A QUANTITATIVE ANALYSIS OF THE LIFE SPANS OF THE GENESIS PATRIARCHS

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Data from two sources (the Septuagint and Masoretic Texts) are used to generate exponential functions for expressing the post-Deluge life spans of the Genesis Patriarchs. When the functions are extended into a period of time less questionable than that of the Patriarchs and used to calculate dates and time spans in that period, two of those based on the Septuagint show reasonable agreement with known values. These functions are then used to establish a correction factor for the Carbon 14 dating process.

Introduction

Exponential functions are used to describe many natural processes. Examples include radioactive decay, build-up and decay of electric charge on capacitors, and certain biological processes. The mathematical expression of an exponential function is usually based on the number e.**

As an example, consider the time function $f(t) = 1\text{-}e^{-t/T}$, where t is expressed in an appropriate unit of time and T is the time constant peculiar to a given process. For an exponentially increasing function such as this, T is the time required for the function to increase to 63.2% of its maximum value. This function begins at $f(t) = 0$ when $t = 0$ and approaches 1 as t approaches "infinity."

An exponentially decreasing function based on the same time constant T would have the form $f(t) = e^{-t/T}$. T is the time required for the function to decrease to 36.8% of the initial value. At $t = 0$, $f(t) = 1$, and f(t) approaches 0 as t approaches infinity.

When an exponential function is plotted on a logarithmic scale the function assumes the form of a straight line.

With this brief background, attention will now be turned to the post-Flood Patriarchs.

Genesis Patriarchs

Graphical plots of the decreasing life-spans of the Patriarchs delineated in the Book of Genesis seem to indicate an exponential decay function. This possibility has been investigated by Patten[1] and Armstrong.[2] Both works ascribe this decrease to changing environmental conditions following the Deluge.[3, 4]

Whitcomb and Morris suggest that the collapse of a possible vapor canopy during the Deluge subsequently left the earth exposed to hazards previously unknown; e.g., cosmic rays. It is also noted that Carbon 14 is formed in the upper regions of the atmosphere. Carbon 14 is, of course, the basis of a much used radioactive dating process. The vapor canopy could have prevented Carbon 14 from reaching the lower levels of the atmosphere (life zones) so that antedeluvian organic remains would contain little or no Carbon 14.

Armstrong[5] assumes, ". . . that the rate of change or increase of the concentration of radioactive carbon (C_{14})* is proportional to the rate of change or decrease of average lifetime. This seems plausible if both changes are due to the same cause." He attempts to establish a correction factor for the Carbon 14 dating process based on the Patriarchal geneologies.

However, Armstrong assumes that the Carbon 14 reached a steady state level around 1000 B.C. Melvin Cook[6] claims that such a steady state has not been reached.

The author believes the lower age limit "pegged out" at 70 years** around 1000 B.C.; it followed an external exponential process just so far and was then inhibited by other factors. If this is true, a correction factor based on the geneologies alone cannot be determined; the beginning point (i.e., time of the Deluge) must be known.

It would be interesting to determine if there is an exponential function that closely approximates the data provided in Genesis 11.

Mathematical Analysis

Graphs showing the Patriarchal life spans as a function of time elapsed since the Deluge can be somewhat ambiguous. For instance: The Masoretic Text states that Arphaxad was born two years after the Deluge and lived 438 years. It is no problem plotting 438 on the vertical axis, but what value should be used on the horizontal axis to represent this state of longevity? He lived from two years after the Deluge until 440 years after the Deluge.

Should this longevity be affixed on the horizontal axis to the time of his birth (2), the midpoint of his life span (221), or the time of his

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**$e = \lim_{x \to 0} (1 + x)^{1/x}$

*That is, in organisms living after the Flood.

**This of course has varied, decreasing to around 36 years in ancient Greece and Rome and to around 49 years in Europe during the Middle Ages. However, 70 seems to be the expected value, given sound hygenic practices, freedom from pestilance, etc. This level has been attained again by modern advanced nations.

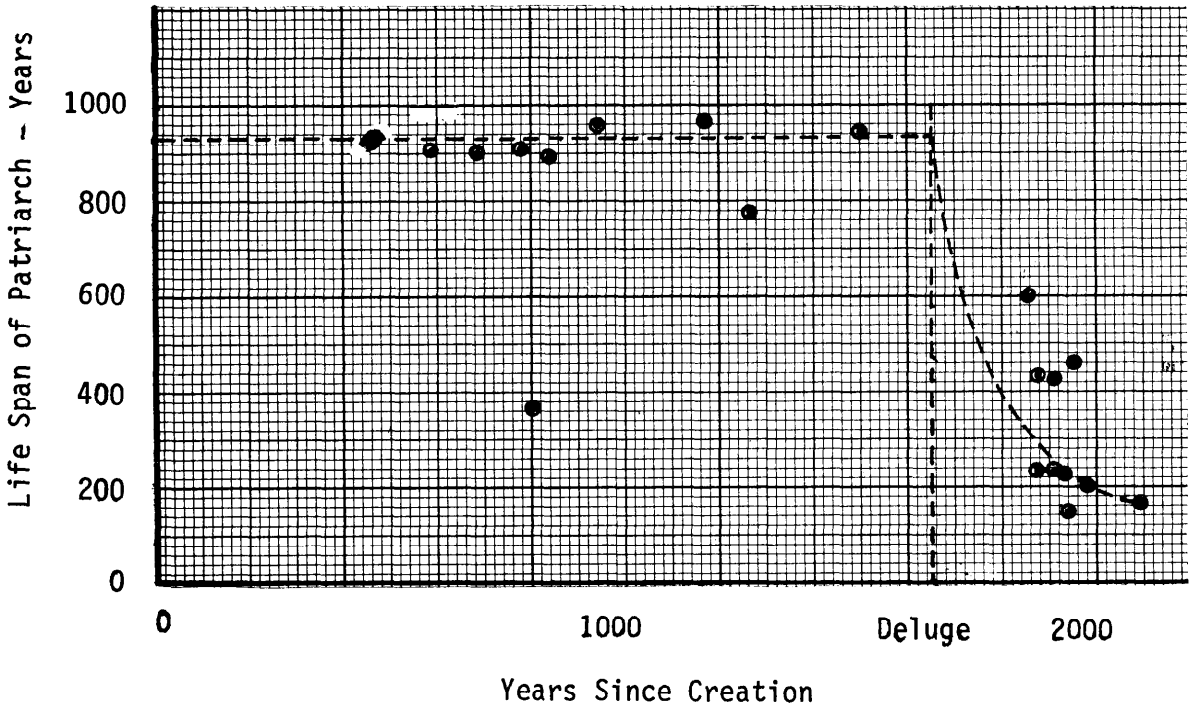

Figure 1. Plot of Patriarchal Life Spans from Masoretic Text.

expiration (440)? Armstrong plots the age of the Patriarch in question against the time of his maturity; or as he puts it, the time of his "first begetting."

There are two major divergent accounts of the Patriarchal gencologics: the Masoretic and the Septuagint. Tabulation of data from these texts is given in Tables I and II.[7] The first column in each table gives the age at "the first begetting." Thc second column gives the age at death (life span), except for Enoch "who was translated and did not see death." The mid-points (half the age attained) of each life span are plotted in Figures 1 and 2 for these texts, respectively.

A regression analysis provides a "curve of best fit" for the given data. This has been done for the dates of maturity and the mid-points of the life spans for the Septuagint and the dates of maturity for the Masoretic Text. The life span mid-points for the Masoretic Text did not lend themselves to this analysis. The results are expressed as

$$A = ke^{-t/T}$$

where A = age (life span) of Patriarch; k = a constant determined from the analysis (This should be approximately equal to the pre-Deluge average life span.); t = time elapsed since the Deluge; and T = the time constant determined from the analysis.

The function determined from the Masoretic Text based on the dates of maturity is

$$A = 929e^{-t/244}.$$

	Table I Masoretic Text		Table II Septuagint	
	Age at "Begetting"	Lifespan	Age at "Begetting"	Lifespan
Adam	130	930	230	930
Seth	105	912	205	912
Enos	90	905	190	905
Cainan	70	910	170	910
Mahalaleel	65	895	165	895
Jared	162	962	162	962
Enoch	65	365	165	365
Methuselah	187	969	187	969
Lamech	182	777	188	753
Noah	500	950	500	950
Shem	100	600	100	600
Arphaxad	35	438	135	535
Cainan	—	—	130	460
Salah	30	433	130	460
Eber	34	464	134	404
Peleg	30	239	130	339
Reu	32	239	132	339
Serug	30	230	130	330
Nahor	29	148	179	304
Terah	130	205	130	205
Abraham		175		175

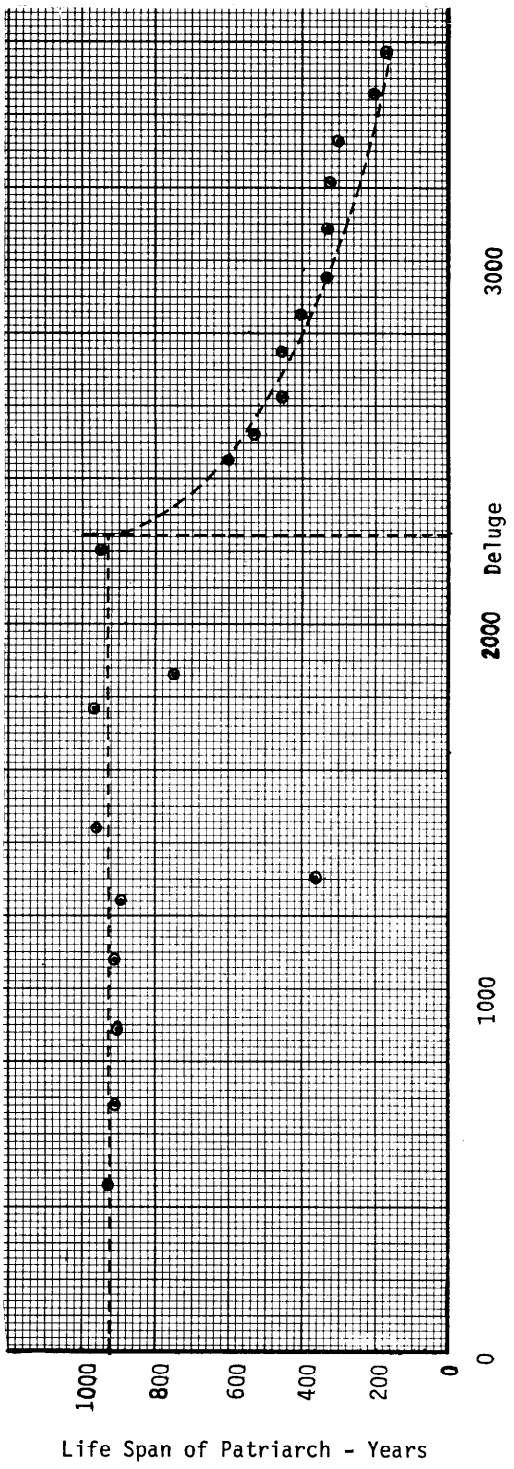

Figure 2. Plot of Patriarchal Life Spans from Septuagint.

The function determined from the Septuagint based on the dates of maturity is

$$A = 929e^{-t/1163}.$$

The mid-points of the life spans from the same data yield

$$A = 929e^{-t/1010}.$$

To eliminate the aforementioned ambiguity, a plot can be made showing the age at expiration on the vertical axis and the entire period of time the individual lived shown horizontally. On semi-log graph paper (logarithmic scale on one axis), the exponential function (straight line) to which the life spans are assumed to be related should cross each of the life spans. This is shown in Figure 3 based on data from the Masoretic Text.

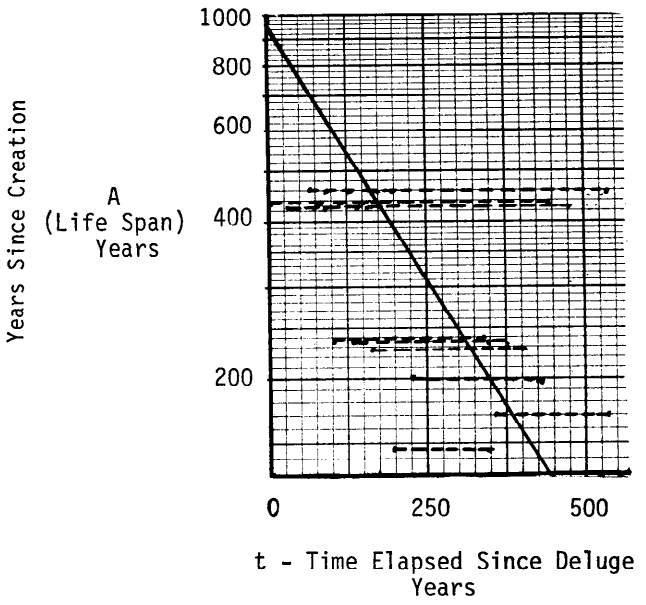

Figure 3. Visual Construction of Exponential Function Based on Masoretic Text. The solid line represents the exponential function. The dotted lines represent the life spans of the post-Flood Patriarchs. Nahor, whose life span is not crossed by the solid line, is represented by the bottom-most dotted line.

A straight line can be drawn across the life spans only if Nahor is excluded. If Nahor is excluded and a line is drawn from the 925 year point on the vertical axis, the resulting time constant is 225 years, so that

$$A = 925e^{-t/225}.$$

Consider now a similar plot based on the Septuagint. This is shown in Figure 4.

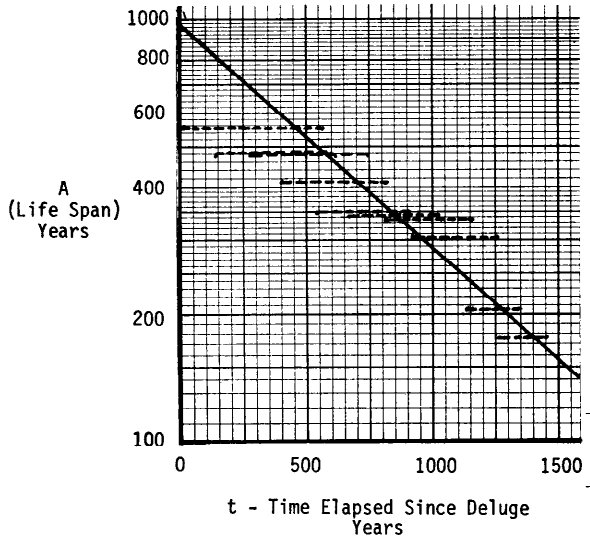

Figure 4. Visual Construction of Exponential Function based on Septuagint Text. The solid line represents the exponential function. The dotted lines represent the life spans of the post-Flood Patriarchs.

Again constructing a line from the 925 year point on the vertical axis, every life span is crossed. The time constant in this case is 850 years, so that

$$A = 925e^{-t/850}.$$

The five relations are tabulated in Table III.

TABLE III

Exponential Functions Representing Patriarchal Life Spans after the Deluge

	Regression Analysis		Visual Construction
	Maturity	Mid-point	
Masoretic Text	$A=929e^{-t/244}$ I*	Not Applicable	$A=925e^{-t/225}$ II
Septuagint	$A=929e^{-t/1163}$ III	$A=929e^{-t/1010}$ IV	$A=925e^{-t/850}$ V

Preference might be given to the function that is most compatible with data from a time period that is not so questionable as is that of the Patriarchs. However, the data must come from a period of time prior to that in which the lower level of the life span (70 years) was reached.

The ages (life spans) of Abraham and Joshua provide the data for one such compatibility test. (Other known life spans could also be used.) They are used to calculate the time interval separating Abraham and Joshua by means of the exponential time constant.

Two values, v_1 and v_2, of an exponential function separated by an interval of time $\bar{t}$ are related as follows:

$$\frac{v_2}{v_1} = e^{-\bar{t}/T}, \text{ where } v_2 \text{ is greater than } v_1.$$

The interval $\bar{t}$ is then determined, when v_1 = life span of Joshua = 110 years; and v_2 = life span of Abraham = 175 years, as follows:

$$e^{-\bar{t}/T} = 110/175 = .629$$
$$-\bar{t}/T = \ln(.629.) = -.464$$
$$\bar{t} = .464T$$

The value of $\bar{t}$ calculated in this manner is somewhat ambiguous since the ages on which it is based are spans of time rather than points. Nevertheless, it will provide an indication of the validity of the function, since it is known that this period was some four or five hundred years.

The five values of $\bar{t}$ are shown in Table IV.

TABLE IV

Calculated Time Span between Abraham and Joshua

			T (years)	$\bar{t}$ (years)	Table III Functions
Regression Analysis	Masoretic	Maturity	244	113	I
	Septuagint	Maturity	1163	540	III
		Mid-point	1010	469	IV
Visual Construction	Masoretic Text		225	104	II
	Septuagint		850	395	V

Another compatibility check can be made by determining when the lower limit of 70 years is reached by each of the functions, knowing this occurred prior to the time of David (who lived to 70 years of age): circa 1000 B.C. This can be done by setting the expression equal to 70 and solving for t. By Regression Analysis:

$$929e^{-t/T} = 70$$
$$e^{-t/T} = 70/929 = .0753$$
$$-t = T\ \ln(.0753)$$
$$t = 2.59T$$

By Visual Construction:

$$925e^{-t/T} = 70$$
$$e^{-t/T} = 70/925 = .0757$$
$$-t = T\ \ln(.0757)$$
$$t = 2.58T$$

The date of the Deluge derived from the Masoretic Text is approximately 2460 B.C. From Table II (Septuagint), it is approximately 3398 B.C. The "70 year date," computed from the Deluge dates, is tabulated in Table V for the five functions.

TABLE V

Initial Date of 70 Year Life Span

			t (years)	70 Year Date (B.C.)	Table III Functions
Regression Analysis	Masoretic Text	Maturity	631	1829	I
	Septuagint	Maturity	3007	391	III
		Mid-point	2611	787	IV
Visual Construction	Masoretic Text		581	1879	II
	Septuagint		2194	1204	V

*Roman Numerals are provided merely to identify the functions.

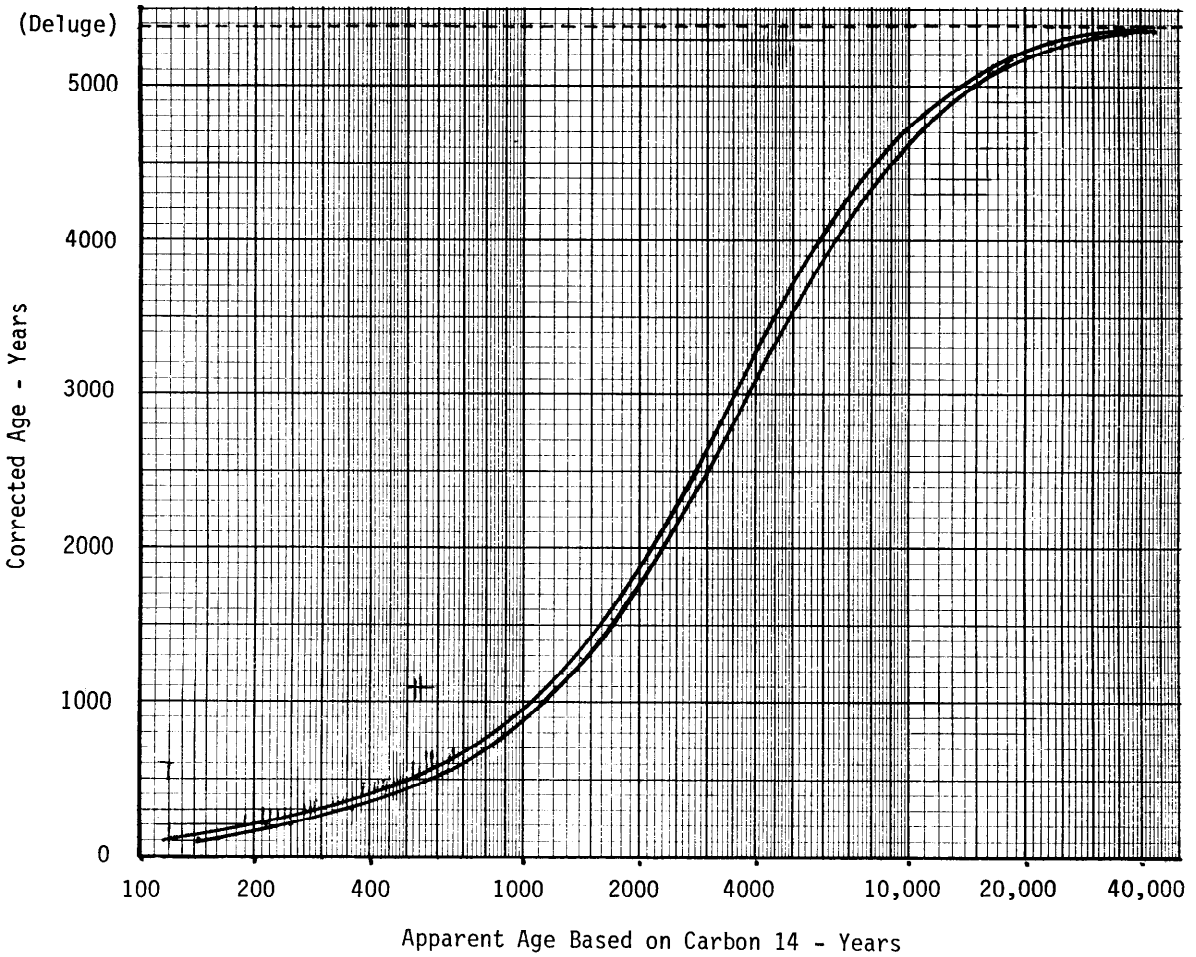

Figure 5. Correction Curves for the Carbon 14 Dating Process. The upper curve is derived from the exponential function with a time constant of 850 years. The lower curve is derived from the exponential function with a time constant of 1010 years.

The 3398 B.C. Deluge date and the 850 year and 1010 year time constants for functions IV and V as shown in Table IV have been used to determine alternative correction factors to the Carbon 14 dating process. This is shown in Figure 5.

The result of a Carbon 14 test on charcoal indicating a date of 2620-2630 B.C. for an ancient structure in Durrington Walls in England is reported in *The Genesis Flood.*[8] It is pointed out that the date of the ancient structure according to compelling archaeological evidence should be at least 1000 years later. This means an apparent age of 4600 years for a 3600 year old object. The curve based on the 850 year time constant (V) in Figure 5 indicates a true age of 3550 years for an object dated by Carbon 14 at 4600 years. This is mentioned as a point of interest only; many such comparisons would be necessary to verify a potential correction curve.

Many Carbon 14 "adjustment factors" have been suggested. If the rate of Carbon 14 build-up has varied, no single correction factor can take that variation into account.[9]

Conclusion

None of the exponential functions presented precisely indicates the time span and date against which they are checked. However, two of them (IV and V) yield values close to those expected; these being the two based on the Septuagint (mid-point and visual construction). One might be tempted to conclude that the Septuagint is the preferred text.

However, no firm claim is made for the validity of these functions; they are presented as comparative mathematical models of the time-dependent decreasing Patriarch longevity and as a potential correction factor for Carbon 14 dating. It is hoped that further work will continue in this area.

References

[1]Patten, D. W. 1970. A symposium on creation II. Baker Book House, Grand Rapids, Mich., p. 38.
[2]Armstrong, H. L. 1965. An attempt to correct for the effects of the flood in determining dates by radioactive carbon, *Creation Research Society Quarterly*, 2(4):28.
[3]Whitcomb, J. C. and H. M. Morris. 1961. The Genesis flood. The Presbyterian and Reformed Publishing Co., Philadelphia, Penn., pp. 23-25, 399-405.
[4]Patten, *Op. cit.*, pp. 33-35.
[5]Armstrong, *Op. cit.*
[6]Cook, M. A. 1966. Prehistory and earth models. Max Parrish, London, p. 6.
[7]Teachout, R. A. 1971. A new case for Biblical chronology, *Bible-Science Newsletter*, 9(1):1ff. January.
[8]Whitcomb and Morris, *Op. cit.*, p. 43.
[9]Hefferlin, Ray. 1972. A mathematical formulation of a creationist-flood interpretation of radiocarbon dating, *Creation Research Society Quarterly*, 9(1):68-71.

ENTROPY PRIOR TO THE FALL

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The assumption that the second law of thermodynamics was not in effect in the physical universe until after the Fall and imposition of the curse leads to many difficulties. Processes essential to life in the natural order, as well as thermodynamic order and predictability in all of nature are dependent upon the relationships involved in the second law. Scriptural data may be used to deduce that prior to the Fall the state of nature was one of natural, not supernatural order, though the living creatures and ecological systems were in a state of physical perfection.

It is therefore postulated that conditions described by the second law came into existence after Creation and prior to the Fall, that the disruptive and degenerative effects of random processes upon living systems were divinely constrained, and that the removal of this constraint constituted one aspect of the curse.

The assumption that conditions described by the second law of thermodynamics did not exist until after the Fall and the imposition of the curse upon all creation as recorded in Genesis 3 has apparently been widely accepted in creation-science circles without discussion. It would appear, however, upon careful examination of the place of the second law in the natural order that such an assumption leads to many serious problems. The purpose of the author is to consider foundations of the second law and its place in the natural order, and to suggest modifications to the above assumption which will eliminate the difficulties which inhere in it.

Foundations of Thermodynamics

Classical thermodynamics is concerned with energy transformations and equilibrium properties of macroscopic systems, systems sufficiently large for reproducible measurements of their properties to be made. The microscopic or atomic structure of the systems is not in view. The first law is the law of energy conservation.

The second law deals fundamentally with a property of physical systems called entropy, which has been found always to increase in irreversible processes in isolated systems. A thermodynamically reversible process is an ideal, hypothetical process in which all temperature, pressure, concentration and other gradients producing changes are infinitesimally small and all rates are infinitesimally slow. Obviously all real processes are irreversible, since they involve finite gradients and rates, and they therefore produce increased entropy.

The entropy, S, is related to the Gibbs free energy, G, by the equation:

$$G = E + pV - TS,$$

where E = internal energy, V = volume, p = pressure, and T = absolute temperature. For a process occurring at constant temperature and pressure, the change in free energy is $\triangle G = \triangle E + p\triangle V - T\triangle S$. Thus free energy involves the entropy and is therefore related to the second law. But the equilibrium constant for a chemical reaction is related to the free energy by the equation:

$$\log_{10} K = -\frac{\triangle G^0}{2.303\,RT}$$

where R is the gas constant, 1.987 cal/mole-deg; T is the absolute temperature; and $\triangle G^0$ is the increase in standard free energy of the products over the reactants. If $\triangle G^0$ is large positively, the reactants essentially will not react. If $\triangle G^0$ is large negatively, the reaction will go far to completion at equilibrium.[1]

Therefore, the direction of a chemical reaction and the equilibrium point are determined by application of the second law of thermodynamics through the relationship of the equilibrium constant to free energy and thus to entropy. Recall, also, that the second law may be used to describe the direction of the flow of heat and the flow of substances under pressure and concentration gradients, etc. These observations apply to the present natural order in the universe.

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