be very persistent to point out that, as a result of the interaction of the gaseous mixture and the electric discharge in all supposed "origin of life" experiments, all derived amino acids and other products had to be *isolated* in a trap so that the products would not come into contact again with the source of energy. Since any source of energy is far more efficient in the destruction of the organic products involved than in their production, the necessary function of the trap was removal of the synthesized organic substances from the chemically active area of the apparatus. If the synthetically formed amino acids had not been removed by trapping they would have broken down because of their thermodynamically unstable nature.

Reductionist biochemists presumably are proponents of the philosophy of naturalism. As scientists

Table V. Ideas on the Origin of Life.
“Resolved: Life on the earth came from some inorganic source.”

ABIOTIC	PRO-Position (No scientific theory or hypothesis is possible) 1. Macroscopic ideas: Ancient people believed in spontaneous generation of whole organisms, because they thought they saw mice come from mud and snakes from horses' hair, etc. (Aristotle, others) 2. Microscopic ideas: Next, people believed in spontaneous generation of microbes or bacteria because Pouchet (1860) and others thought they saw such occur in nutrient broths. 3. Sub-microscopic ideas: Today many scientists believe in spontaneous generation of subvital units of matter that formed into coacervates or proteinoids. (Darwin believed in one or many beginnings; Oparin believed in one combination of sub-vital units; Miller, Fox, Ponnampertuma have used controlled experimentation to synthesize amino acids, which are not living.) 4. Cosmic ideas: Over the decades and still today some scientists <i>believe</i> that life came to the earth from other planets or other parts of the universe by way of spores or meteorites. 5. Theistic ideas: Over the centuries some scientists <i>believe</i> life is result of supernatural creative acts of Creator God; life that has always been complex. (Note: Beliefs in #1 thru #4 all entail unnatural events.)	Con-Position Conclusive controlled experimentation of Francisco Redi (1650) with covered and uncovered meat <i>established</i> that life came from life, at least flies from maggots which came from eggs laid by flies. Conclusive work by Appert and controlled experimentation by Louis Pasteur (1864) with swannecked flasks <i>established</i> that bacteria may be dust-laden and a source of bacterial life from life. Instantaneous synthesis of amino acids requires human intervention, hence no man can study spontaneous generation, which by definition entails <i>no external</i> intervention. (Blum and Cook point out chance of life coming from no life; Coppedge indicates high improbability of <i>only left-handed</i> protein substances in living organisms.) These ideas “beg the question,” side step problem of origin of life; no other planets known from space probes (Mercury, Venus, Mars, Jupiter, or Saturn) seem to have life as we know it. Heat of meteorites, x-rays, ultra-violet light would have real deleterious effects on life. No scientific study possible, but a Creator of life would not be in contradiction to concepts of cause and effect, or degradation or degeneration from complex organizational order.
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they are supposedly devoted to studying naturally occurring objects and/or events. But the cold trap has *no natural* analogue. There is no such chamber known in the present natural environment; and no such chamber is known of any presumed primitive environment, which could function as a “trap.”

In sum, then, specific unnatural features are involved in the laboratory experiments by which scientists purport to represent or simulate some imagined primitive atmosphere. An oxygen-free atmosphere is unknown (and specific geologic evidence can be used to deny that there ever was an oxygen-free atmosphere on this earth). Also, no natural chamber is known that could “trap” organic substances supposedly formed after lightning discharges or ultraviolet radiation. In order to protect the integrity of proper, orderly scientific endeavor these aspects of the “establishment” materialistic, mechanistic ideas about the origin of life on the earth should be made fully evident.

What If Life Is Synthesized?

Now students might ask the science teacher, what if scientists do synthesize living substance? Of course, if scientists are successful some day in synthesizing living substance, their work will be the result of careful planning and controlled execution — so that the whole process can be repeated. All careful, proper scientific work must be repeatable.

Since living substance is complex, if scientists do successfully synthesize living substance (no scientist creates matter), they will do so because of a planned “recipe,” a proper complex mixture of elements (of unknown origin which they have not produced). Thus biology teachers should make explicitly clear that synthesis of living substance, if it ever occurs, will be a forthright attestation of the human intellect involved. Human intelligence will have been involved since

scientists selected the “ingredients.” Human intelligence will have been involved since the process will not have been an accident, and will necessarily be repeatable according to a definite formula.

And so, by analogical reasoning, if human intelligence of necessity will be involved in any successful *synthesis* of living substance, then it follows logically that an Intelligent Creator was involved in the *ultimate* origin of life on the earth. Even the most elementary student really has no difficulty in noting pattern and order— hence has an appreciation of design. All school buildings, all machines, all play equipment are carefully assembled according to some plan—as is easily appreciated by students of all ages. They *know* there was some blueprint for all of man's inventions. So they can understand that God was the Designer of all original life on the earth. (See circumstantial evidence in Table VI.)

Table VI. Two Sets of Evidence.

Circumstantial Evidence for Spontaneous Origin of Life on the Earth
1. Synthesis of coacervates and cell-like globules 2. Synthesis of amino acids (non-living “building blocks” of living substance) 3. Production of synthetic “equivalents” of urea, rubber, cloth fibers
Circumstantial Evidence for Creator Origin of Life on the Earth
1. Chemical tendency away from life, tendency toward breakdown 2. Complex pattern (design) of DNA code, molecular interdependency, cell organelle and organ interactions 3. Definite pattern (design) of exclusively “left-handed” amino acid structure 4. Law of Biogenesis: Life comes from existing life.

Theistic Alternative

The belief that God created life is very ancient and is traceable to the Hebrew traditions regarding first origins. In fact the position that God created life on earth was long held by scientists through the centuries until popularization of the philosophy of naturalism. Essentially, the belief in some sub-microscopic coming together of sub-molecular units of matter, or the belief that life came to the earth from space, are *substitute* concepts to the long held belief that God created all life—the idea of the theistic origin of life on the earth.

Actually the theistic concept of the ultimate origin of life, in twentieth century science, is a viable and fully rational belief. How rational is the belief that presently known complex cellular life came into existence, once upon a time, after some chance combination of sub-molecular units of matter as a result of supposed, unknown natural processes?

Thus, science teachers, who are responsibly concerned about the integrity of science teaching, can explain to students that a belief in the Eternal Creator as the source of plant and animal life, including human beings, on the earth is wholly logical, rational and in keeping, in turn, with the cause and effect assumption so fundamental to careful, proper scientific thinking. Many scientists, today, accept that the Creator God was the First Cause. Thus theistic beliefs about the ultimate origin of life on the earth are not in any way anti-scientific.

Students should recognize that modern scientists utilize elemental materials at their disposal to prepare a certain mixture in their experimental equipment. *But whence cometh the elemental materials?* Do re-

ductionist biochemists create elemental matter? No! Do reductionist biochemists create life? No! Pasteur and many leading biologists who founded the biological sciences believed that the Creator God created matter. For them, the Creator God was the First Cause of life on the earth; and this is true, once again, of a minority of theistic biologists.

The Theistic Framework

Furthermore, the instantaneous chemical reactions in the biologists' experimental apparatus (which are *not spontaneous* chemical reactions, since scientists intervene externally to select "ingredients") may properly be associated with the sustaining acts of God, the Almighty. Hence the theistically oriented biologist may most rationally maintain, in candid responsible manner, that the instantaneous chemical reactions detectable in scientific experiments regarding the *synthesis* of amino acids are associated conceivably with on-going, sustaining actions of the Providential God in whom he or she believes. Again, in maintaining the integrity of proper academic freedom of *all* students and *all* teachers, these aspects of creation/evolution discussions should be made evident.

In short, the evidence for God—the Sustainer—is verily all around the theistic biologist. Truly, he or she is without excuse in pointing to possible evidences of the Creator's activity in the chemical reactions that are *not seen* involving the ingredients that are *seen*. Therefore, the scientist who describes regularities of naturally occurring objects and/or events in expressions of various scientific laws, natural laws (or laws of nature), may very well be describing the way God acts as He sustains and maintains His creation.

EXTRAPOLATIONS IMPLICATIONS

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Abstract

Scientific and engineering data are taken within the constraints of physical, biological and chemical systems. The validity of the data is further limited to the adequacy of the sampling regime, and both repeatability and accuracy of the measurement process. Models built from such data ought to be bounded by these conditions and extrapolation from the models should show healthy scientific restraint and reasonable justification. Those which do not, often lead to incorrect decision-making and mislead others either intentionally by disregarding boundary conditions or facts, or unintentionally by carelessness. Evolutionary theorists are guilty on both counts and creationists should learn from this and be critical of their own data extrapolations.

Introduction

Whenever an investigation of a system is undertaken and a researcher begins to select samples for test and data collection, there are several questions that first must be asked. What is the purpose of the experiment? Should I take a stratified sample or a random sample? How much uncertainty can I afford? (That is: how much risk am I willing to take?) Questions like these can lead to a specially planned experimental design rather than haphazard trials which are costly in terms of time, materials, and funding and which may be totally insensitive to critical interactions between factors of interest.¹ Usually, some kind of random sampling and order of testing is set up to ensure that: a)

the sample is representative of the population from which it was taken, and b) unforeseen bias such as equipment drift or environmental changes do not unduly affect any one segment of the experiment. A simple example of a nonrepresentative sample would be if a new drug were injected into a group of male pre-medical students to assay its effects on human physiology. Here no account is taken of the restricted age, sex, race, geographic location, or current state of health and therefore any results would hold only for male pre-medical students in the age, health, and geographic range included in the experiment. Another important element is the size of the sample, for this determines the sensitivity of statistical comparisons and the confidence which may be assigned to experimental results.

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Examples

By way of example look at the graphical distribution of weight loss in milligrams between new and old metallic alloy samples in Figure 1a and 1b. In this hypothetical experiment, the researchers were attempting to develop a new plating alloy with increased resistance to chemical etching. Because metals making up the new alloy were expensive the investigators used only a very small number of samples of the new alloy compared with the old; consequently the results from 1a are difficult to interpret and may even lead to the conclusion that the new alloy has more resistance to corrosive chemicals than the old alloy. In 1b however, new results emerge. There appears to be a decrease in the level of resistance to etching in the new alloy (where more of the metal was dissolved in the etching solution). The only difference between the two results is sample size. Due to a smaller sample size used in 1a, chance sampling fluctuations masked the alloy effect. There is more to sound experimentation and analysis than just grabbing a few samples and running a quick statistical test.

Of course this discussion applies to Creation scientists and evolution scientists alike, and while I am more apt to question assumptions and interpretations of scientists from both camps, rather than their methods or analysis, this reminds me of a very weak case built up by George Gaylord Simpson in his book, *The Major Features of Evolution*.² In an attempt to demonstrate the microevolution of certain physical characters of *Kosmoceras* ammonites he took samples from different depths (which he assumed must represent

different ages) and measured them. He then used regression analysis to test whether or not the parameter, terminal diameter, changed with depth (age) of the sample. What was amazing was that the coefficient of determination (r^2) for the best case was only 0.22. This roughly indicates that up to 78 percent of the assumed theoretical model was due to something other than the relationship between depth of sample and terminal diameter. Rather than present this interpretation, Simpson merely published that his relationship was significant by plugging the results into the regression routine, calculating the correlation coefficient, r , and looking into a table to see if it was larger than some expected value for the sample size used. He did not publish a more rigorous model analysis such as residual plots or tests for the significance of the slope and intercept, and he did not bother with the fact that r^2 indicated a poor model fit. Confidence envelopes on regression models with such poor model adequacy could be so wide as to prove useless for all practical purposes. Even if the model were a good fit, this would not prove that there was a genetic evolution taking place. A simpler model would state that there was differential sorting of ammonites based on shell diameter, among other things, during the sedimentation process.

Dr. Duane Gish confronted an eminent British evolutionist on a similar issue. This scientist had included in his evolutionary textbook, an alleged example of observed evolution. The example claimed that there was an evolutionary trend in shell coiling from one

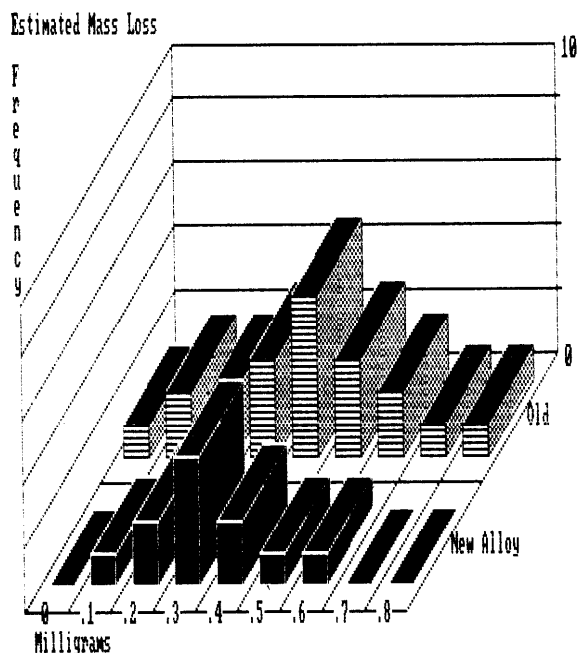
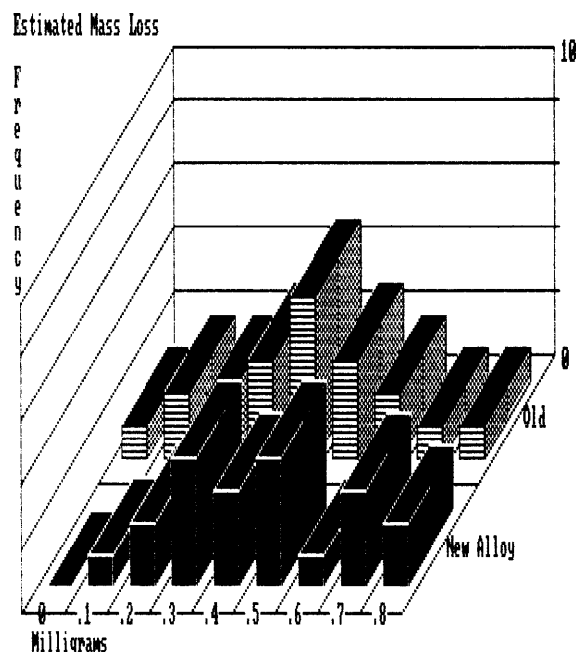


Figure 1(a). Results of a hypothetical experiment in which samples of two different metallic alloys were weighed, immersed in etching solution, and reweighed. Resistance to etching was determined by how much of the alloy was dissolved in solution. The higher the mass loss the less resistant the alloy is to etching. Insufficient sample size in this trial may lead to false conclusions due to "sampling error" (the samples do not adequately represent the true response of the population from which they were taken).



(b). Results of the same alloy experiment as shown in (a), with one notable difference. In this trial equal sample sizes of both alloys were used leading to quite different conclusions than those of the previous trial. Whether or not the new alloy had significantly more metal etched away (as the figure seems to indicate) would have to be determined by an appropriate statistical test since the distribution of mass loss, shown in the figure is not sufficiently different to tell otherwise. However, the total amount of mass loss for all samples (.92 milligrams for the new and .77 milligrams for the old) also support this conclusion.

direction to another and he retained this example in his textbook for college students despite the fact that it had been demonstrated that the coiling was related to the water conditions in which the invertebrate happened to find itself not due to phylogenetic trends. This is similar to the pitfalls outlined by Professor E. H. Andrews in his book *Is Evolution Scientific?*. Dr. Andrews cautions us that we must remember that theory is something other than fact. It is a mental construct, a model used to interpret facts. He gives the following illustration. Heavy smokers have a higher incidence of lung cancer than non-smokers. This leads some to the theory that smoking causes cancer. However a valid alternate theory is that whatever causes a heavy smoker to be dependent on smoking also predisposes them to be more prone to cancer or to the influence of carcinogens. The FACTS are identical for both theories, only the interpretations differ.³

Collecting of Data

Of utmost importance to the integrity of an interpretation is the validity of the data gathering process. By this I mean that the measurement process must be demonstrated to be in a state of statistical control.⁴ Furthermore accuracy (how close it is to a given value, and precision, how well it repeats the same set of measurements) should be determined and specified, allowing workers to assess the usefulness of results. (The practice of dating events in history to the nearest few million or billion years, after discarding undesirable values, is really stretching credulity.) An acceptable way of demonstrating control, accuracy, and repeatability is to take repeated measurements on a set of items in the range of interest over time and then to plot averages and ranges of each subset of measurements as in Figure 2. An upper control limit and lower control limit are derived statistically from the data set. Points beyond these limits (Figure 3) indicate an out-of-control condition which needs to be corrected and verified before the measuring apparatus can be considered reliable. The conditions under which the data are taken are also very important.

Dr. Melvin A. Cook criticizes much of the carbon-14 dating work on this count.

What is the justification for applying highly precise, analytical methods in an environment where contamination (by precisely the same isotope being analyzed) is greater by a factor of more than a hundred than the radioactivity-generated product one wants to determine.⁵

The amount of remaining sample, after preparation of the specimen, also brings these dating methods into question. Measurement errors are far more common than researchers are willing to admit, and when measurements vary greatly, a-priori preferences of the scientist or engineer often influence which data will be used and which ignored. (In 1983 I attended a scientific symposium on extinction at Chicago's famous Field Museum of Natural History where an eminent leader in the field of human evolution openly admitted this fact.) Engineers are often taught to throw out' outlying measurements data that do not fit their models even before good evidence of the cause of such measurements has been identified. Bias in recording data may cause misjudgments. For example in record-

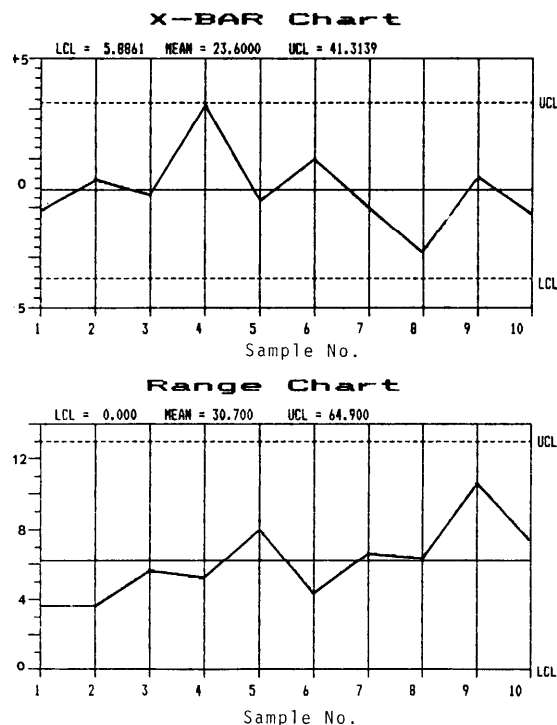


Figure 2. The results of repeated measurements on the same standard materials. Here a sample of five standards in the measurement range of interest were taken and weighed on 10 consecutive occasions (say 30 minutes apart). On each occasion the five readings were averaged, and the range was computed (highest minus lowest). Statistical limits are then computed for variation in averages and ranges using standard formulas. Finally the averages and ranges are plotted on separate charts against these computed limits and against a central line (average of the averages, or average of the ranges). Since all averages and ranges fall within the computed limits we can conclude that the measurement process is under control. (Normally at least 25 consecutive averages and ranges are used to compute statistical control chart limits.)

ing the results of 1000 weighings, operators showed a definite favor for either a zero or a five as the last digit in the report. A bias was also seen in favor of even over odd numbers.⁶ Even in critical areas, lab to lab variations can be quite substantial. This is well documented for such items as radiometric dates (recall how Richard Leakey's 1470 man was initially dated 220 million years old by the K-Ar method and was redated to a less unacceptable 2.6 million years old).⁷

When all the aforementioned considerations are addressed, we are still left with the task of formulating valid interpretations of the data which means that any extrapolations must be justified within the constraints of the measurement process and the system under study. This is especially true of natural systems which are seldom linear. A recent text in the area of regression analysis puts it this way: "Generally regression equations are valid only over the region of the regressor variables contained in the observed data."⁸ The reason for this is that beyond the actually observed levels of each factor—factors being such variables as temperature, pressure, laboratory, etc.—the model, which is only an approximation, may be totally useless. Consider a practical example. An acoustical

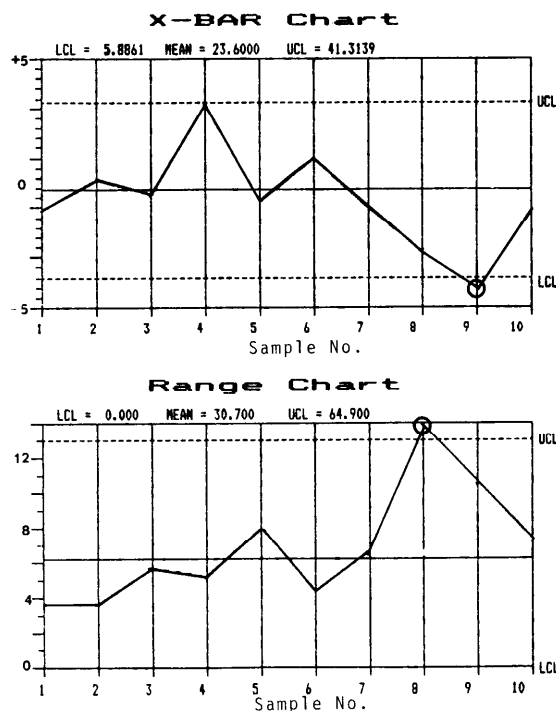


Figure 3. A point is found beyond the UCL (upper control limit) on the range chart for sample number 8. This out of control condition indicates two things: Firstly, that no interpretation of the mean of sample 8 can be made (although it appears to be in control) and secondly, that something has happened to cause an increase in the variability of the measurement process. Until the cause for this is found and eliminated one cannot rely on this process. In sample number 9 the variability is now under control (the equipment had been improperly used), and the level of the results are out of control as indicated by the point below the LCL (lower control limit) of the control chart for averages. This may indicate a drift or improper setting. Whatever the cause, it must be found and identified because the measurement process is unreliable until this is corrected.

engineer takes data on the amplification response of a transducer from 100 Hz to 3000 Hz and plots the data in Figure 4a. If he were to extrapolate this data back to 10 Hz and forward to say 20,000 Hz he might predict unlimited amplification of high frequency signals. Common sense and the laws of physics ought to tell this engineer that unlimited amplification is not probable and that he has not yet reached the limiting frequency level. The actual response curve of the same device from 10 Hz to say 20,000 Hz is seen in Figure 4b.

By the same token Dr. E. H. Andrews charges evolutionary theoreticians (biologists) in this way:

Secondly, in evolution, one finds the error of extrapolation, and this comes out in two ways. First of all, the observable processes of mutation and natural selection, which can be observed in the laboratory—processes you can actually carry out and see happen and with which there are no real problems or difficulty—have been forced back in time to explain changes of a kind that have never been observed in the laboratory—changes of a magnitude which cannot be envisaged in terms of anything that ever has been observed in the laboratory: . . . The theory of evolution requires

the extrapolation of observable things, such as various changes that can be wrought in the fruit fly, on which a tremendous amount of work has been done, to realms and events remote both in time and scale from the area in which the ideas have been validated.⁹

He also charges evolutionists with philosophical extrapolation of the limited biological concept of change to include the whole realm of nature including sociology, and providing extrapolated versions of natural selection to such non-validated areas as chemical evolution.

Another illustration from electronic engineering may provide some clarification. In this case a designed experiment was to be planned and one of the factors to be considered was the magnitude of the current. The preliminary data in Figure 5a indicated that the current could probably be increased until the upper power limit on the instrument was reached (40 watts). However, when more data were taken beyond the 20 amp range a threshold was reached at 30 watts (coded data) which indicated that most of the energy increase due to current increases greater than 20 amps was being dissipated and probably decreasing the life of the instrument. The linear model from 0 to 20 amps was invalid beyond the observed current range as proved experimentally in Figure 5b.

This concept of extrapolation may be the most important objection to the general theory of evolution and to uniformitarian geology voiced by Creation scientists. In other words, where facts are presented, creationists tend to agree with evolutionists (consider microevolutionary changes in gene frequency in the peppered moth *Biston betularia* for instance), but disagree fundamentally in interpretation of these facts, not only because of differences in world view, which creationists tend to admit while evolutionists may try to disguise, but from the scientific view that only models constructed from properly obtained data, not irrationally extrapolated, are valid representations of reality. Dr. Henry M. Morris points out another valid objection to uniformitarianism as does Dr. Andrews. that selecting facts such as measured rates which best suit an apriori model, rather than accepting an overall average or recognizing the existence of other rates, is not objective science.¹⁰ Creationists have also been accused of rejecting all data that indicate an old universe, but it would be more accurate to say that Creation scientists simply emphasize these facts more because they are not aired at all by uniformitarians. Most Creationists with whom I have spoken have indicated that the subject is still open. No evolutionists that I have ever met or read would ever tolerate such openmindedness about chronometric processes!

Let us now turn to a few typical examples from the concepts and models of evolutionary thought which clearly use questionable extrapolations. These will serve to illustrate the kind of objections which Creation scientists are pointing out, but they are not meant to be comprehensive or exhaustive.

CHEMISTRY—The Primitive Atmosphere'

The concept of a primitive reducing atmosphere is not exactly an extrapolation from present data since there is no data from the present atmosphere or geo-

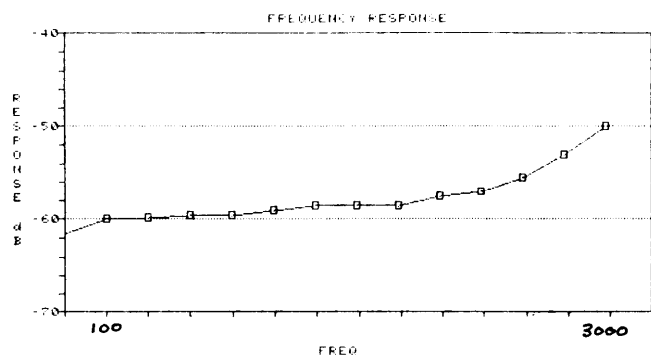
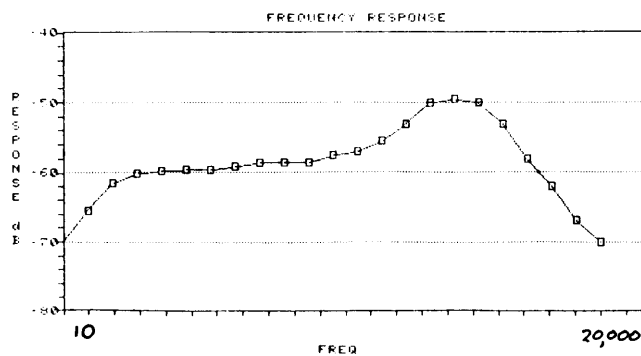


Figure 4(a). The response of an audio transducer to signals of various frequencies is plotted on this graph. Note that the frequency signals chosen range only from 100 Hertz (cycles per second) to 3000 Hertz.



(b). The same audio transducer is tested as before, only this time over a wider range of frequencies from 10 Hertz to 20,000 Hertz. Notice how different the response actually is at the high and low ends (beyond 100 and 3000 Hertz) than we would have predicted by extrapolation from (a).

logical samples which support the idea of extrapolation. An example of extrapolation would be assuming that our present oxidizing atmosphere can be post-dicted back in time. There is evidence in the form of old'oxidized rocks to support this. To postulate a reducing atmosphere falls more into the realm of wishful speculation or pipedreams than valid or invalid extrapolation. Nevertheless, the chemical evolutionist will devise a clever laboratory synthesis requiring teleonomy (thoughtful planning involving a kind of know-how), specific precursors, controlled conditions, and traps. He will obtain a few small polyaminoacids or perhaps some nucleotides by protecting them from the very conditions that produced them.

He will go on to extrapolate to an unknown primordial soup of his own invention, where his poly-aminoacids and other products are now in concentrations sufficient to drive the necessary chemical reactions in the right direction. These concentrations being extrapolated from the tiny yields obtained from the planned experiment. The energy source is also extrapolated from a controlled electric discharge inside glassware apparatus to gigantic lightning bolts containing enough energy to start the desired reactions, but not sufficient enough to damage the products just fractions of a second later! Concerning optically active levo (l-form) amino acids, these researchers are willing to obtain a yield, unstable as it may be, which is insignificantly biased in the favor of the l-form, or not

biased at all, and by methods unknown to the laws of chemistry, extrapolate back in time to a soup containing conveniently isolated regions of just the compounds needed in biomolecular syntheses, despite the fact that from a purely chemical point of view there is no selectivity between the two forms (l- and d-) for they are chemically alike. The method of isolation of the l-form is extrapolated from the man-made glass trap or bentonite filter, to natural segregation on a scale unknown to the laboratory chemist. We could show how there is almost no information contained in these laboratory products, yet the evolutionist extrapolates the auto-genesis of information many magnitudes greater without a chemist to plan, guide or control the synthesis.

Probably the most horrendous extrapolation of all is from unstable, physico-chemical, soap-like blobs of compounds with comparatively minute molecular weights and trivial primary structure, which were delicately manufactured in the laboratory, to the incomprehensibly complex biological molecules, (containing not only primary, but also secondary and tertiary structure with coded recognition sites) organelles, membranes, hereditary systems and codes. All this occurs in the absence of enzymatic stepwise, cell-mediated, reactions without the extracellular influences of hormones and other compounds.

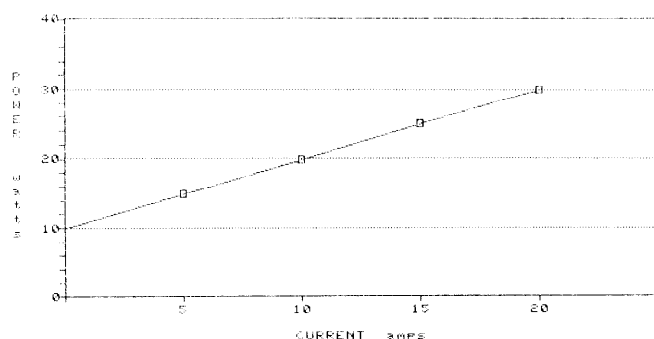
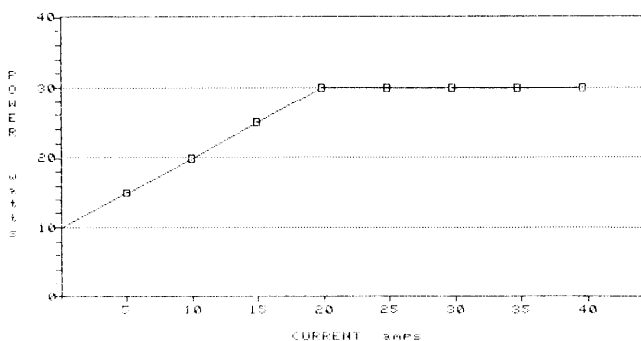


Figure 5(a). An electronic device [power output (Watts)] was chosen for use in an experiment. Since the amount of current (amps) through the device affected the power output, the machine was set at several different current levels (0-20 amps) and the output measured and plotted.



(b). When the same electronic device was actually measured over a wider range of current (0 to 40 amps), the observed power output was very different than predicted by extrapolation from (a). No higher output was measured from 25 to 40 amps than was obtained at 20 amps, and yet a much higher output (50 Watts) would be expected based on the limited results of the preceding plot.

Creationists stagger at this level of extrapolation, recognizing that it is tantamount to nothing short of blind illogical faith when it is realized that the fundamental laws of chemistry taught to college students, such as: mass action, stoichiometry and equilibrium, all preclude such events in the first place in much the same way that the laws of physics precluded unlimited amplification of high frequency inputs by the audio device shown earlier.

Biology

Creationist biologists Lane Lester, Gary Parker,¹¹ Frank Marsh,¹² and William Tinkle have argued that there exist tremendous amounts of variation in the plant and animal kingdoms, as well as among bacteria and protists. These are recognized by the evolutionist. However the Creationist recognizes that while variability and flexibility exist in the organisms, at the same time a discontinuity exists between fundamentally basic kinds, and this is true from the fossil record of life also. These boundaries are maintained by such mechanisms as reproductive and behavioral isolation including genetic incompatibility and temporal isolation. In both field and laboratory studies these facts are well substantiated.

For example, breeders of livestock and crops have been able to select pre-existing traits such as short sheep legs or high sugar content in beets by continued breeding and separation, much as one would separate all the kings and aces from a deck of cards by continued shuffling and separation. In the laboratory similar work was done by great geneticists like Morgan, and Goldschmidt who worked with fruit flies. What linked all these accomplishments together was an emerging fact that all the traits in question would be selected only so far, i.e., variability could be carried to a point, and then there would be no change just as if a limiting condition had been reached such as that illustrated in Figure 5b. This held for thorax bristles on fruit flies as well as sugar content in beets and a host of other phenotypes. As a matter of fact, artificial selection can actually lead to a weaker genetic system for both organisms and breeder. With wheat, for instance, men have been selecting and screening phenotypes (and therefore genotypes) for so long that a recent article in *Scientific American* explained that modern breeding methods have reduced genetic variability in cultivated wheats and that the best hope for crop improvements is backcrossing with the wild type in order to protect the now impoverished crops from diseases and climatic changes, and to increase the possibility of effecting more improvements in these crops. As the authors state: "... the genetic material of the cultivated wheats has already been exploited for breeding purposes almost to its full capacity."¹³

The charge against evolutionists who formulate their elaborate scenarios, is that they failed to halt when obvious natural system constraints or limits were met. Evolutionary scientists postulated unlimited variability and directional natural selection by extrapolating from the limited within-kind variation and directed artificial selection despite biological constraints. This is analogous to an engineer promising unlimited amplification after having seen Figure 4b in the transducer example. In addition evolutionists extrapolated vastly the rate

of generation of beneficial mutations from a data set which indicates that while mutation rates may fluctuate they tend towards degradation not integration and creation. In fact Goldschmidt abandoned the concept of gradual evolution caused by induced slightly beneficial mutation guided by natural selection after spending the better part of his scientific career trying to prove it. Running up against the system constraints, Goldschmidt admitted that extrapolation of micro-evolutionary variation to the gigantic changes required to support macroevolution was inappropriate. (Of course what he offered in return was no better—the hopeful monster's route to crossing systematic kind boundaries, which had only contrary evidence from field and lab.)

Dr. Walter Lammerts also demonstrated definite limits to variability in the plant kingdom even when the mutation rates of roses were accelerated in a classic creation science research project.¹⁴ Dr. William Tinkle reminds us that the laws of Mendel and Hardy-Weinberg equilibrium tend to maintain the status quo regarding the gene pool within kinds.¹⁵

Other areas of illogical evolutionary extrapolation include the concepts of 'protective' and 'warning' colorations which are derived from the observation that some species appear to mimic the patterns and/or colors of others, (In many cases even mimicry is just assumed because it presupposes that the model existed prior to the alleged mimic.) It all started when some reports were published that indicated that certain pattern configurations and colors on the wings of *Lepidopterans* (butterflies and moths) protected them in the wild by decreasing predation from birds and other insects. This was developed to the point that biologists had an apriori expectation that certain colors and patterns served functional purposes directly traceable to natural selection and that both 'mimic' and 'model' were to be found in every instance. Unfortunately for these theorists, the situation proved to be much more complex than expected and genetic evidence tended to refute rather than support the idea that such relationships were the result of evolution as pointed out by Dr. Lane Lester.¹⁶

Wolfgang Wickler showed that some of the components of a pattern were independently controlled by different genes and insisted that this kind of mechanism could only lead to the conclusion that the entire system of genes had to originate SIMULTANEOUSLY in order for the patterns and colorations to be effective. He also stated that in many forms, only one of the sexes will either 'mimic' or 'model' which calls into question the role of natural selection because it apparently works against the males in the cited cases. His most stunning contribution regarding extrapolation is found in the section dealing with the distribution of the coral color pattern in snakes. We find that it bears absolutely no resemblance to the family tree of snakes and is distributed among snakes with different kinds of venom and non-poisonous snakes as well. It is found in nocturnal and diurnal forms. The distribution of coral type color bands in snakes appears to be a mosaic. Clearly then, indiscriminate extrapolation to warning, protective, cryptic and other functional roles for all these patterns is unwarranted. In fact Wickler states that any attempt at a neat explanation

is doomed to failure.¹⁷ Silberglied, Aiello and Windsor of the Smithsonian Tropical Research Institute demonstrated experimentally that so called protective coloration patterns in *Anartia fatima* — a tropical butterfly served no such function.¹⁸

An interesting observation regarding the extrapolation of mimicry and homology is that it has caused most biologists to overlook what may prove to be a fascinating research program (the possible verification of a mosaic distribution of traits throughout the biosphere), which is of interest to Creation scientists.^{19,20} G. Evelyn Hutchinson, one of America's great ecologists, wrote an article in which he recognized the mosaic nature of the environment. This may or may not prove to be related to trait distribution.²¹

Evolutionists assume that single-celled life forms are so simple that multicellular forms evolved from them. As research has advanced in the past 50 years or so, one fact is clear, single celled organisms are anything but simple. They are complex and there is no logical reason to suggest that many-celled organisms evolved from them except that many is a larger quantity than one! The Evolution Protest Movement published a favorite quote of mine concerning this form of extrapolation which reads:

With the fullest confidence it may be affirmed that the more anything—or any part of anything—is examined, the more complex it turns out to be: there is always a beyond. Nothing is simple. Nothing ever was simple—not even Simple Simon. Simple things did not come first, for the simple reason that simple things never existed, except in the imagination of simpletons, wrongly and perversely conditioned.²²

Consider this quote from within the evolutionary camp:

Criticism is frequently leveled at biological scientists of all types that they are extending their hypotheses far beyond the point permitted by their data. If one wishes to compile the largest book in biology, it could well be a collection of these accusations, each asserting that such-and-such an author is indulging in speculation or guesswork. Probing into the dark, however, is one of the most important features of the scientific method.²³

I can add this article to his "largest book in biology" and while science may advance from time to time by speculation, let's not peddle those speculations as facts to be force-fed to undergraduate biology majors!

Geochronology

I will discuss just two areas where extrapolations would appear to be valid, and yet are not carried out by evolutionary geologists. The first deals with the amount of sediment, or dust, found at present, and the rate at which it is known to deposit. One of the most famous is the moon dust. Here meteoric dust is settling at a known rate on the surface of the moon. If we measure the depth of this dust on the surface of the moon and extrapolate the present rate of influx of this dust back in time we could estimate or place an upper limit on the age of the moon. Evolutionists are unwilling to perform this task, at least publicly, because this leads to an embarrassingly young age for

the moon which is more consistent with Creationism. An interesting interchange on this subject was recently printed.²⁴ Estimates of earth sedimentation might have been similarly extrapolated but were not.

Professor Andrews indicates that if present rates of terrestrial sedimentation are extrapolated back, that the depth of sediment that would be expected, if the earth were billions of years old, would be about 500,000 feet. Yet the observed depth is only 1/10th of this. To circumvent this evolutionists extrapolate present erosion rates millions of years back in time attempting to explain the missing 9/10 of the earth's sediment. This Andrews points out is extrapolation with a vengeance! Since sedimentation is a process, Dr. Andrews questions whether it might not be more appropriate to select some kind of average rate rather than ignoring all rapid rates.

My argument is, however, that the accepted geological time scale was originally fixed by just such crude assumptions and has not been recalculated to take account of the complexity of the sedimentation process. Indeed, it is doubtful whether any age estimate based upon sedimentation rates would be accepted today if it were advanced for the first time!²⁵

A second area where some extrapolation may appear to be valid, but is not recognized by most geologists is the rate of certain electromagnetic decay phenomena. Two that come to mind are the speed of light pursued by Barry Setterfield²⁶⁻²⁸ and Dr. Tom Barnes' work with the earth's electromagnetic dipole moment. An acceptance of the speed of light decay as a real phenomenon, rather than just an anomaly or simply a trend towards increasing accuracy in the measurement process, is actually quite new and there is not yet agreement even within the Creationist camp. The point to remember is that it is being given serious consideration even by Creationists who have objections to it, but evolutionists are ignoring the data altogether.²⁹⁻³²

Dr. Barnes' very painstakingly collected data from studies of the overall dipole moment of the entire earth. When extrapolated backward in time this suggests an upper age limit for the earth in thousands of years rather than millions.^{33,34} Since in Barnes' work the data are gathered over a period of about 150 years and extrapolated backwards to only a few thousand years, this would appear to be more valid than extrapolations from radioisotope dating methods where measurements taking only hours are extrapolated out to billions of years. Some examples of this have already been discussed.

One which is of interest to many, is the Grand Canyon area where uniformitarian geologists claim that the Colorado river began carving out this massive canyon 1.8 million years ago and subsequently eroded away the strata, thus exposing the older rocks. All this, they claim took place at the slow pace of known river-erosion today. If the river has not been eroding for 2 billion years, and we will never prove it one way or the other— then the Canyon must have been formed quickly. Creationists, of course point to evidence of a rapid cutting of the canyon probably caused by a massive flooding and runoff in a relatively short time. They remind evolutionists that the missing strata from

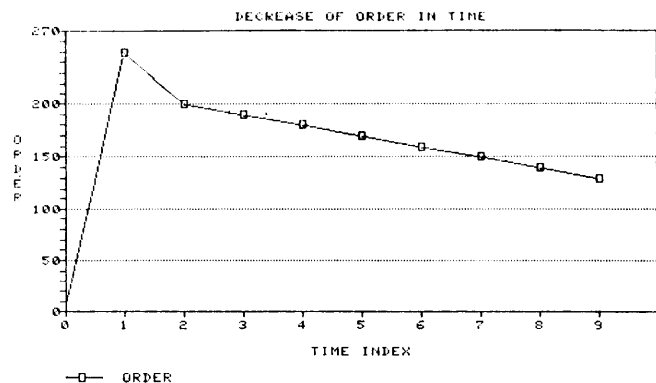


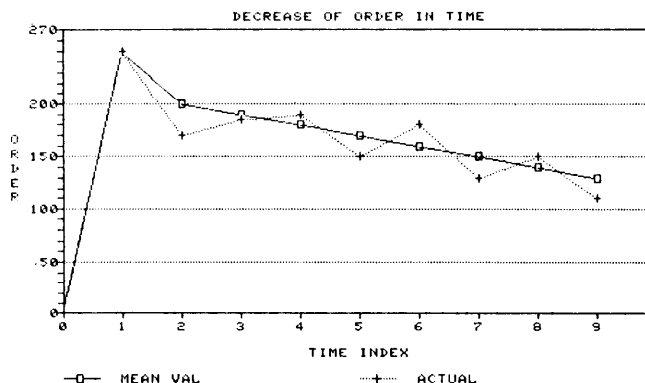
Figure 6(a). Both the order and time scales are arbitrary and no actual measurements were taken. Nevertheless, the model of decreasing order in the cosmos is accepted by both evolutionists and creationists. The line from time 0 to time 1 (the beginning) is extrapolated by either model. In fact, the vast majority of the graph is extrapolated since by either model, measurements are only taken over a very small time range. (Of course for young age creationists, that portion of the line is relatively large in proportion to the rest of the line when compared with the long age supporters, and is therefore more valid.)

the canyon walls are not missing because there is no evidence that they were ever there! This does away with 200 to 300 million years of uniformitarian time.

Dr. Henry Morris has pointed out that most of the assumptions of uniformitarian dating methods are wildly extrapolated. These include a) closed system—despite evidence that leaching contamination and mixing take place in most systems, b) constant rate—again, despite experimental evidence that rate is affected by environmental factors, c) initial concentration of daughter and parent ratios—regardless of the scientific fact that such an extrapolated determination is impossible to make.

It should be noted that much of the above cited work by Creationists, and other items such as the shrinking sun, earth's heat dissipation, rates of elemental influx/efflux, also represent extrapolations and therefore are subject to the same constraints mentioned at the outset of this paper. Whenever possible, Creation scientists ought to take care to clearly explain any limitations in their models as to both system boundaries and data collection schemes.

A conceptual example is given in Figure 6a where background fluctuations are shown in Figure 6b (i.e.: local increases in order).³⁵ This kind of a model of order decreasing with time from index one to nine is an acceptable model for both creationists and evolutionists. Both are responsible for telling readers exactly how much of the model is the range of data, such as observed measurements between say four and five, and how much is extrapolated in either a valid or invalid way. The limitation here is the line drawn between index-time zero to one. Incidentally since this figure is only for illustration, neither scale is meaningful, just conceptual. Therefore the slope of the line between zero and one is not meant to represent the process of the beginning of the universe, only that there was such a beginning (increase in order). This is because a relative increase in order or information of this nature has never been observed, so that the origin



(b). This is identical to (a) except that a hypothetical—actual value—line is added to represent local fluctuations in order about the original—mean value—line.

of that line is clearly not derived from even an extrapolated model. For evolutionists, if they were to deal openly with the issue, they would not postulate the Big Bang as if it were a proven fact rather than a derived hypothesis from one interpretation of astronomical data. They do this despite valid alternate interpretations of that data,³⁶⁻³⁹ and the inadequacy of the explanation under cause and effect evaluation. The problem is that such a line viewed by most readers, especially students, implies something much more substantial than in fact exists without proper explanations pertaining to its actual origin.

Creationists postulate scientifically that since the system is running down it must have started up and since no known mechanism exists that could start it up, according to thermodynamics, that it must have been started up from outside itself by a cause greater than the system. The cause, being outside the system is not measureable, although the nature of the cause can certainly be inferred from the effects (complexity, etc.). Nevertheless, the only way to present the data is to explain that the line from zero to one is inferred not observed, and that it is inferred on a scientific basis from valid laws of physics, although even that is a limited inference since the laws do not tell us about a period preceding them. This is much like the audio transducer response example except that we cannot scientifically extend our model backward beyond one or forward beyond nine by taking more data.

I agree with the British, Australian and some American Creationists, who at this juncture have no reservations about describing the origin of the line up to one as being taken on good authority from revelation rather than human observation. To those who accept it, revelation is fact and it is a far sight better than materialistic guesswork.

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ARCHAEOLOGY AND THE ANTIQUITY OF ANCIENT CIVILIZATION: A CONFLICT WITH BIBLICAL CHRONOLOGY? — PART I

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Abstract

Near the end of the 19th century, A.D., White made the claim that historical and scientific evidence regarding the antiquity of ancient civilizations proved that the Biblical chronology was impossibly short and of no historical value. During the course of the 20th century, historians have been steadily decreasing their estimate of when ancient civilization began. In recent years, several scholars have been working on a radical revision of ancient history which reduces the antiquity of ancient civilization even further. These recent revisions of ancient history may very well prove to eliminate entirely any supposed conflict between Biblical chronology and the antiquity of human civilization.

Introduction

One of the issues in the Creation/evolution controversy is the antiquity of man, both primitive man and civilized man. In this article, we will be concerned primarily with the issue of the antiquity of the ancient civilizations.

The publication of Darwin's book, *Origin of Species*, in 1859 produced an upheaval in the history of human thinking, but not because evolution was a new idea. The concept of an evolutionary development of life

forms had been around since the time of the ancient philosophers, more than 500 years B.C., and was in fact popular among many intellectuals for a century before the publication of Darwin's book. But the appearance of *Origin of Species*, whatever the reason, sparked a new interest in this ancient concept that swept over the entire globe like a tidal wave and caught the imagination of people of every station and walk.

One of the most enthusiastic supporters of evolution in the early days after the publication of Darwin's book was Andrew Dixon White. In 1896, after years of diligent research, White published a large two-volume

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work entitled, *A History of the Warfare of Science with Theology in Christendom*. The entire work was devoted to showing how the new “scientific” thinking (evolutionism) had triumphed over the oppressive superstitions of the Biblical religion.

Chapter 6 of Volume 1 is entitled, “The Antiquity of Man, Egyptology, and Assyriology.” The chapter begins with these words:

In the great ranges of investigation which bear most directly upon the origin of man, there are two in which Science within the last few years has gained final victories. . . . The first of these conquests relates to the antiquity of man upon the earth.¹

The first half of the chapter is a historical survey of the conclusions of Christian and Jewish theologians regarding the antiquity of man and the age of the earth from their study of the Old Testament chronological data. White then, in the remainder of the chapter, proceeds to show how recent archaeological discoveries proved that the antiquity of man was much greater than any interpretation of the Biblical chronology could possibly accommodate.

The conclusions of several Egyptologists regarding the date for the beginning of ancient Egypt’s dynastic history are cited by White: Marriette dates the beginning of the first dynasty at 5004 B.C., Brugsch at 4500 B.C., and Meyer at 3180 B.C. White also correctly points out that Egyptian civilization was already highly developed even during the first few dynasties which suggested to him a lengthy pre-dynastic period of development. White also points out (correctly) that there are no major discontinuities in the history of ancient Egypt that could possibly correspond to the worldwide Flood of the book of Genesis. The conclusion White arrives at is that the Biblical chronology is impossibly short and is of no historical value. The purpose of this study is to re-evaluate this conclusion in the light of more recent developments.

Biblical Chronology

Throughout this article, our discussion will be based upon three assumptions that are generally held by many Creationist scholars; no attempt will be made at this point to defend these. The first assumption is that the chronological data contained in the Old Testament is accurate. This issue is, of course, tightly bound with the larger issue of the inspiration and inerrancy of Scripture which is far beyond the scope of this article.

The second assumption is that there are no gaps in the genealogies of Genesis 11 which would mean that there is a total of 352 years from the time of the Flood to the birth of Abraham.^{2,3} Some Creationists do feel that there may be gaps in the genealogies of Genesis 5 and/or Genesis 11 but for the purposes of this discussion we will be conservative and assume no gaps, at least in Genesis 11. These first two assumptions allow us to calculate the dates of the major events of Old Testament history, some of which are shown in Table I. The date that is of the greatest interest to us for our present discussion is that of the Flood; 2519 B.C.

If we further assume that the Flood of Genesis 9-11 was indeed a worldwide catastrophe that laid down

Table I. Dates of Major Events in Old Testament History According to Biblical Chronology.

Event	Date B.C.
The Great Flood	2519
Birth of Abraham	2167
Jacob Enters Egypt	1877
Exodus From Egypt	1447
Conquest of Canaan	1407
Death of Solomon	931
Babylonian Exile	587

the vast majority of the sedimentary rock strata, we can safely conclude that the archaeological remains from any pre-Flood civilization were obliterated and that the archaeological record we now possess is entirely post-Flood (except perhaps for isolated artifacts). This is why we are concerned only with post-Flood chronology.

If we accept these three assumptions, then the problem before us is whether the 2500 B.C. date for the Flood is compatible with the date of the most ancient civilizations that have been discovered by archaeologists. In White’s day, over 85 years ago, the beginning of Egypt’s dynastic history was variously dated between 3000 and 5000 years B.C. What is the current state of affairs?

Egypt

This history of ancient Egypt is of primary importance for two reasons. First because of the great continuity of Egypt’s 31 dynasties spanning over 2700 years according to the conventional dating of these dynasties. Secondly, because the chronology of ancient Egypt is considered to be so well established that contacts with Egypt are used to determine absolute dates for many other kingdoms of ancient times that otherwise would have only a relative chronology. For example, an archaeologist digging in Palestine or Syria can assign an upper limit to an absolute date on the B.C. time scale to a certain level of a tell if he can find in that level some Egyptian artifacts that can be identified as belonging to the reign of a particular Pharaoh or from a particular dynasty. In this way, the absolute dates of other ancient civilizations are determined by where they fit into Egypt’s history.

If it can be shown that Egyptian civilization is more ancient than 2500 B.C., then we will have good reason to question one or more of our three assumptions discussed above. We have already seen that at the turn of the century, there was a great divergence of opinion among Egyptologists regarding the date of the beginning of Egypt’s dynastic history. Since that time the more ancient dates have been rejected and there has emerged a much more uniform consensus which places the beginning of the first dynasty at c. 3100 B.C. (although some favor a date as late as c. 2900 B.C.) In 1975, Johannes Lehmann noted that:

In the course of a single century’s research, the earliest date in Egyptian history— that of Egypt’s unification under King Menes [first King of the first dynasty]— has plummeted from 5876 to 2900 B.C., and not even the latter year has been established beyond doubt. Do we, in fact, have any firm dates at all?⁴

Likewise, the date of the beginning of Egypt's pre-dynastic period has also been lowered and it is now generally dated somewhere during the interval between 5000 and 4500 B.C. (see Table II).

Even more recently this 20th century consensus has been challenged by Jewish, Christian, and secular writers who are calling for a complete revision of ancient history. An important aspect of this revision is a radically different view of Egyptian chronology which reduces the antiquity of Egypt's dynastic history even further.

Table II. The Periods of Egypt's Ancient History.

Period	Dynasties	Commonly Accepted B.C. Dates
Pre-dynastic	—	c. 5000 - c. 3000
Proto-dynastic	1-3	c. 3000 - 2613
Old Kingdom	4-6	2613 - 2181
First Intermediate	7-10	2181 - 2133
Middle Kingdom	11,12	2133 - 1786
Second Intermediate	13-17	1786 - 1567
New Kingdom	18-20	1567 - 1085
Third Intermediate	21-24	1085 - 715
Late Dynastic	25-31	715 - 332

Oedipus and Akhnaton

Our story begins with a Jewish scholar, Immanuel Velikovsky, born in Russia in 1895. Velikovsky received a medical degree from the University of Moscow and studied psychoanalysis in Vienna under Wilhelm Stekel, one of Freud's disciples. From 1924 to 1939 Velikovsky lived in Palestine and practiced psychoanalysis.

In 1939, shortly before his death, Sigmund Freud published his last book entitled *Moses and Monotheism*. In this work, Freud developed the theory that the 18th dynasty Egyptian Pharaoh Akhnaton was the first monotheist and that Moses borrowed the concept from him. Velikovsky read Freud's book shortly after it was published and his interest in Pharaoh Akhnaton was immediately stimulated. During that same year, 1939, Velikovsky left Palestine to spend a sabbatical year doing research in New York. He never returned to his practice of psychoanalysis in Palestine.

Velikovsky's initial studies impressed him with a number of remarkable parallels between Pharaoh Akhnaton and the legendary figure of Greek tragedy, Oedipus, who curiously enough, was the subject of one of Freud's psychoanalytic theories earlier in his career. The puzzling thing about these parallels was that the various tragedies about Oedipus were written by playwrights separated by 700 miles from Egypt and by 700 years from the era of Akhnaton! The challenge of such a puzzle launched Velikovsky into an intense study of ancient times and resulted in a radical reconstruction.

Ages in Chaos

Basic to the reconstruction is the recognition that ancient Egyptian history, which for modern historians is the foundation and reference point for synchronizing the histories of many other ancient kingdoms, is in a state of chronological disarray. The history of ancient Egypt was first arranged into 31 dynasties by a third century A.D. Egyptian priest by the name of Manetho.

For many years scholars have recognized that Manetho's chronology left much to be desired. In 1927, the well known Egyptologist James Breasted wrote that the chronology of Manetho was:

a late, careless, and uncritical compilation, the dynastic totals of which can be proven wrong from the contemporary monuments in the vast majority of cases, where such monuments have survived. Its dynastic totals are so absurdly high throughout, that they are not worthy of a moment's credence, being often nearly or quite double the maximum drawn from contemporary monuments, and they will not stand the slightest careful criticism. Their accuracy is now maintained only by a small and constantly decreasing number of modern scholars.⁵

Velikovsky has gone even further and has called Manetho's chronology "a most confused and deliberately extended and misleading list."⁶ In another place Velikovsky writes:

In composing his history of Egypt and putting together a register of its dynasties, Manetho was guided by the desire to prove to the Greeks, the masters of his land, that the Egyptian people and culture were much older than theirs and also older than the Babylonian nation and civilization.⁷

Rather than trying to sort out the chronology of Manetho and the various king lists recorded on monumental inscriptions, Velikovsky has taken an entirely different approach in his attempt to recover the history of ancient Egypt. Velikovsky noticed that despite the fact that the Old Testament historical narratives record many contacts between Egypt and Israel, the modern student of Egypt's ancient history was unable to identify any of these contacts in reading the books of modern historians (one exception to this will be noted later).

Not only were there no synchronisms between the histories of Israel and Egypt but there were countless discrepancies and enigmas encountered in the attempt of archaeologists to reconcile the history of the Ancient Near East with the results of their excavations. Velikovsky's approach was to ignore the chronology of Manetho and the monumental king lists and instead to search for direct historical links between Israel and Egypt using the Hebrew Scriptures and the available Egyptian inscriptions. Using this approach, Velikovsky began the task of rewriting ancient history.

After 12 years of research, the first installment of the reconstruction was published in 1952 under the title *Ages in Chaos*. This work covers a period of 600 years from the time of the Exodus to the era of Ahab and Jehoshaphat. In *Ages in Chaos*, Velikovsky synchronizes the end of the Middle Kingdom in Egypt with the Exodus and identifies the Hyksos, who ruled Egypt during the Second Intermediate Period, as being the Amalekites of Scripture (see Table II).

The beginning of the New Kingdom in Egypt is moved from the 16th century B.C. to the 11th century B.C. and numerous synchronisms between Egypt during the 18th dynasty and Israel during the Monarchial Period are established (see Table III). Tuthmosis I is identified as the Pharaoh who according to I Kings 9:16 captured the Canaanite city of Gezer and gave it as a dowry to his daughter who married Solomon.⁸

Table III. Egypt's Eighteenth Dynasty.

Ruler	Commonly Accepted Dates B.C.
Amosis	1570 - 1546
Amenhotep I	1546 - 1526
Tuthmosis I	1525 - 1512
Tuthmosis II	1512 - 1504
Hatshepsut	1503 - 1482
Tuthmosis III	1504 - 1450
Amenhotep II	1450 - 1425
Tuthmosis IV	1425 - 1417
Amenhotep III	1417 - 1379
Akhnaton	1379 - 1362
Smenkhkare	1364 - 1361
Tutankhamun	1361 - 1352
Ay	1352 - 1348
Horemheb	1348 - 1320

Queen Hatshepsut (conventionally dated 1503-1482 B.C.) is identified as the Queen of Sheba who visited King Solomon during the middle of the 10th century B.C. Thirty-eight pages of evidence are given in support of this identification.⁹ Velikovsky points out that the Talmud indicates that "Sheba'in the title Queen of Sheba is not a geographical designation but a personal name."¹⁰ A quick check of the NAS concordance shows that the word Sheba is used both ways in the Old Testament (three times as a personal name, once as a Canaanite city, and once as a nation or place). Velikovsky also points out that Josephus speaks of the Queen who visited Solomon as being the ruler of Egypt and Ethiopia. A series of reliefs on the walls of Queen Hatshepsut's splendid temple near Thebes tell of her journey to the land of Punt which Velikovsky identifies as Israel.

Tuthmosis III (sole reign: 1482-1450 B.C., according to conventional dating) is identified as the Pharaoh Shishak of Scripture who despoiled the temple of Solomon in the fifth year of Rehoboam, Solomon's son and successor. Hieroglyphic inscriptions cut in the walls of the great Amon temple in Karnak record the military campaigns of Tuthmosis III. Velikovsky reveals that one of these reliefs pictures a large quantity of temple furnishing and utensils that corresponds in a remarkable way to descriptions in the Old Testament of the furniture and equipment made for the tabernacle and temple.¹¹ This relief at the temple of Amon does not mention or picture any idols or images of gods or goddesses, a fact which is consistent with Velikovsky's contention that it depicts spoil taken from the Jerusalem temple.

Amenhotep II (conventionally dated 1450-1425 B.C.) is identified as the King Zerah who invaded Judah and was defeated by King Asa (910-869 B.C.), the great-grandson of Solomon. Curiously enough, the Scriptural account of this battle (II Chronicles 14) calls Zerah an Ethiopian; Velikovsky points out that there was Ethiopian blood in the 18th dynasty and that in one monument Amenhotep I is pictured with a black face.¹²

The Amarna period (conventionally dated 1379-1352 B.C.) is redated to the time of Ahab and Jehoshaphat (first half of the ninth century B.C.) and Ahab is actu-

ally identified as one of the Amarna correspondents. Pharaoh Akhnaton, who Freud considered to be the first monotheist, is redated to the ninth century B.C., approximately 600 years after the time of Moses.¹³

In 1960, twenty years after its conception, *Oedipus and Akhnaton* was published. This work deals at much greater length with the Amarna period and with the specific problem that first called Velikovsky's attention to the need for the reconstruction.¹⁴

The foreword to *Ages in Chaos* promised that an additional volume would soon appear that would bring the reconstruction down to the time of Alexander the Great. Publication of the sequel was delayed again and again, and in the intervening years, the remainder of the reconstruction grew to three additional volumes instead of one. Finally, after an additional 25 years of research, *Peoples of the Sea* appeared in 1977 covering the period from the Persian era to Alexander the Great. The next year, 1978, *Ramses II and His Time* was published, covering the period of the Neo-Babylonian Empire. A forthcoming volume promises to fill in the period of the Assyrian supremacy. Several articles in *Kronos* provide some of the material from this forthcoming volume¹⁵⁻¹⁸ and defend Velikovsky's rearrangement of dynasties 19 and those following.

In his study of the Assyrian period, Velikovsky argues that the 22nd-24th (Lybian) dynasties and the 25th (Ethiopian) dynasty are the only ones correctly dated in the conventional chronology. One of the reasons for this is that Tirhakah, the third Pharaoh of the 25th dynasty, is mentioned both in eighth century Assyrian inscriptions and in the Scriptures (II Kings 19 and Isaiah 37).

During the reign of Hezekiah, Sennacherib King of Assyria invades Judah and lays siege to Jerusalem. It was earlier in this same campaign that Sennacherib lays siege to the city of Lachish possibly to cut off any aid that might come from Egypt. While at Lachish, Sennacherib sends part of his army to lay siege to Jerusalem and warns Hezekiah not to place his trust in Pharaoh King of Egypt. Isaiah the prophet reassures Hezekiah that the Assyrian siege will be lifted because the servants of Sennacherib blasphemed Yahweh. The plot thickens when an army led by Tirhakah of Cush (Ethiopia) approaches to challenge the Assyrian forces. Ultimately, deliverance comes not from man but from God when a mysterious catastrophe destroys the entire Assyrian army during the night. Just reading the Biblical account shows that the Pharaoh of Egypt and Tirhakah the Ethiopian are one and the same and it was not hard for historians to make the connection with the 25th dynasty Tirhakah.

Babylonian/Hittite Empire

In *Ramses II and His Time*, Velikovsky deals with the Neo-Babylonian period, the time of Jeremiah, Ezekiel, and Daniel. Ramses II (conventionally dated 1290-1224 B.C.) is the third ruler of Manetho's 19th dynasty. Velikovsky argues that the 19th dynasty does not directly follow the 18th and that the correct order is 18, 22-25 (Lybian & Ethiopian) and then 19. He also argues that the 19th and 26th dynasties are identical rather than being separated by over 600 years. Ramses I (of the 19th dynasty) is identified as Necho I (of the 26th dynasty); Seti I (19th) is Psammetichus I (26th);

Ramses II (19th) is Necho II (26th), etc. Necho II is the Pharaoh who killed King Josiah of Judah at Megiddo (609 B.C.) when Josiah attempted to block Necho's passage to Carchemish where Babylonian forces had the remnants of the Assyrian army cornered.

The Hittite Empire of the 13th century B.C. is brought forward over 600 years and is identified as part of the Neo-Babylonian Empire. When the ancient ruins at Boghazkoi first began to be excavated in 1905, art experts dated the stone orthostats to the seventh and sixth centuries B.C. But other scholars were sure that the ruins were that of the Hatti, the enemies of Ramses II during the 13th century B.C. When Hugo Winkler discovered at Boghazkoi in 1906 a copy of the treaty between Ramses II and Hattusilis III, King of the Hatti, the issue was settled. The treaty was a translation of one previously found in Egypt and there was no longer any doubt that the ruins were from the 13th century B.C. Velikovskiy's reconstruction restores the so-called Hittite empire to the 7th/6th centuries B.C. and identifies Hattusilis III as being none other than the dreaded Nebuchadnezzar of Scripture who lived during the time of Daniel the prophet. The ruins excavated in central Anatolia have nothing to do with the Biblical Hittites; 250 pages of evidence are given in support of this portion of the reconstruction.¹⁹

Sea Peoples/Persians

In *Peoples of the Sea*, Ramses III (1198-1166 B.C.) of the 20th dynasty is moved closer to the present era by 800 years. The Sea Peoples that Ramses III repulsed from Egypt in a series of battles are shown to be not the Philistines of Scripture (which is the conventional identification) but rather the Persians using Greek mercenaries. Velikovskiy points out that Greek letters appear on the back of glazed tiles used in a palace supposedly built by Ramses III hundreds of years before the Greek alphabet emerged.

Just a mile away from this palace, a cemetery was discovered and excavated in the 1880s by Griffith and Naville. Based on scarabs of Ramses III, Griffith dated the cemetery to the 12th century B.C. But Naville was equally certain that the cemetery should be dated very late, to the fourth century B.C. because of the style of the paintings and hieroglyphs. By uncovering old enigmas such as this that had been all but forgotten by modern scholars, Velikovskiy shows that Ramses III and the 20th dynasty belong in the Persian and Greek era, 800 years closer to the present.²⁰

Other scholars, who also see a need for a revision of ancient history, have taken issue with much of the latter part of Velikovskiy's reconstruction as presented in *Ramses II and His Time* and *Peoples of the Sea*. Many have now rejected the way Velikovskiy rearranges dynasties 19 and following, his identification of the Hatti of Anatolia as being part of the Neo-Babylonian Empire, and his identification of the Peleset (one of the Sea People) as being Persians of the 5th/4th century B.C.

The Exodus Problem

In 1956, a scholar in California, Dr. Donovan Courville, also began working on a revision of ancient history. Stimulated by reading *Ages in Chaos*, Courville began a similar study of his own taking a somewhat

different approach. Fifteen years later, a two-volume work was published, *The Exodus Problem and Its Ramifications*.²¹ Dr. Courville has also published a number of articles dealing with this revision, three of which have appeared in the *Creation Research Society Quarterly*.²²⁻²⁹

Courville agrees with Velikovskiy that the Exodus occurred at the end of the Middle Kingdom in Egypt and that it was, in fact, the catastrophic nature of the 10 plagues that actually brought about the end of the Middle Kingdom and ushered in the Second Intermediate Period when Egypt was ruled by foreigners (the Amalekites in the Old Testament; the Hyksos in Egyptian records). Courville also agrees with Velikovskiy in his redating of the 18th dynasty although there are significant differences for some of the later periods. Both Velikovskiy and Courville follow the chronology of the Old Testament Scriptures and thus redate the end of the Middle Kingdom to about 1450 B.C. This would bring the Middle Kingdom (and all earlier periods of Egypt's history) closer to the present by about 340 years.

Overlapping Dynasties

Velikovskiy's reconstruction begins at the close of the Middle Kingdom, but Courville extended his revision all the way back to the first dynasty. One of the fundamental assumptions of modern Egyptologists is that the 31 dynasties of Manetho (with one exception) are consecutive and non-overlapping. Courville has challenged this assumption and has presented a wealth of evidence to show that many of these dynasties are contemporary and overlapping, ruling over different segments of Egypt at the same time.

According to Courville's revision, dynasties one and two are consecutive and 3-5 are consecutive but they are roughly contemporary with one and two. Dynasties 7-10 are shown to be contemporary with 14-17 and dynasties 20-23 are shown to be contemporary with 24-26. According to this arrangement, the Old Kingdom period is contemporary with the Middle Kingdom period rather than preceding it by 400-500 years and similarly, the First Intermediate Period is contemporary with the Second Intermediate Period (see Table II). The duration of Egypt's dynastic history is thus greatly reduced and the beginning of the first dynasty is dated around 2150 B.C., about 370 years after the date of the Flood.

The third scholar to do extensive research in this area is John J. Bimson. Earning his Ph.D. from the University of Sheffield, Bimson had a major portion of his dissertation published in 1978 under the title, *Redating the Exodus and Conquest* and has written a number of articles for the British journal *SIS Review*.³⁰ A number of other scholars have been involved to a lesser extent writing primarily for journals devoted to the further investigation of theories of Velikovskiy.³¹ The revision of the history of ancient times is, of course, a massive and complex task and, as we might expect, there are a number of problems that have not yet been fully resolved, a fact which makes the ongoing discussion very stimulating.

The Conquest of Canaan

One of the most difficult and controversial problems in the field of Biblical archaeology is determining at

what point in the sequence of the archaeological ages that the Conquest of Canaan by the Israelites occurred. According to Biblical chronology, the Conquest occurred at about 1400 B.C. The more conservative Biblical scholars who follow the Biblical chronology usually place the Conquest at the end of the Late Bronze I period (see Table IV). More liberal scholars who feel that the Biblical chronology is not correct usually place the entry of the Hebrews into Canaan at the end of the Late Bronze II period or early in the Iron Age.

Table IV. The Archaeological Ages.

Period	Conventional Dates B.C.	Revised Dates B.C.
Early Bronze I-III	3200 - 2300	2200 - 1400
EBIV/MBI Intermediate	2300 - 2000	1400 - 1200
Middle Bronze II	2000 - 1500	1200 - 925
Late Bronze I	1500 - 1400	925 - 850
Late Bronze II	1400 - 1200	850 - 700
Iron Age	1200 - 330	700 - 330

Although Velikovsky's reconstruction requires it, he has written very little about how the archaeological ages should be redated. He has suggested that the end of the Early Bronze Age be synchronized with the destruction of the cities of the plain (Genesis 19) and that the end of the Middle Bronze Age be synchronized with the Conquest of Canaan but has produced very little evidence to support these synchronisms.³²

Courville has given a lot more attention to the problem of redating the archaeological ages and has proposed that the Conquest of Canaan be placed at the end of the Early Bronze Age. This placement of the Conquest involves a lowering of the absolute date of the end of the Early Bronze Age by an enormous 900 years (from 2300 B.C. to 1400 B.C.). A previous article by the present writer has defended at length this synchronism.³³

Table IV shows the archaeological periods in Palestine, the conventional dating of these periods, and the revised dating that has been defended by the present writer in a recent article.³⁴ All of the periods have been shortened somewhat and have been brought forward on the B.C. time scale considerably. Courville, Luckerman, and Livingston favor the idea that the Late Bronze Age and the Iron Age are not consecutive but actually overlap considerably. Courville, for example, has argued that the Late Bronze Age corresponds to the same period of time as the Iron I and Iron II periods.³⁵ Bimson, on the other hand, contends that the Iron Age follows the Late Bronze Age and must be compressed considerably.³⁶ This is an issue that deserves further study.

The Tower of Babel

One of the issues that concerns modern Egyptologists is the origin of Egypt's dynastic civilization. Walter Emery, Professor of Egyptology at the University of London, makes the following three points:³⁷

- (1) The cultural connection between Egypt and Mesopotamia at the beginning of Egypt's dynastic history is beyond dispute and is generally accepted by scholars. One example is the Narmer Palette from Egypt's first dynasty which displays unmistakable Mesopotamian influence.

- (2) Dynastic civilization appeared suddenly in Egypt. There is no development from the more primitive pre-dynastic culture to the highly developed dynastic culture.

- (3) In contrast to Egypt, there is a period of cultural development in Mesopotamia from a pre-historic culture to a dynastic type of civilization.

These three points suggest that the beginning of Egypt's dynastic history is due to a population movement from Mesopotamia to the Nile valley which carried with it the more advanced culture.

Courville identifies this population movement as the result of the dispersion from the Tower of Babel recorded in Genesis 11 and places it at the transition between the Chalcolithic Age and the Early Bronze Age (see Tables IV & V).³⁸ The Tower of Babel incident is not precisely dated in the Biblical narrative, but clearly it is after the Flood and before the time of Abraham. Speaking of the transition between the pre-historic Chalcolithic Age and the Early Bronze Age, William Albright writes;

There must have been an exceedingly intensive transfusion of culture going on in the Near and Middle East. Syria and Palestine naturally became the cultural intermediaries through which Mesopotamia influences streamed into Egypt in the period before the first dynasty.³⁹

Table V. The Pre-Historic Ages in Palestine.

Period	Commonly Accepted Dates B.C.
Paleolithic	2 million - 16,000
Mesolithic	16,000 - 8,300
Neolithic	8,300 - 4,000
Chalcolithic	4,000 - 3,200

Conclusion

While there are some significant differences in the revisions of ancient times proposed by Velikovsky, Courville, and Bimson, the general thrust of all three is to greatly reduce the antiquity of Egypt and the other ancient near eastern civilizations. Courville's revision, in particular, extends all the way back to the beginning of Egypt's dynastic history and leaves over 350 years for post-Flood repopulation and cultural recovery, a period which would include Egypt's pre-dynastic era. If the revision proposed by Courville should prove to be more or less correct, there would be no real conflict between Biblical chronology and the history of ancient civilizations.

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A STATISTICAL ANALYSIS OF THE POST-FLOOD GAP POSSIBILITY

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Abstract

An extensive statistical analysis of the post-Flood lifespans with various calibration models shows that it is possible to find statistical models that predict hundreds and possibly even thousands of years between patriarchs. However, if the interpolation and extrapolation performance of the calibration model plus the model's insensitivity to statistical outliers is considered, there are statistical calibration models using the natural logarithm of lifespan that show no gaps in the Genesis 11 genealogy.

Introduction

Evolutionary anthropologists contend that man in his present form has been in existence from one to two million years. This evolutionary thinking, however, seems to be in direct contradiction with the Bible. Henry Morris has noted this conflict in *Biblical Cosmology and Modern Science*:

To explain a discrepancy between one million and two thousand years, for the time from the first man to the time of Abraham (about 2000 B.C. by secular chronology) in terms of genealogical gaps means that the average such gap between each pair of names in Genesis 5 and 11 is more than fifty thousand years! Each "gap" is therefore more than eight times as long as the entire period of recorded history.¹

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Recently, Richard Niessen countered this evolutionary thinking on genealogical gaps in Genesis 5 and 11 by presenting nine logical and mainly Biblical evidences for a tight chronology.² A follow-up to the Biblical evidence for no gaps was provided in statistical evidence by William Seaver.³ His statistical analysis of these Genesis lifespans showed that the pre-Flood lifespans were stable, that the post-Flood life spans fitted an asymptotic exponential decay curve which converged to the 70-80 year lifespan of Psalm 90:12, and that if there were gaps in the genealogies of Genesis 11 the gaps would have to "systematic, specific, nonrandom, and of the asymptotic exponential decay model form."⁴ In addition to the Biblical and statistical evidence for no gaps, scientific research from other disciplines is also supporting the point of a tight chronology in Genesis 5 and 11. For instance, Humphreys' excellent work on the creation of earth's magnetic fields revealed that it would take approximately 6000 years for the magnetic fields to decay to their present

strength if the current rate of decline was extrapolated back to Creation.⁵ The weight of Biblical, statistical, and scientific evidence for a tight chronology in Genesis 5 and 11 is great, and thus the likelihood of gaps of any significant size are very small. Henry Morris does not deny the possibility that minor gaps could occur in the Genesis 11 genealogical list; but if they exist, the gaps must be relatively small and not thousands of years as proposed by evolutionists.^{6,7}

The intention of this author is not to examine the Genesis 5 genealogy since the Biblical evidence from Genesis 4:25, 26 and Jude 11 allows for no gaps. Niessen's study on tight chronology in Genesis 5 and 11 is an excellent source for the theological arguments. However, the clearest possibility for a gap, according to Morris and Whitcomb, is in the genealogy of Genesis 11 between Eber and Peleg before the Tower of Babel where the lifespans dropped from 464 to 239 years respectively.⁸ Recent statistical model methods developed for the calibration problem shall be used to find point and interval estimates for the generations between patriarchs (particularly between Peleg and previous patriarchs) that provide evidence of the statistical feasibility of a tight chronology for Genesis 11. Not only does this imply that any gaps would have to be minor but also that the Flood date of 2518 B.C. is a stable, safe estimate.

The Apparent Post-Flood Gap

Assuming consecutive generations, that is, no gaps in the Genesis 5 and 11 genealogies, the dates for the year of birth and lifespan are given in Table I.^{9,10} A semilogarithmic graph of the post-Flood lifespans versus the generations in Figure 1 as done by Dillow reveals the gap possibility between Eber and Peleg.^{11,12} However, a graph of these same lifespans versus the patriarchs year of birth after Creation in Figure 2 with semilogarithmic scale accents the apparent gap between Eber and Peleg to such an extent that two different models seem to be necessary to fit the post-Flood data: one before Peleg and one after him. Since the four patriarchs, Shem, Arpachshad, Shelah, and Eber, are insufficient data points to derive

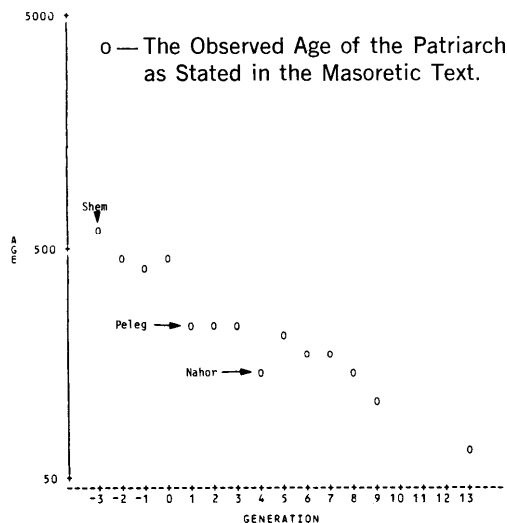


Figure 1. Semilogarithmic Graph of Lifespans Versus Generation of Patriarch.

a statistical model, attention is focused on all the lifespans inclusive of Peleg down to Moses' contemporaries. With these ten observations, it is possible to derive statistical models which fit this post-Flood era and provide predictions of how many generations away Eber's lifespans are from Peleg. While point estimation of the generations or the gap is the primary concern, a statistical interval estimation procedure (where appropriate) will be used so that there is a measure of confidence about any perceived gap. As noticed in Table I, Peleg's generation will be the base, and the generations from Peleg to Joseph are assumed to be consecutive in light of Seaver's statistical chronological work on the post-Flood data.¹³

Statistical Calibration Models

Most statistical regression models involving the prediction of a point require determining the value of Y corresponding to a given X . For example, to calibrate a thermocouple, we assume that the temperature reading given by the thermocouple is a linear function of the actual temperature with an error term ϵ_i such that the observed temperature = $\beta_0 + \beta_1$ (actual temperature) + ϵ_i or

$$Y_i = \beta_0 + \beta_1 X_i + \epsilon_i \quad (1)$$

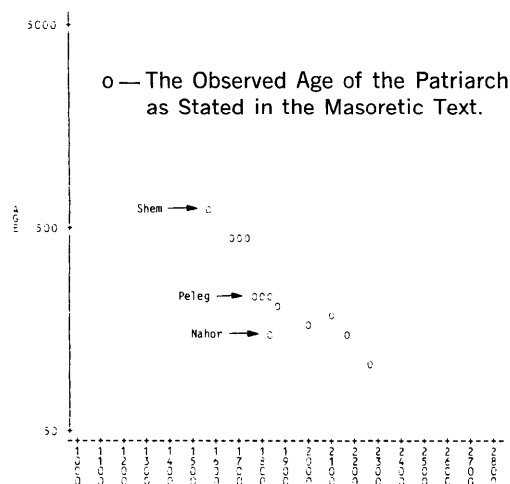


Figure 2. Semilogarithmic Graph of Lifespans Versus Year of Birth after Creation.

where β_0 and β_1 are unknown parameters. The calibration problem is concerned with measuring the actual temperature X^* from the observed temperature Y^* given the data $(Y_1, X_1), (Y_2, X_2) \dots, (Y_n, X_n)$ which is used to derive the estimating equation,

$$\hat{Y}_i = b_0 + b_1 X_i \quad (2)$$

where b_0 and b_1 are estimates of β_0 and β_1 respectively. For the post-Flood data, Y_i equals the lifespan which is completely known, and X_i equals the generation of the patriarch which is assumed partially known. Thus, the prime concern in calibration analysis is point estimation of the X values from the known Y values.

There are several competing point estimators of X , each with advantages and disadvantages. There is the classical estimator,

$$X_c^* = (Y^* - b_0)/b_1 \quad (3)$$

Table I. Selected Post-Flood Lifespans

Patriarch	Year of Birth After Creation	Year of Birth Before Christ, B.C.	Life-Span†	Age at Birth of Son	Generations from Peleg
Noah	1056	3118	950	502	?††
Shem	1558	2616	600	100	?
Arpachshad	1658	2516	438	35	?
Shelah	1693	2481	433	30	?
Eber	1723	2451	464	34	?
Peleg	1757	2417	239	30	1
Reu	1787	2387	239	32	2
Serug	1819	2355	230	30	3
Nahor	1849	2325	148	29	4
Terah	1878	2296	205	130	5
Abraham	2008	2166	175	100	6
Isaac	2108	2066	180	60	7
Jacob	2168	2006	147	91	8
Joseph	2259	1915	110	?	9
Moses' Contemporaries	---	---	70	---	13

†Ages are taken from the Masoretic Text.

††If the generations are consecutive, then Noah through Eber's generations would be -4, -3, -2, -1, and 0 respectively.

where b_0 and b_1 are the least square solutions to β_0 and β_1 in (1) above based upon n observations. With this classical estimator, interval estimates for X^* (the number of generations) can be constructed.^{14,15} Lwin and Maritz have noted that the classical estimation model does best when estimation is confined to extrapolation (the extremities of the range and outside of the calibration range) which is the need for this gap analysis.¹⁶ In addition, with the classical predictor

model it is possible to compare the fitted values $\hat{Y}_i$ and the observed values Y_i (called residuals, $e_i = Y_i - \hat{Y}_i$) to flag any unusual observations (called outliers) that could hinder the model from accurate prediction. Figure 2 definitely seems to indicate that Nahor's lifespan was shorter than expected and thus a possible statistical outlier. As noted by Belsley, Kuh, and Welsch and other statisticians, there are numerous outlier diagnostics for the classical linear regression model.¹⁷⁻¹⁹

A second possible estimator where generation is regressed against lifespan is the inverse estimator

$$X_i = \beta'_0 + \beta'_1 Y_i + \epsilon'_i \quad (4)$$

where β'_0 and β'_1 are the parameter values of the population and ϵ'_i is again some measurement of error. The sample inverse estimation model is shown as follows:

$$X_{inv}^* = b'_0 + b'_1 Y^* \quad (5)$$

Intuitively, this inverse estimator seems viable. However, the inverse point estimator is only superior to the classical estimator when X^* lies in a small interval about X_0 , i.e., estimation is restricted to the interior of the calibration range.^{20,21} Thus, it should be expected that this estimator will do well for Peleg through Moses' contemporaries and not well outside of this range.

A third feasible estimator of generation X^* is a non-parametric regression approach based on the median of pairwise slopes.²² This basic regression model (equation (6) below), developed by Thiel,

$$Y^* = b''_0 - \text{Median}\{b''_i\} X_{np}^* \quad (6)$$

does not allow for interval estimates for an individual observation; but it is not affected by statistical outliers, such as Nahor. Equation (6) can be converted to a nonparametric calibration model as shown below:

$$X_{np}^* = (Y^* - b''_0) / \text{Median}\{b''_i\} \quad (7)$$

Finally, there is the non-linear predictor of Schwenke and Milliken but confidence intervals for small samples are not exact, and this procedure is totally valid only when Y and X can both be taken as random variables, a requirement also necessary for the inverse estimator.²³ Thus, attention shall focus only on the classical, the inverse, and the nonparametric models.

If the post-Flood data from Peleg to Moses' contemporaries do support the hypothesis $|\beta_1| > 0$, then the calibration model in general is appropriate.²⁴ The more significant the relation between Y and X or $\ln Y$ and X , the better the calibration model will perform.

Point Estimation of the Generation Gap by the Lifespan Models

Using only the lifespans and not the natural logarithm of lifespan [$\ln(\text{lifespan})$ or $\ln Y$] from Peleg to Moses' contemporaries, Table II shows the equation results for the classical, the inverse, the nonparametric, and the jackknife model (which Duncan and others have noted as more insensitive to one outlier in the data).^{25,26} The intercepts, 258.114, 271 and 258.3, and the slopes, -14.45, -15.00, and -14.51 respectively for the classical, the inverse, and the jackknife models are not that different, respectively. Assuming consecutive generations, all four lifespan models are 11 to 14 generations from Eber at $X = 0$, creating a possible gap of 12 to 15 generations between Eber and Peleg. With the median begetting age of Table I being 34 years and ignoring Noah and Shem who were born before the Flood, we could be dealing with a gap of at least 416 years $([1 + 14.25] \times 34)$ between Eber and Peleg. There are also large generation prediction gaps for the other three pre-Peleg Patriarchs as shown in Table II. For instance, Shem is off by at least 16 generations $(-3 - (-19.23))$ to almost 21 generations

Table II. Comparative Analysis of Gap Possibilities by Four Lifespan Models.

Model	Classical	Inverse	Nonparametric	Jackknife
Equation	$X^*_i = \frac{(Y_i - 258.114)}{(-14.45)}$	$X^*_i = 16.049 - .0588Y_i$	$X^*_i = \frac{(Y_i - 271)}{(-15.00)}$	$X^*_i = \frac{(Y_i - 258.3)}{(-14.51)}$
Sum of Squares				
Interpolation (SS_{inter})	20.764	17.671	23.617	20.615
Sum of Squares				
Extrapolation (SS_{extra})	862.311	519.923	703.379	853.001
General Predictions [†]				
Prior to Peleg				
Shem (-3)	-23.66	-19.23	-21.93	-23.55
Arpachshad (-2)	-12.45	-9.71	-11.13	-12.38
Shelah (-1)	-12.10	-9.41	-10.80	-12.04
Eber (0)	-14.25	-11.23	-12.87	-14.18

[†]Assuming consecutive generations, the expected generations away from Peleg are indicated in parentheses. The SS_{extra} are computed from these expected values and the predicted values for each model.

(-3(-23.77)). Furthermore, all four lifespan models have a very low sum of squares $\left(\sum_{i=1}^n (X_i - X^*)^2\right)$

for interpolation (with the inverse model the lowest at 17.671) but extremely large sum of squares for extrapolation. These findings are excellent fuel for the evolutionists' argument that there are gaps in the genealogies or to the idea that there is one statistical model for the pre-Peleg patriarchs and another for Peleg and those that follow.

In addition to examining the sum of squares for the X (the generation) to measure the fit of the calibration model, further insight into the adequacy of a statistical model is gained by comparing the observed values of the lifespan (Y_i) versus the predicted values for lifespan (Y_i). These differences, $e_i = Y_i - Y_i$, are called residuals. Extremely large residuals, large studentized residuals, large studentized residuals with the i^{th} observation deleted, large diagonal elements of the hat matrix, large changes in fit at some data point i standardized by the standard error of the fit with the i^{th} point omitted, plus other outlier diagnostics can be used to flag extreme observations that have diverse but drastic effects on linear models.²⁷ With a Pearson correlation of .9218 (significant at a probability less than .0001) between lifespan and generation for the classical and the inverse models, it is tempting to conclude that the model is appropriate. However, Nahor is flagged as a outlier by numerous statistical diagnostics but particularly by a studentized residual with the i^{th} observation deleted of -4.28, significant at a probability less than .005. Removal of Nahor from the classical or inverse lifespan models does not change the generation predictability appreciably even though the Pearson correlation does increase to .9783. In fact, with the removal of Nahor, various outlier diagnostics suggested by Hoaglin and Welsch flag Peleg, Joseph, and Moses' contemporaries as suspect influential observations.²⁸

While the evolutionist who desires to show gaps in the Genesis 11 genealogies to support his beliefs or the researcher who may even want to push back the Flood date further than 2518 B.C. with partial gaps to accommodate various archaeological suppositions may embrace any of these four lifespan models to validate his stance, the poor performance of these four

calibration models in extrapolation, the outliers in the models, and the previous research of Dillow and Seaver all suggest that there must be a better statistical and Biblical model. This model, if it exists, should do well in interpolation and extrapolation for generation, should be minimally affected by outliers, and should not differ drastically from previous research on these patriarch ages. The natural logarithm model [$\ln(\text{lifespan})$ or $\ln(Y)$] is such a possibility.

Point Estimation of the Generation Gap by the Natural Logarithm Models

Dillow used the natural logarithm model

$$\ln Y = \ln b_0 + b_1 X \quad (8)$$

to describe the non-linear or exponential decay relationship between generation and lifespan over the patriarchs from Noah to Moses' contemporaries.²⁹ Seaver's non-linear model, the asymptotic exponential decay, not only described the relationship between lifespan and generation better over the observations from Shem to Moses' contemporaries but also predicted well outside of the data's range.³⁰ There are non-linear calibration models as mentioned earlier, but such sophistication is statistical overkill. The easiest approach is to take the models in equations (2)-(7) and replace Y with $\ln(Y)$ producing the following three new calibration models.

$$X^*_c = (\ln Y^* - \ln b_0)/b_1 \quad (9)$$

$$X^*_{inv} = b_0^1 + b_1^1 \ln Y^* \quad (10)$$

$$X^*_{np} = (\ln Y^* - b_0^1)/\text{Median}\{b_1^1\}. \quad (11)$$

Of course, these calibration models based on natural logarithms could be converted to an exponential decay curve of the form,

$$\hat{Y}_i = b_0 e^{-b_1 X_i} \quad (12)$$

This conversion is not necessary since the concern is the prediction of X, the generation.

Still assuming consecutive generations but using the $\ln(\text{lifespan})$ or $\ln(Y)$ calibration models, the sum of squares interpolation in Table III are slightly less than those for the basic lifespan model (as shown in Table II) with greater improvements for the nonparametric

Table III. Comparative Analysis of Gap Possibilities by Four Natural Logarithm Models

Model	Classical	Inverse	Nonparametric	Jackknife
Equation	$X^*_i = \frac{(\ln Y_i - 5.6780)}{(-.0995)}$	$X^*_i = \frac{49.4525 - 8.5579 \ln Y_i}{}$	$X^*_i = \frac{(\ln Y_i - 5.9342)}{(-.1309)}$	$X^*_i = \frac{(\ln Y_i - 5.7018)}{(-.1064)}$
Sum of Squares Interpolation (SS_{inter})	20.473	17.443	21.844	18.628
Sum of Squares Extrapolation (SS_{extra})	52.284	17.402	3.504	38.033
General Predictions [†]				
Prior to Peleg				
Shem (-3)	-7.22	-5.29	-3.53	-6.53
Arpachshad (-2)	-4.06	-2.50	-1.13	-3.58
Shelah (-1)	-3.95	-2.50	-1.04	-3.47
Eber (0)	-4.64	-3.09	-1.57	-4.12

[†]Assuming consecutive generations, the expected generations away from Peleg are indicated in parentheses. The SS_{extra} are computed from these expected values and the predicted values from each model.

(23.617 to 21.844 SS_{inter}) and the jackknife models (20.615 to 18.28 SS_{inter}). This finding is extremely significant in that it points out that all of the Y and $\ln(Y)$ models have similar descriptive ability for the data of Peleg to Moses' contemporaries and that the natural logarithm transformation did not affect interpolation results. Further support of this point is provided by a similar Pearson correlation for the $\ln(Y)$ model [classical and inverse only] of .9229, significant also at $\alpha < .0001$. However, for the four pre-Peleg patriarchs there is an astronomical decrease in the sum of squares extrapolation: from 862.311 to 52.284 for the classical model, from 519.923 to 17.402 for the inverse model, from 703.379 to 3.504 for the nonparametric model, and lastly from 853.001 to 38.003 for the jackknife model as shown in Tables II and III. In light of these extrapolation results and the specific generation difference in Table IV, the nonparametric calibration model based on $\ln(Y)$ is by far the best point estimator of patriarch generations. This particular nonparametric model misses Eber by only 1.57 generations and is easily within one generation of Shem, Arpachshad, and Shelah (see Table IV). None of the other three $\ln(Y)$ calibration models predict large gaps in the generation; but there are consistent gaps of 2-4 generations for Shem, Eber, Nahor and Isaac.

Table IV. Generation Differences for the Classical, Inverse, Nonparametric, and Jackknife Calibration Models

Patriarch	Classical	Inverse	Non-parametric	Jack-knife
Shem	4.22	2.29	.53	3.53
Arpachshad	2.06	.60	.87	1.58
Shelah	2.95	1.50	.04	2.47
Eber	4.64	3.09	1.57	4.12
Peleg	-1.03	-1.59	-2.50	-1.12
Reu	-.03	-.59	1.50	-.12
Serug	.59	.09	.79	.52
Nahor	-2.84	-2.69	-3.16	-2.62
Terah	1.43	1.10	.33	1.04
Abraham	.84	.75	.12	.95
Isaac	2.13	1.99	1.34	2.22
Jacob	1.09	1.25	.79	1.31
Joseph	-.82	-.23	-.42	-.41
Moses'				
Contemporaries	-1.36	-.09	-.12	-.66

These findings give extreme credence to the faith of the Creationist that there cannot be large gaps of thousands of years in the Genesis 11 genealogy but no more than around a hundred years. However, the $\ln(Y)$ nonparametric model is even more significant in that there is a statistical model that can be fitted to the untouched Genesis 11 lifespans without compromising the Biblical truth of consecutive generations noted by Niessen.³¹

Additional Evidence for the $\ln(Y)$ Nonparametric Calibration Model

In light of statistical theory mentioned earlier, a natural question is why does the $\ln(Y)$ inverse calibration model do better than the $\ln(Y)$ classical model in extrapolation? The reason for this discrepancy is the greater outlier tendencies in the variable $\ln(Y)$ than in the variable generation. This is more obvious when Nahor, a statistical outlier having the studentized residual with the i^{th} observation deleted of 2.4 which is significant at a level of significance of .025 (but not as significant as in the classical lifespan model), is deleted from the data. The equations for the classical and inverse calibration models with Nahor omitted are shown below:

$$X^*_i = (\ln(Y^*_i) - 5.7392)/(-.1045) \quad (13)$$

and

$$X^*_i = 50.9177 - 8.7861 \ln(Y^*_i). \quad (14)$$

While there are slight coefficient changes in these models compared to the full data equivalents in Table III, the biggest changes occur in the SS_{inter} and SS_{extra} . The SS_{extra} for the classical model reduces drastically from 52.284 to 31.840 but there is only a miniscule change from 17.402 to 16.712 for the inverse model. The inverse model shows marked improvement from 16.443 to 9.351 for SS_{inter} while the classical changes slightly from 20.473 to 19.773. The improvements for the inverse model were thus over the interpolation range and conversely were for the classical model over the extrapolation range, which is to be expected in light of the outliers and statistical theory.

Additional insight into the impact of observations such as Nahor, Peleg, Isaac, and Moses' contemporaries on the $\ln(Y)$ classical model can be gained by examining the recursive residuals. Recursive residuals are independently and identically distributed and, unlike or-

dinary residuals, do not have the deficiencies of the data in one part being spread over all the residuals.³² For instance, in studentized residuals with the i^{th} observation deleted (such as Nahor), there is an isolated look at whether one observation is a statistical outlier. It is not uncommon for one statistical outlier to mask others in the same data set, and recursive residuals flag this problem. Basically, for this Genesis data set of 10 points, discard the first patriarch, Peleg, and fit the model to the remaining nine points. The first recursive residual is then defined as the standardized residual of the first observation. Next Peleg and Reu are discarded, and the model is fitted to the remaining eight observations. The second recursive residual is then computed. The process is repeated down to the last two observations (Joseph and Moses' contemporaries) since at least two points are needed for the fitting of a two-parameter model. The recursive residuals are given in Table V and a normal probability plot of these residuals is in Figure 3. According to Galpin and Hawkins, Nahor would definitely be an indicative of other possible outliers such as Peleg (-.1216) and Isaac (-.0937).³³

A significant by-product of the recursive residual analysis is a recursive calibration model with sum of squares extrapolation computed in Table V. Remembering that the SS_{extra} are only computed for the patriarchs Shem through Eber, it is interesting to note the continual improvement in the SS_{extra} as successive observations are deleted. In fact, the recursive calibration model after omission of Peleg, Reu, Serug, and Nahor

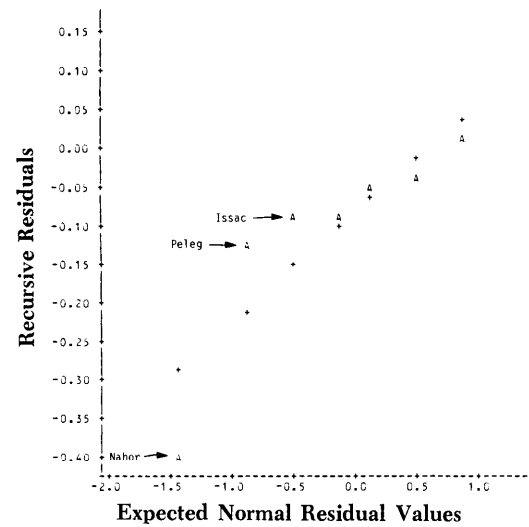
$$X^* = (\ln Y^* - 6.0464)/(-.1387) \quad (15)$$

is almost identical to that for the nonparametric $\ln(Y)$ model in Table III (the best calibration model using all the data),

$$X^* = (\ln Y - 5.9342)/(-.1309). \quad (16)$$

This recursive calibration model has $SS_{\text{extra}} = 4.39$ whereas the nonparametric $\ln(Y)$ model had $SS_{\text{extra}} = 3.504$. Also, the recursive calibration model for Jacob, Joseph, and Moses' contemporaries is almost identical to that of the nonparametric $\ln(Y)$ model.

While interval estimates for an individual observation are not possible for the nonparametric model nor for the inverse model since generation is not a random variable, it is possible to construct such an interval estimate for the classical calibration model.³⁴ Since the



A — the actual recursive residual for the patriarchs (Table V)
If +s are connected with a straight line, recursive residuals that deviate markedly from this line may be considered outliers.

Figure 3. Normal Probability Plot of Recursive Residuals.

recursive classical $\ln(Y)$ model for Terah is practically identical to the nonparametric $\ln(Y)$ calibration model and is highly significant (a Pearson correlation of .9813, significant even at $\alpha = .005$), an interval estimate for the generation of the patriarch can be computed for Shem through Eber according to the following formulas, where

$$g = ts \left[\frac{(Y^* - \bar{Y})^2 / \sum (X_i - \bar{X})^2 + b_1^2(1 + 1/n) - [t^2 s^2 / \sum (X_i - \bar{X})^2][1 + 1/n]}{[t^2 s^2 / \sum (X_i - \bar{X})^2][1 + 1/n]} \right]^{1/2} \quad (17)$$

and

$$\begin{aligned} X_{\text{upper}} &= \bar{X} \pm [b_1(Y_0 - \bar{Y}) + g] / [b_1^2 - t^2 s^2 / \sum (X_i - \bar{X})^2] \\ X_{\text{lower}} & \end{aligned} \quad (18)$$

These 95 percent confidence interval estimates, which are not symmetric about the point estimate for generation, are shown in Table VI below,

The largest difference from the assumed consecutive generation and the upper interval estimate is no more than 4.57 generations for Eber and no less than 2.02 generations $[-2(4.02)]$ for Arpachshad. Assuming the median begetting age of 34 years as done earlier, there could be gaps of not more than 70-170 years at the maximum for the interval estimate analysis.

Table V. Recursive Residual Analysis for the Classical $\ln(\text{Lifespan})$ Model.

Observation	Patriarch	Lifespan	Recursive Calibration Equation with Prior Observations Deleted	Recursive Residuals	Sum of Squares Extrapolation
1	Peleg	239	$(\ln Y^* - 5.6780)/(-.0995)$	-.1216	52.31
2	Reu	239	$(\ln Y^* - 5.7269)/(-.1054)$	-.0478	33.59
3	Serug	230	$(\ln Y^* - 5.7505)/(-.1082)$	+.0148	26.81
4	Nahor	148	$(\ln Y^* - 5.7414)/(-.1072)$	-.3949	29.24
5	Terah	205	$(\ln Y^* - 6.0464)/(-.1387)$	-.0382	4.39
6	Abraham	175	$(\ln Y^* - 6.0840)/(-.1424)$	-.0860	6.04
7	Isaac	180	$(\ln Y^* - 6.1942)/(-.1526)$	-.0937	13.67
8	Jacob	197	$(\ln Y^* - 6.0292)/(-.1383)$	+.1092	3.86
9	Joseph	110	$(\ln Y^* - 5.7174)/(-.1130)$	-----	29.09
10	Moses' Contemporaries	70	-----	-----	-----

Table VI. Ninety-five Percent Confident Estimates for the Individual Pre-Peleg Patriarchs*

Patriarch	Consecutive Generation	Point Estimate of Generation	Lower Interval Estimate	Upper Interval Estimate
Shem	- 3	-2.53	.28	-7.01
Arpachshad	- 0	-.26	2.18	-4.02
Shelah	- 1	-.18	2.25	-3.91
Eber	0	-.67	1.83	-4.57

*These are not simultaneous confidence interval estimates but only individual interval estimates.³⁵

Validation of the Model

To the non-statistician it would seem as if there has been model manipulation in locating a statistical model that fits the generation and ln(age) relationship. However, the discussion thus far has focused on checking the adequacy of the model and to a large extent on model validation. According to Montgomery and Peck, the essence of model validation is determining "if the model will function successfully in its intended operating environment."³⁶ This validation process involves testing the predictive performance of the model in the interpolation and extrapolation modes, examining signs and magnitudes of the model coefficients, comparing the model predictions and coefficients with physical theory, and studying the stability of the model coefficients as a result of outliers or diverse correlation structures.³⁷ Much of this has already been done. Considering the extrapolation mode and the stability of the coefficients, the nonparametric calibration ln(age) model (equation 16) which is based on the actual data without any omissions and which is outlier resistant seems to be the better post-Flood model. In terms of interpolation, the inverse and classical calibration models using ln(age) (equations 13 and 14) fare slightly better.

To complete the model validation process, there are a few possible statistical approaches.³⁸ First, the collection of fresh data with which to investigate the model's predictive performance is a possibility, but with historical data as in Genesis this is not feasible. Seaver, in his study of the Genesis lifespans, did show how the asymptotic exponential decay curve provided excellent estimates for today's lifespan.³⁹ A second choice for validation is data splitting. For a time sequenced data set, the observations would be split into an estimation data set and a prediction data set; but for the Genesis data there are not enough observations for such an approach according to Snee.⁴⁰ However, another version of data splitting which essentially takes n observations and splits these into n subsamples of size one is a simplistic validation procedure. The regression model is then fitted to the remaining n - 1 observations and the resulting equation is used to predict the withheld observation, y_i . If the predicted value with the i^{th} observation deleted is noted $\hat{y}_{(i)}$, then the prediction error for the point i is

$$e_{(i)} = y_i - \hat{y}_{(i)} \quad (19)$$

and the prediction error for all points is the sum of squares for the n deleted residuals over the interpolation range that is, $\sum e_{(i)}^2$.^{41, 42} This sum of squares is called the PRESS statistic and can be found by either formula below:

$$\text{PRESS} = \sum_{i=1}^n (y_i - \hat{y}_{(i)})^2 \quad (20)$$

or

$$\text{PRESS} = \sum_{i=1}^n \left(\frac{e_i}{1 - h_{ii}} \right)^2 \quad (21)$$

The formula in equation (21) makes it easy to see that the PRESS statistic is just a weighted sum of squares of the residuals, where the weights are related to the outlier tendencies of the observation (h_{ii}).⁴³

Performing this kind of analysis on the inverse and classical calibration models using ln(age) as shown in Table VII provides a way to validate the overall predictive performance and to flag observations that degrade the predictive performance of the model. While the original inverse and classical models explained 85 percent of the variability in the response variable ($R^2 = .8517$), an approximate coefficient of determination for prediction (called R^2_{pred}) can be calculated for each model from the PRESS statistic information as follows:

$$R^2_{\text{pred}} = 1 - \text{PRESS} / \text{sum of squares for response variable} \quad (22)$$

From Table VII the inverse model explains about 80 percent of the variability in predicting new observations. The drop in explainability from 85 to 80 percent is due to the high prediction error squared for Nahor primarily (9.072), followed slightly by Isaac and Peleg. For the classical ln(age) model, the explainability drops from 85 to 75 percent and is again primarily due to Nahor and Isaac (.10505 and .05678 respectively) but also to Moses' contemporaries at .08746.

The bottom line of this type of validation is that the ln(age) calibration models work well in interpolation. Again certain patriarchs are highlighted as influential observations for these models signifying even more that the outlier resistant nonparametric calibration model is a better choice for explaining the post-Flood data of Genesis.

Conclusions

This statistical analysis of gaps in the post-Flood genealogy of Genesis 11 with calibration models, which consider lifespan as a random variable and generation as fixed, has several important conclusions and implications. First, the Genesis 11 lifespan data is very complicated because of the statistical outliers: Nahor who died before his time, Peleg and Reu who lived to be of the same age in an era of declining lifespan, Isaac who lived longer than expected at 180 years, and Moses' contemporaries who lived to 70-80 years according to Psalm 90:12. With at least 40 percent (4 out of 10) of these data having outlier tendencies, only recent statistical outlier diagnostics have enabled the researcher to flag these unusual observations and to examine their diverse impact on the mathematical model for longevity and on the creationist view of consecutive generations in Genesis 11.

Secondly, it is possible to choose a statistical model based on lifespans which will predict large gaps of hundreds of years or more between the pre-Peleg patriarchs, which the evolutionists might extend to thousands of years or more to maintain his position on the age of the earth. However, when sound statistical reasoning considers the interpolation and extrapolation

Table VII. One by One Data Splitting Validation of the Inverse and Classical ln(Age) Calibration Models.

Generation	ln (Age)	Inverse Model			Classical Model		
		Residual e_i	h_{ii}	Square of Prediction Error $[e_i/(1 - h_{ii})]^2$	Residual e_i	h_{ii}	Square of Prediction Error $[e_i/(1 - h_{ii})]^2$
1	5.476	-1.585	.203	3.957	-.102	.296	.02100
2	5.476	-.585	.203	.539	-.003	.223	.00001
3	5.438	.086	.183	.011	.059	.167	.00494
4	4.997	-2.687	.108	9.072	-.283	.128	.10505
5	5.323	1.101	.136	1.624	.143	.105	.02539
6	5.165	.747	.103	.694	.084	.100	.00869
7	5.193	1.988	.106	4.947	.212	.112	.05678
8	4.990	1.255	.109	1.984	.109	.141	.01597
9	4.700	-.226	.217	.083	-.082	.187	.10115
13	4.248	-.094	.631	.065	-.136	.541	.08746
Press				22.976			.33543
$R^2_{\text{prediction}} = 1 - 22.976/117.60 = .8046$					$1 - .33543/1.36756 = .7547$		

quality of the calibration model plus the impact of statistical outliers, the existence of gaps in the Genesis 11 genealogy is not a tenable position. It is an encouragement to the Creationist to know that there exists a statistical model which shows no gaps between Eber and Peleg or between any of the other patriarchs and which reveals that the differences in ages in Genesis 11 are statistically possible.

Thirdly, these findings of no gaps using only part of the post-Flood data from Peleg to Moses' contemporaries plus the earlier research of Dillow and then Seaver who used all the data of Genesis 11 gives even further confirmation that any gaps would have to be systematic, specific and nonrandom and of the exponential decay, more probably, of the asymptotic exponential decay form. The excellent performance of the nonparametric ln(lifespan) calibration model and the parametric ln(lifespan) recursive model in extrapolation and interpolation gives tremendous confidence in a Flood date of 2518 B.C. and a Creation date of 4174 B.C. and shows the scientific and statistical reliability of the Scriptures.

Finally, from a statisticians' viewpoint, there is a simplistic beauty in a series of numbers that is easy to acknowledge as randomness and nonmeaningful and thus, miss the Creator behind them. However, close examination of the complexity of the lifespans in Genesis 11 in this research causes one to stand in awe of God's wisdom, God's character, and His revelation to man.

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PANORAMA OF SCIENCE

More on Growth of a Population

Creationists, at least those of the young-Earth variety, are very much interested in the growth of populations, in order to see how the population increased so quickly after the Flood. An example from Canadian history may be of some interest. In a book on Canadian history it is stated:

In the conquered province of Quebec, the people multiplied with astonishing celerity. In 1760, their numbers were approximately 60,000, and in 1790, 160,000, an increase in one generation of about 166 percent, about five per cent annually. The birth rate after the conquest seems to have been higher than before it; in 1770 it had reached the astronomical figure of 65 per 1000. After all, there was land and food for all . . .¹

The conquest was the British conquest of Canada in 1759 and 1760. Later the book states: ". . . there is some evidence (from the census) that the death rate was no higher in Upper Canada (now Ontario) in 1851 than it is in Ontario today . . .," and a little later:

The statement made above, that the death rate in Upper Canada in 1851 may have been no higher than it is today may seem surprising, given our modern advantages, but the usual impression of the period as one of enormous infant mortality, epidemic disease, short lives and numerous deaths may need some revision. Certain causes of death carried off large numbers, but others fewer than today. Thus while 20 percent of all deaths were returned as from contagious diseases, there were only fifty deaths reported in the whole province from cancer.²

Editor's Note: One of the referees asked if the effects of immigration was included in the population growth. Harold's answer is as follows:

The increase mentioned (More on the Growth of a Population) was wholly or mostly due to births. After 1759 there would have been very little immigration for quite a few years.

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Contributed by Harold L. Armstrong

On the Nature of the Grains of Wind-Blown Sand

It is often taken for granted that grains of wind-blown sand, such as that found in a desert, should be more rounded than those on a beach. But a study, a few years ago, in the Simpson Desert, Australia, showed that the grains there are quite angular.¹

This may be of interest to Creationists because, while such deposits as loess, or the sand which went to form sandstone, are often supposed to have been

deposited by the wind, the Flood would seem to have been a very likely agent. The study cited here would seem to show that it is hard to decide one way or the other by the shape of the grains.

There is another possible clue, however, which seems to have been little noticed. One might expect wind-blown sand often to contain vegetable material, such as tumbleweed, bits of brushwood, etc. Such debris is common in many sand dunes. And if the sand remained or hardened, the debris would remain as fossils.

When the sand was deposited by water, on the other hand, such debris would be floated away. As far as I can learn, fossilized debris is not common in sandstone. So this may be evidence that the sand was deposited by water; and what better opportunity has there been for such deposition than during the Flood?

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Contributed by Harold L. Armstrong

LETTERS TO THE EDITOR

Genesis 1

Frequently a question returns to me, does Genesis 1 refer to the entire Universe, or only to our Solar System? I am hoping you will place the following discussion in your "Letters to the Editor," where others can constructively criticize it. There are several verses in the Bible that bear on this problem.

We may recall that the Hebrew word *shamayim*, heaven(s), appears in Genesis 1:1. It is an unusual plural form, serving like the English word "sheep," and how it is used in the sentence will determine whether it shall be considered singular or plural. In Genesis 18 it is translated "firmament." According to the KJV translators, the verse should read "In the beginning God created the heaven and the earth."

Actually the word "heaven(s)" is of little help in clarifying just how much was created "in the beginning." To Bible writers "heaven(s)" was everything above their heads, and "earth" was everything under their feet. The Bible recognizes three heavens: (1) 1st heaven, atmospheric, Genesis 1:6-8; (2) 2nd heaven, starry, Genesis 15:5; and (3) 3rd heaven, Paradise where God dwells, II Corinthians 12:2.

More helpful in our problem of what was included in the work recorded in Genesis 1:1 are the words of Christ (Matthew 19:4) "Have ye not read that he which made them at the beginning made them male and female . . . ?" Other versions read: RSV, NEB "Made them from the beginning"; NASB "he who created them from the beginning"; Mark 10:6, NEB "in the beginning, at creation, God made them male and female." It thus appears that in the same great event "in the beginning," the earth and the heaven(s) and

man, male and female, were created, and that according to Bible history (chronology) the date when man was created was “in the beginning” some 4,000 years B.C.

Because a making of “stars” is recorded (Genesis 1:16) as part of the work of the Creator on Day Four of Creation Week, some have assumed that there were no starry heavens, no Universe, until Day Four some 6,000 years ago. We understand that the Trinity (Father, Son and Holy Spirit) have always existed, “from everlasting” Micah 5:2. If the Universe came into existence only a few thousand years ago, what was the occupation of the Trinity through eternity before Creation Week?

Looking again at the accomplishments of Day Four (Genesis 1:14-19) we find that a “greater light” was made to rule the day (our sun) and a “lesser light” to rule the night (our moon). The “stars” were also made. Because the sun and the moon are members of our Solar System, why not be consistent and assume that “the stars also” are the planets of *our* System? This would place the origin of the heavenly bodies located outside our Solar System at some time (any time) before about 4,000 B.C. If this is true, modern astronomers can deal with light from these sources according to *natural* measuring processes. For time without end the light from at least some such sources would be crossing the vast area now occupied by our Solar System. Stellar space is roomy. I believe Alpha Centauri, the nearest “outside” star to our System, is something like 25,600 billion miles away.

Definitely appropos to our problem of *which* stars were created during Creation Week are the following references:

Genesis 1:1 “In the beginning God created the heaven and the earth.”

Isaiah 65:17 “I create new heavens and a new earth.”

Isaiah 66:22 “The new heavens and the new earth which I will make.”

2 Peter 3:13 “We . . . look for new heavens and a new earth.”

Revelation 21:1 “I saw a new heaven and a new earth: for the first heaven and the first earth were passed away.”

To our knowledge our earth is the only astronomical body inhabited by beings who rebelled against their Creator. Upon what basis can we assume (1) that the Universe did not come into being until Creation Week (some 6,000 years ago), or (2) that these sinless heavens (the Universe) would need to be made new in the foreseeable future? Personally it is much easier for me to believe that “the first heaven and earth” (Revelation 21:1) that are to be made new are those astronomical bodies which were created on Day Four, i.e., possibly our own complete Solar System.

It would appear that it was the Creator’s original intention to hold face-to-face communion with the new order of being, man (Genesis 3). However, because of disobedience man was denied any further direct face-to-face communion, and instead received God’s Word indirectly in the form of the Bible. This holy book was for a sinful human race, and I believe its first chapter was provided to answer the natural question, What was the origin of our earth and of life upon it? Rather

rarely the expression “In the beginning” may also apply to the origin of our Universe. See John 1:1, 2 and Colossians 1:16. We also learn that the Word (the Son) was with His Father from everlasting (Micah 5:2), before all things, and that by Him all things consist (Colossians 1:17).

I have touched on a number of points, but the chief emphasis has been on an attempt to discover whether Genesis 1:1 applies only locally to our Solar System, or also to the entire Universe. I sincerely solicit discussion of this point in the *CRSQ*.

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Dooyeweerd on Mechanism vs. Vitalism

In the *CRSQ* 21:78 there was an interesting and unusual challenge implied in the fact that across the page from Dr. Verbrugges’ article on the Dooyeweerdian biologist De Wit was Prof. Armstrong’s article, “Vitalism— A Neglected Weapon?” The challenge lies in the fact that for Dooyeweerd Vitalism falls short of being satisfactory along with Mechanism. This situation should be explained and the proper weight should be given to the propositions involved.

It must be understood that for Dooyeweerd a true Biblical view of science denies at the root dichotomies such as Vitalism vs. Mechanism. The dichotomous world-view began with the Greeks polarizing Form and Matter. The medievals applied this polarization to Nature and Grace. For the moderns it is Natural Science versus Personality.

In the field of biology this polarization is expressed as Vitalism vs. Mechanism. And this form of dichotomy is actually the one Dooyeweerd was most concerned to disabuse. That subject forms the very climax of his 2000-page magnum opus — *The New Critique of Theoretical Thought*. And on page 733 of Vol. 3 he starts that section by stating: “The old dilemma-mechanism or vitalism— is in the nature of the case unacceptable from our standpoint.” The final 50 pages of the work is given to articulating that thesis.

As I contemplated writing this article the vision arose of a number of cans of big juicy worms. Dooyeweerd is not easy to explain at best, some of his stands are controversial, there’s much to explain in little space. However this is a unique opportunity and I must do what I can.

As briefly as possible let me explain the groundwork of Dooyeweerd’s position: Reality is conceived of as an intermodal coherence of sovereign spheres. Awareness of this coherence is a fundamental of human nature intrinsic to the fact man is created in God’s image. In other words, comprehension of the inter-modal coherence of spheres goes beyond intellectual receptivity and involves what is meant in saying man is made in God’s image. This is articulated in the four-page conclusion of the *New Critique* and more concisely in the section “The Creation Motive” starting on page 28 of the important companion book — *Roots of Western Culture*.

It would be good for me to come up with an on-the-spot definition of the term intermodal coherence such that it cannot be relegated as being a distant intellectual vagary. Rather surprisingly, the best lead

I have found in that direction occurs in Mr. Ralph Ancil's article (*CRSQ* 20:30-9) entitled "The Limits of Human Thought and the Creation Model." This lead consists in inferences from what Mr. Ancil writes as to Gödel's theorem. It is explained how this highly prestigious model mandates that a mathematical system can only be determined from another system different and more powerful. This further implies that the system is incomplete without such information from outside it. Transferring this model to Dooyeweerd's intermodal coherence is simply a matter of substituting the term sphere for system and including beside the sphere of mathematics all the other spheres of existence. Rather obviously there would then also be some order in this progression of spheres. That in short is just what is signified by Dooyeweerd's intermodal coherence.

How does this apply to disabusing the biological dichotomy of mechanism versus vitalism? To this end let us first focus on the concept of substance. In naive experience the concept of substance is obvious and undeniable. Not so the concept of substance in the field of science. In this field the concept of substance usually refers to essence—as in saying, for example, that the nucleus of an atom is its essence or substance. However it must be understood that this traditional scientific concept of substance is challenged by Dooyeweerdians to the last man. Yet I myself frankly would hardly feel confident to challenge this concept except for the amazing light furnished by the Gödel-Ancil model. The most important thing in a given sphere is not some inner essence but information found in the next highest sphere. The spheres are relative to each other and it would be false absolutism to identify even the nuclei as substance-essence. I am aware this proposal raises problems I cannot pause to deal with. The important thing now is to give the fullness of the picture here. To dispose of the substance-essence concept is not to dispose of "meaning." Contrarily, a Dooyeweerdian will insist there is "Meaning" everywhere just as strongly as he will insist there is "substance-essence" practically nowhere. The catch is that the term substance-essence must be reserved for the Creator—the Lord Jesus Christ. To impute substance-essence to any of the spheres is simply a form of idolatry. And perhaps the most obvious of these idolatries is the attempt to ultimately find "life in a test tube," which is what is usually implied in the term "Vitalism."

Prof. Armstrong has a first-rate Christian intellect. I do not in the least think that in his use of the word Vitalism he is seeking to encourage the thought that the human mind working in a laboratory is fitted to ultimately probe the final secrets of life. Indeed, his article itself shows quite the reverse. I am sure that what he sought to imply with the word Vitalism was something like "the law of the spirit of life." If he had been better acquainted with the intermodal coherence, though, I question if he would have used the language that he did. However, once the impact of the Gödel-Ancil model makes itself felt I do not see how the academic community will be able to ignore any longer the validity of the basic concept of intermodal coherence as expressing God's law-system for the universe.

The final challenge here is that Creationists and Dooyeweerdians should minimize their differences in

order to maximize their similarities. When language difficulties are resolved the focus by all means should be on what the two groups uniquely hold in common.

It is almost 20 years ago now that Duyvene De Wit passed away in the midst of a correspondence with George Howe which was calculated to promote meetings between the two groups. It can only be hoped that the interest generated by Dr. Verbruggen's recent series of articles (*CRSQ* 21:79-81, 137-40, 182-4) will be such that this spark will be rekindled.

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Reply to Wolfe

I really think that Mr. Wolfe and I are not all that far apart in our thinking. However, there are two points on which I might remark.

First of all, is the relation of vitalism and mechanism not different from that of form and matter, say? Form and matter are complementary; they can both be present. Indeed, a Peripatetic or a Schoolman would hold that they must be present, or else there would be nothing. But vitalism and mechanism are contradictory views; if one is true, the other must be false.

In the second place, I was considering vitalism as a weapon. It seems unlikely that many secular people will go to the trouble of understanding Dooyeweerd. But they can understand the question, vitalism versus mechanism. Indeed, the contrast could be put into the form of a syllogism. If certain principles are inadequate to explain something, there must be other principles, which must have some validity. The principles of physics and chemistry, as they apply to lifeless matter, are inadequate to explain the existence of life. Therefore, there must be other principles, having to do with the existence of life. And we might lump these other principles under the work of Creation. (Without denying, of course, that the principles of physics and chemistry ultimately go back to Creation.)

Thus, anyone who admits vitalism should, if he is consistent, admit at least the possibility of Creation. Nor is that all. For if Creation is admitted as the explanation of the existence of life, one is entitled to wield Ockham's razor, and ask whether, then, Creation is not likely also the explanation of the diversity of life. And that leaves evolution with nothing at all to do.

H. L. Armstrong
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For all its greatness, the scientific mind is not infallible. In its reasonings it came to be the victim of foibles, of biases, of prejudices and even of sheer blindness to the obvious.

Jaki, Stanley L. 1984. God and man's science: a view of Creation in *The Christian vision: man in society*. Lynne Morris, editor, The Hillsdale College Press, Hillsdale, MI, p. 45.

QUOTE

. . . Regardless of differences on the extent of original sin, the nature of justification, the relationship of nature and grace, etc., all truly Christian intellectual endeavor is founded on the assumption of an Eternal, Triune God who has created the world, and who by means of the God-man Jesus Christ, his “only begotten” Son, is in the process of redeeming a fallen mankind from the ravages of human rebellion against divine prerogatives. Moreover, it is a fundamental assumption that our knowledge of this God and his redemptive activity is grounded in the Old and New Testaments.

Burke, Thomas J. 1984. Introduction in *The Christian vision: man in society*. Lynne Morris, editor. The Hillsdale College Press, Hillsdale, MI, pp. xiii, xiv.

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