SOME MATHEMATICAL CONSIDERATIONS ON RADIOCARBON DATING,

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

Sensitivity

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

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

where for sake of argument and sense we have assumed an exponential decay. This law of radioactive decay has taken on the position of a postulate since von Schweidler[1] first proposed it in 1905. Creationists should be especially alert to tacit assumptions in established science, and should not hesitate to challenge such assumptions, especially when they are counter to biblical evidence. It is in this regard that the exponential decay is held in this paper. More will be said about it later. However, exponential decay probably preserves the sense and order of magnitude when compared with actuality, which is all that is required in this section.

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

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

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

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

from which

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

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

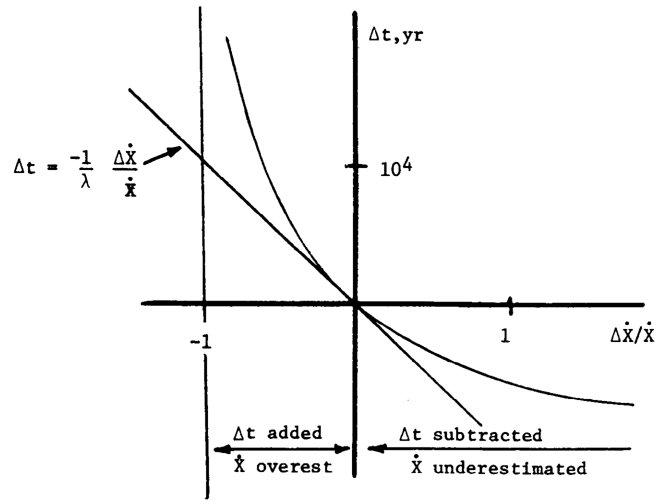

Figure 1. Error, Δt, in years, in the calculated age vs. $\Delta\dot{X}$, the error in determining the rate of decay. The relation probably gives a curve, as shown; but over a certain region the curve may be approximated by a straight tangent drawn to it. The equation of the tangent is $\Delta t = (-1/\lambda)(\Delta\dot{X}/\dot{X})$. The result is that to the left, the rate of decay is overestimated; to the right it is underestimated.

Stochastic Process Models

Radioactive decay is rightfully a transport problem and *might* be modeled by intro-differential equations of the Ambartsumian[2] or Chandrasekhar[3] type. This writer knows of no serious attempt to relate these equations to the problem of radiocarbon dating let alone solve them for the difficult to formulate circumstances of α or β transport and emission in the biological environment. Putting aside the problem of proper constitutive equations, decay phenomena are invariably modeled as a stochastic process thus avoiding the picking of constitutive equations altogether.

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

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

which yields the exponential decay given by

$$X(t) = X_0 e^{-\lambda t} \quad (6)$$

This solution also results from the solution to the linear death stochastic process defined on the positive integers and continuous in time (as shown in Figure 2) where

$$P(X + 1 \to X) = \lambda(X + 1)\Delta t$$
$$P(X \to X) = 1 - \lambda X \Delta t \quad (7)$$

and where the probability of more than one decay in time interval Δt is negligible. Hence the Chapman-Kolmogorov equation is

$$P_X(t + \Delta t) = P_X(t)(1 - \lambda X \Delta t) + P_{X+1}(t)(\lambda(X + 1)\Delta t) \quad (8)$$

with boundary conditions

$$P_{X_0}(0) = 1, \; P_X(0) = 0 (X < X_0), \; P_X(t) = 0 (X > X_0) \quad (9)$$

Therefore on rearranging and dividing by Δt,

$$\lim_{\Delta t \to 0}\left(\frac{1}{\Delta t}(P_X(t + \Delta t) - P_X(t))\right) = \lim_{\Delta t \to 0}(-\lambda X P_X(t) + P_{X+1}(t)\lambda(X + 1)) \quad (10)$$

$$\frac{dP_X}{dt} = -\lambda X P_X + \lambda(X + 1)P_{X+1}; \; X = X_0, X_0 - 1, \ldots, 1, 0$$

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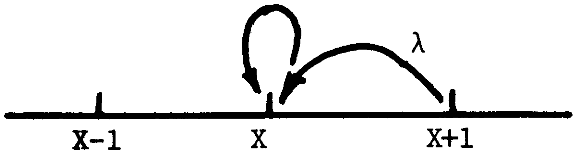

Figure 2. The scheme for decay according to a "linear death" stochastic process. The probability of more than one decay in an interval is here assumed negligible.

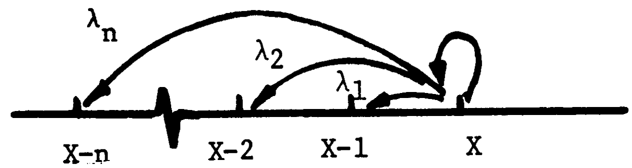

Figure 3. The scheme for the linear death process in which there may be coincidences of decay. The constant λ relate to the coincidence of the corresponding number of decays in the interval.

This differential-difference equation is readily solved[4]

$$P_X(t) = \binom{X_0}{X} e^{-X_0 \lambda t}(e^{\lambda t} - 1)^{X_0 - X} \qquad (11)$$

from which we may compute the mean and variance for this process,

$$m(t) = \Sigma_{X=0}^{X_0} X P_X(t) = \ldots = X_0 e^{-\lambda t}$$
$$\sigma^2(t) = \Sigma_{X=0}^{X_0}(X - m(t))P_X(t) = \ldots = X_0 e^{-\lambda t}(1 - e^{-\lambda t}) \qquad (12)$$

Thus the mean value for this sample stochastic model yields the solution of the traditional deterministic model, but with much more information as a by-product. Hence the validity of $X = X_0 e^{-\lambda t}$ should be further tested with respect to the observed variance, $\sigma(t)$. Anderson[5,6] has recently done this and found the exponential decay to be wanting. Hence there is reason to suspect the very mathematical foundation of radiocarbon dating.

Let us now consider the linear death process but with no restrictions on the coincidence of decay, as shown in Figure 3. In this case the decay constants $\lambda_i (i = 1, 2, \ldots, n)$ are asigned for coincident of n decays in time Δt. Let

$$\lambda = \Sigma_{i=1}^{n} \lambda_i \qquad (13)$$

Then the Chapman-Kolmogorov equation may be applied, as above, to obtain

$$P'_X = -\lambda X P_X + \lambda_1 (X+1) P_{X+1} + \ldots + \lambda_n (X+n) P_{X+n}$$
$$P_{X_0}(0) = 1, P_X(0) = 0\ (X < X_0), P_X(t) = 0\ (X > X_0) \qquad (14)$$

where the prime indicates differentiation with respect to time. This differential-difference equation will be solved directly for $m(t)$ by starting from,

$$m(t) \equiv \Sigma_{X=0}^{X_0} X\, P_X(t) \qquad (15)$$

Hence combining with our differential equation

$$m' = \Sigma_{X=0}^{X_0} X P'_X = -\lambda \Sigma_{X=0}^{X_0} X^2 P_X$$
$$+ \Sigma_{i=1}^{n} (\lambda_i \Sigma_{X=0}^{X_0} X(X+i) P_{X+i}) \qquad (16)$$

which after some manipulation become

$$m' = (-\Sigma_{i=1}^{n} i\lambda_i)\, m - \Sigma_{i=1}^{n} \lambda_i (\Sigma_{X=0}^{i-1} X(X-i) P_X) \qquad (17)$$

Further manipulation of summation indices yields

$$m' = -\Lambda m + Q(t), \ m(0) = X_0 \qquad (18)$$

where

$$\Lambda = -\Sigma_{i=1}^{n} i\lambda_i$$
$$Q(t) = -\Sigma_{i=1}^{n} \lambda_i (\Sigma_{X=0}^{i-1} X(X-i) P_X)$$
$$\vdots$$
$$= -\Sigma_{j=1}^{n-1} (\Sigma_{i=j+1}^{n} (j + j\,(i - j - 1))\lambda_i) P_j \qquad (19)$$

Hence solving for $m(t)$,

$$m(t) = e^{-\Lambda t} (\textstyle\int_{s=0}^{t} e^{\Lambda s}\, Q(s) ds + X_0) \qquad (20)$$

For large X_0 the P_j in $Q(t)$ are surely small since they are the probabilities $P_0, P_1, \ldots, P_{n-1}$. This may be simplified,

$$m(t) \approx X_0 e^{-\Lambda t} = X_0 e^{-(\Sigma_{i=1}^{n} i\lambda_i)t} \qquad (21)$$

Therefore if this stochastic model is correct, the decay constant is a composite one. Anderson[5,6] interprets his data as showing coincidence and a variable decay constant. The more complicated case for small X_0 should not be ignored, as it reduces the computed age.

If the decay constant is $\Sigma_{i=1}^{n} i\lambda_i$ rather than λ_1 then one might ask whether the experiments to calibrate radiocarbon decay are performed over a sufficient length of time. This situation is like the orbit of Mercury where it was finally discovered that the apsidal precession was the overall determining feature of the orbit as compared to a strictly Keplerian path.

Clearly $\Lambda > \lambda_1$ and hence the respective computed age will be shorter. This possibility might substantially reduce radiocarbon ages if the sample had experienced an environment where $\lambda_i (i > 1)$ where nonzero and comparatively large. Specifically, if decay rates are equated,

$$\lambda X_0 e^{-\lambda\tau} = m' = \Lambda e^{-\Lambda t} \qquad (22)$$

where ages τ and t correspond to decay constants λ and Λ, respectively, then

$$t = \frac{\lambda}{\Lambda}\tau + \frac{1}{\Lambda} \ln \frac{\lambda}{\Lambda}$$
$$\approx \frac{\lambda}{\Lambda}\tau \quad (\text{when } \tau \text{ is large}) \qquad (23)$$

There is no compelling reason to choose the linear death process. In fact if the stochastic model is to be retained (for reasons of mathematical tractability, at least), then it should be of prime interests to creationist to discover *which* stochastic model. A promising candidate should be the nonhomogeneous death process investigated by Kendall.[7] In this case $\lambda = \lambda(t)$ is a function of time and

$$m(t) = X_0 e^{-p(t)}, \ p(t) = \textstyle\int_{s=0}^{t} \lambda(s) ds$$
$$\sigma^2(t) = X_0 e^{-2p(t)} \textstyle\int_{s=0}^{t} \lambda(s) e^{p(s)} ds \qquad (24)$$

and

$$m'(t) = -X_0 \lambda(t) e^{-p(t)} \qquad (25)$$

This last formula might be of special interest in radiocarbon-treering analyses. However the use of such formulas awaits further research into the nature of the radiation-decay process. A number of effects, other than a variable decay constant, can be incorporated by letting λ vary.

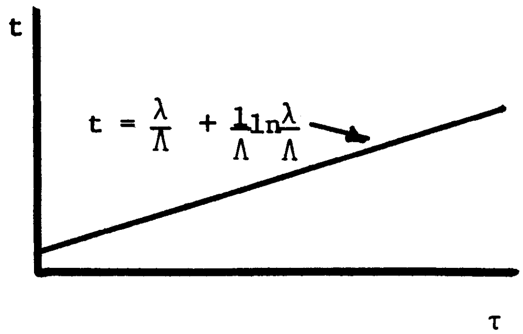

Figure 4. The true age, t, of a sample vs. the age τ calculated on the assumption of strictly exponential decay. Note that t might be considerably less then τ. The relation is given in Equation (23).

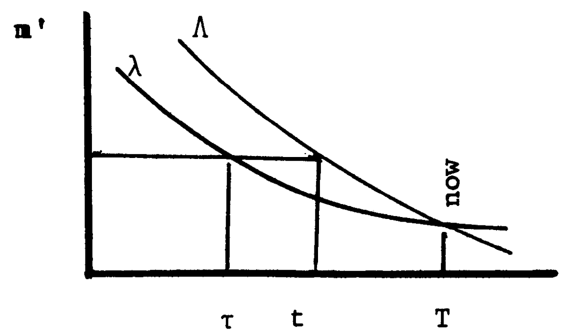

Figure 5. This shows how m', the mean rate of decay, may have been greater in the past than it would be according to the uniformitarian assumption, although the two rates coincide just now. This possibility would arise from composite decay, and is indicated by the curve marked "Λ". The one marked "λ" is according to the assumption of simple exponential decay.

A Simple Dating Model

Next attention will be given to a special case of the non-homogeneous model of Kendall. Let the radiocarbon specimen be born at time $t = t_1$ and die at $t = t_2$ and let $t = T$ be the present time at which the specimen is tested. This is shown in Figure 6. Let $X(t)$ be the number of C-14 atoms in the specimen at time t and $C(t)$ is the available input to the specimen. Hence λ will be assumed constant and $\lambda < 0$.

The moment of birth (i.e. at the beginning of growth) may be written

$$X' = \lambda X + C(t),\ X(t_1) = 0,\ \lambda < 0 \tag{26}$$

and the solution is

$$X(t) = e^{-\lambda t}\int_{t_1}^{t} e^{\lambda s}\, C(s)ds,\ t_1 \leqslant t \leqslant t_2 \tag{27}$$

Define

$$X_0 = X(t_2) = e^{-\lambda t_2}\int_{t_1}^{t_2} e^{\lambda s}\, C(s)ds \tag{28}$$

Hence for $t > t_2$

$$X' = \lambda X,\ X(t_2) = X_0 \tag{29}$$

and

$$X(t) = \begin{cases} e^{-\lambda t}\int_{t_1}^{t} e^{\lambda s}\, C(s)ds, & t_1 < t < t_2 \\ X_0 e^{-\lambda(t - t_2)}, & t_2 < t \end{cases} \tag{30}$$

from which,

$$X_T = X(T) = [e^{-\lambda t_2}\int_{t_1}^{t_2} e^{\lambda s}\, C(s)ds]\ e^{-\lambda(T - t_2)} \tag{31}$$

If $C(T) = A$ then the uniformitarian solution with $C(t) = C(T)$ is

$$\tilde{X}_T = X(T)\,|_{C=A} = (A/\lambda)e^{-\lambda t'_2}\,(e^{\lambda t'_2} - e^{\lambda t'_2})\, e^{-\lambda(T - t'_2)} \tag{32}$$

In order to compare the nonuniformitarian and uniformitarian solutions we observe that $X_T = \tilde{X}_T$ which yields

$$(A/\lambda)(1 - e^{\lambda(t'_2 - t'_1)}\, e^{-\lambda(T - t'_2)}) = e^{-\lambda T}\int_{t_1}^{t_2} e^{\lambda s}\, C(s)ds \tag{33}$$

where t'_1 and t'_2 are the beginning and end of growth for the sample as computed from the uniformitarian model, i.e.

$$t'_2 - t'_1 = \Delta\tau = t_2 - t_1 \tag{34}$$

Decay rates might also have been equated. Hence

$$(A/\lambda)e^{\lambda t'_1}\,(e^{\lambda\Delta\tau} - 1) = e^{-\lambda T}\int_{t_1}^{t_1 + \Delta\tau} e^{\lambda s}\, C(s)ds \tag{35}$$

And, since ΔT is small, then approximations can be

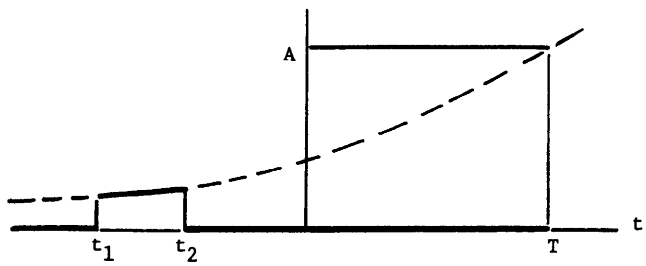

Figure 6. A sample is supposed to have taken up carbon 14 from times t_1 to t_2. Later, at time T, the present, it was tested; and from the result A, the amount of carbon 14 available to the sample when it was taking up carbon 14, is calculated.

$$\begin{aligned} (A/\lambda)e^{\lambda t'_1}(e^{\lambda\Delta\tau} - 1) &\approx \frac{1}{2}(\Delta\tau)[e^{\lambda(t_1 + \Delta\tau)}\, C(t_1 + \Delta\tau) + e^{\lambda t_1}\, C(t_1)]\ e^{-\lambda T} \\ &\approx \frac{1}{2}(\Delta\tau)\, e^{\lambda t_1}\ [e^{\lambda\Delta\tau}\, C'(t_1)\,\Delta\tau + C(t_1)]\ e^{-\lambda T} \\ (A/\lambda)e^{\lambda t'_1}\,(\lambda\Delta\tau) &\approx \frac{1}{2}(\Delta\tau)\, e^{\lambda t_1}\ [(1 + \lambda\Delta\tau)C'(t_1)\Delta\tau + C(t_1)]\ e^{-\lambda T} \end{aligned} \tag{36}$$

where the theorem of the mean for integrals, the theorem of the mean for derivatives, and the Maclaurin approximation for $e^{\lambda\Delta\tau}$, are used, respectively. Finally,

$$Ae^{\lambda t'_1} \approx \frac{1}{2}\, e^{\lambda t_1}\ [C(t_1) + C'(t_1)\,(\Delta\tau) + \lambda(\Delta\tau)^2 C'(t_1)]\ e^{-\lambda T} \tag{37}$$

relating t'_1 vs. t'_1.

With this comparatively simple relation the deficiencies of the uniformitarian solution for various models of $C(t)$ can be qualified. The work of Barnes[8] on the effect of the terrestrial magnetic field on radiocarbon dates would suggest,

$$C(t) = Ae^{\mu(t-T)},\ \mu < 0 \tag{38}$$

where μ may be decay constant for the field strength. Though it is rather arbitrary to postulate that an exponential specific productivity follows from an exponentially decaying field, it as least preserves the sense and is as good as, if not better than, the associated assumptions found in the uniformitarian literature. For this simple function the indicated integration can be performed

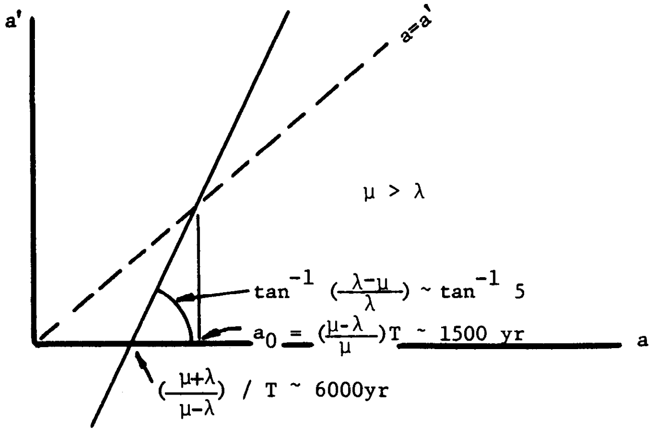

Figure 7. Possible relations between the historic age, a, of a sample dated by carbon 14, and a', the calculated age. The broken line shows the relation $a = a'$, according to the uniformitarian assumption. The solid line is another possible solution, as is discussed in the text. Its slope is about $(\lambda - \mu)/\lambda$ which is around 5. Note also that a and a' coincide at about 1500 years.

$$(A/\lambda)e^{\lambda t_1'}\,(e^{\lambda\Delta\tau} - 1) = e^{-\lambda T}\int_{t_1}^{t_2 + \Delta\tau} e^{\lambda s}\,Ae^{\mu(s - T)}ds \tag{39}$$

which for $\Delta\tau \ll 1/\lambda$ yields, after some manipulation,

$$a' = (\frac{\lambda + \mu}{\lambda})\,a - (\frac{\mu - \lambda}{\lambda})\,T \tag{40}$$

where a and a' are the ages,

$$a \equiv T - t_1,\ a' \equiv T - t_1' \tag{41}$$

And according to Reference 8

$$\lambda \approx -\ln 2 / 5600,\ \mu \approx -\ln 2 / 1400 \tag{42}$$

and using $T = 2000$ yr.,

$$a' = 5a - 6000 \tag{43}$$

Also the $a = a'$ point is given by

$$a_0 = (\frac{\mu - \lambda}{\lambda})\,T \tag{44}$$

The exponential decay model for $C(t)$ yields a straight line relationship between the uniformitarian age and the nonuniformitarian age, such as is shown in Figure 7. In comparing this model with actual data we may regard a' as the radiocarbon age and a as the historic age.

Clearly there exist some (many) function(s) $C(t)$ which would cause our computed a to agree with the ovserved historic age. Though one may suspect the values of the slope and intercept there are some reasons for confidence in the straight line solution, as actual plots of the radiocarbon vs. historic ages shows.[9] Of course, in such plots made by uniformitarians we see that the slope is very nearly one and intercept zero.

If one examines the variance of the data and does not discount the Bible as a source of highly accurate chronological data, then the straight line is expected relating a' to a. The important feature of this solution is that for $a' > a_0$ the radiocarbon age is an overestimate while an underestimate for $a' < a_0$ and for values of a' large compared to a_0 the radiocarbon age is nearly a constant factor too large where this factor might be on the order of five. If this be correct then large radiocarbon dates are gross overestimations of actual age. In the next section this solution will be applied to Libby's data.[10]

This solution must not be pushed too far since choice for $C(t)$ and the very constituent equations were not derived directly from physical considerations. Firstly, the straight line solution may only be a local approximation for, say, $a' < 30{,}000$ yr., since the actual solution must have an asymptote at $a \approx 6000$. For, according to the Hebrew Old Testament, creation occurred at slightly less than 6000 years ago.[11,12] This asymptotic behavior is suggested in Figure 8.

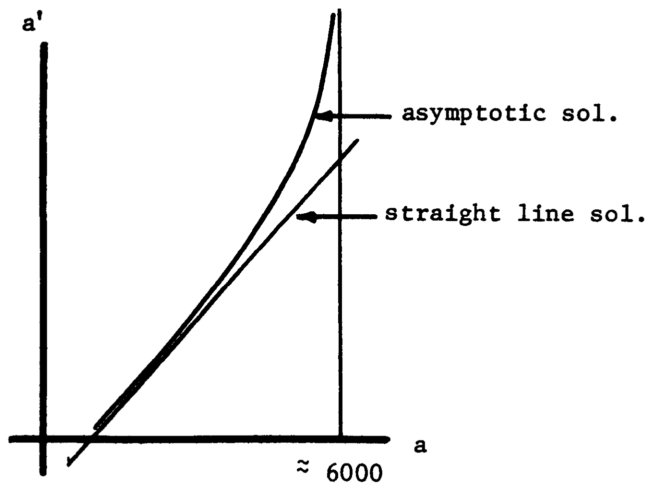

Figure 8. A linear relation between a and a' can apply only over a limited range. Eventually the relation must approach an asymptote, as shown. For even the oldest calculated ages must correspond to true ages no more than about 6000 years, according to the data from Scripture.

Secondly, $C(t)$ must be derived from quantitative analyses considering the total effects of, at least, the Noahic Flood and the decay of the earth's magnetic field. Having obtained a representative $C(t)$, the associated nonhomogeneous stochastic process of the Kendall type could then be derived in order to arrive at the variance and other statistics.

The Data

In Reference 10 the data Libby used in calibrating his exponential decay equation are given. Some of the better data have been exerpted, including most of those used to draw the decay curve on page 10 of Reference 10; these data are shown in Table 1.

The plot of these data in Figure 9, shows the extent of the data of both the assigned historical age and the individual data (plus-or-minus one standard deviation). Libby carefully chose data from his repository to show that $a' = 1.00a + 0.00$ which is precisely what he wanted and precisely what he obtained. However, here using much the same data $a' = 1.43a - 1713$ was obtained giving $a_0 = 3980$. I am unable to distinguish my choice of a data base from Libby's. It is just as appropriate for a creationists to cast out data as it is for a uniformitarian! A linear regression of the individual data yields again a slope of about 1.4 and an $a_0 \approx 3000$ yr.

The observed value of a_0 is particularly important since it simultaneously shows the qualitative correctness of our methods while pointing out the anti-biblical prejudice of the uniformitarian. Since there was reason to suspect a slope larger than 1.4, possibly as large as 5, then the assignment of the historical ages in Libby's data must be questioned.

Specifically, a_0 acts as a pivotal value above which historic ages have arbitrarily been assigned great values in

TABLE 1

Table 1. The historic ages *a*, and ages *a'* according to carbon 14, of some samples used by Libby.

Sample No.	a	a'	average
1	4650±75	3099±770	3979±350
		4234 600	
		3991 500	
12	4575±75	4721 500	4802 210
		4186 500	
		5548 500	
		4817 240	
267	2280	2190 450	2190 450
4	4700-5100	4803 260	4883 200
		4961 240	
810	≳5000	5744 300	5744 300
72	2625±50	2096 270	2531 150
		2648 270	
		2239 270	
819	~4700-5100	5317 300	5317 300
	1500-2700	1466 250	1449 200
		1452 290	
576	1950-2050	1917 200	1917 200
81	3750	3845 400	3621 180
		3407 500	
		3642 310	

order to accommodate evolutionary history and to contradict the ages in Genesis. Similarly, values of a less than a_0 have been diminished, again in agreement with secular historical research and to discredit as much biblical prophecy as possible by having prophecy given after the prophesied event took place.

According to this brief analysis the pivotal point is at $a_0 \approx 3000$ yr. (or about 1000 B. C.). And according to the Book of Proverbs, man's folly will reveal him and that Wisdom cries everywhere despite man's iniquity. Here, in this analysis, does the reader once again see man's perversion pointing to the biblical truth?

I fully expect that if historical ages were performed by a Bible believing Christian and if *only* biblically related samples were used, that a much larger slope, approaching five would be observed. I restrict consideration to only biblically related samples in the conviction that no other chronology than that in the Bible is valid, and that other chronologies have validity insomuch that they can be related to scriptural events.

For additional examples of the straight line plot, and historic age distortions see the a' vs. a plots in Egyptian chronology chapters of Reference 9.

Global Radiocarbon

Before proceeding to a discussion of the global mechanisms for the production and transport of radiocarbon, a simple model treated by Cook[13] will be examined. Let C be the C-14 concentration in the biosphere (or equivalently in an average unit of volume). Assume that k_1 is the constant rate of C-14 production (the specific productivity) and $-k_2C$ the rate of decay (the specific activity). Therefore

$$\frac{dC}{dt} = k_1 - k_2C \tag{45}$$

Note that the maximum value of C occurs when $dC/dt = 0$ since, from observation $k_1 > k_2C$. Hence

$$C_m = k_1/k_2 \tag{46}$$

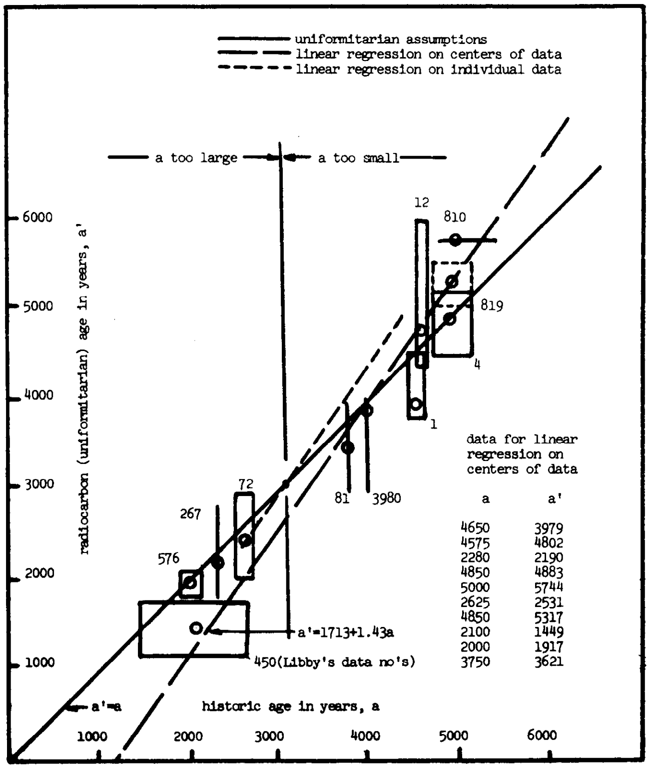

Figure 9. Here the data from Table 1, true and indicated ages, are plotted. The lines indicate several relations, to fit the data as well as possible, as is explained in more detail in the text.

Next define

$$Y = C/C_m = Ck_2/k_1 \tag{47}$$

and note that Y_p is the ratio of the specific activity to specific production at present,

$$Y_p = C_pk_2/k_1 \equiv R \tag{48}$$

Changing variables in our differential equation,

$$\frac{dY}{dt} = k_2(1 - Y), \; Y(0) = Y_0 \tag{49}$$

from which

$$Y(t) = 1 - (1 - Y_0)e^{-k_2t} \tag{50}$$

and

$$Y_p \equiv R = 1 - (1 - Y_0)e^{-k_2t_p} \tag{51}$$

which on solving for Y_0,

$$Y_0 = 1 + (R - 1)e^{k_2t_p} \tag{52}$$

This relation is plotted in Figure 10.

It is reasonable to associate $t = 0$ with the time of the Flood and Y_0 with the activity/productivity ratio just after the Flood year. Various values for the specific activity and specific productivity have been computed since Libby's original work. For the moment let us adopt 12.4 and 18.8 counts per minute per gram from amongst values recently mentioned in the literature. Hence $Y_p = R = 12.4/18.8 = .66$ which from our graph gives $Y_0 = .42$ for $t_p = 4322$ as taken from Ozanne's chronology (Reference 11). Note that for $R = .66$ the maximum possible t_p is about 9000 years corresponding to an improbable $Y_0 = 0.0$. Furthermore, all feasible values for R yield values of t_p not more than several thousands of years.

If $Y = Y_0$ at the time of the Flood, then let $Y = Y_c$ at $t = t_c < 0$ at the time of creation (Fall),

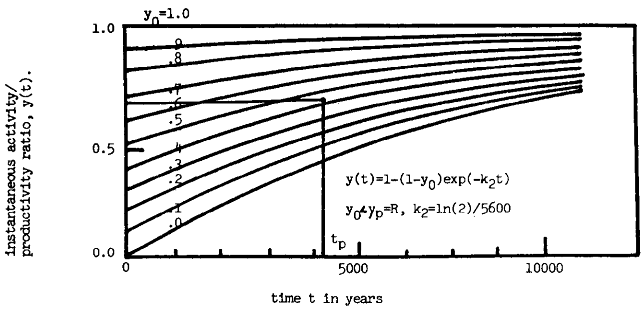

Figure 10. The ratio Y of the specific activity and specific productivity of carbon 14 at any time t, plotted vs. t. The various curves labelled with numbers are for the marked magnitudes of Y_0, the magnitude of Y at time zero.

$$X_c = 1 - (1 - X_0)e^{-k_2 t_c} = \ldots = 1 + (R - 1)\, e^{-k_2 (t_p + t_c)} \qquad (53)$$

If $t_c = -1656$ then $X_c = .75$. Hence this would suggest that the specific activity was greater than the specific productivity in the pre-Flood world, which is not unexpected for a denser pre-Flood atmosphere capable of greatly attenuating the C-14 production-transport mechanism.

Toward a Creationist Model for Radiocarbon Dating

To the best of my knowledge nothing approaching a comprehensive mathematical model for radiocarbon data can be found in the literature. I am convinced that such a model would be of great value to Bible research, e.g. in the areas of chronology and Bible-lands geophysics and archeology.

This model must start with an accurate description of the boundary conditions. Specifically the trajectories of Bev range cosmic radiation in the earth's magnetic field must be analyzed in order to determine the fraction not reflected. Much attention [14] has been given to the paths of captured particles, but little attention to the open paths. This analysis should provide for geographical dependence of radiocarbon ages.

The next step is the analysis of the atomic and molecular kinetics that produce fast (5-10 Mev) neutrons to thermal (4-1.6 Mev) neutrons to C-14 and other products. This part of the model is quite complicated but adequately explained in the literature (e.g. see various bibliographies in Reference 9). The exchange of molecular and atomic carbon (C-12, C-13, C-14) between the domains of the biosphere, ice, oceans, etc. is poorly modeled.

Existing models are designed to produce the desired uniformitarian result with little regard for the actual physical processes involved. For example, Rafter and O'Brien[15] and Lingenfelter and Ramaty[16] choose first order exchange models with no mention of the fact that the actual constitutive equations must be of the second order in order to represent the diffusion type transport problem.

For example, if $j = 1, 2, \ldots$ is a domain index for the atmosphere, polar regions, ocean surface, etc. then we would expect equations for the concentration C_{ij} ($i = 1, 2, \ldots$ is the index C12, C14, etc.) of the form,

$$\partial^2 C_{ij}/\partial h^2 = -k_{ij}(h, t)\partial C_{ij}/\partial t + A_{ij}(h, t) \qquad (54)$$

where A_{ij} is the source function and k_{ij} is the diffusion strength. The solution of the exchange problem then supplies the initial conditions for the radiocarbon age equations.

Conclusions

Creationists are well aware of uses of science to unite man against God. Hence we are not surprised to note that the closing chapter of Olsson's book (Reference 9) is titled, "Radiocarbon as an Example of Unity of Science".

The above hueristics discredit the uniformitarian radiocarbon dating. When properly understood, radiocarbon dating corroborates the Bible in every case. In fact, despite efforts to the contrary, uniformitarians seem to be unable to present their basic data in a way that does not belie their intent and does not point to the Biblical record. A fine example of this is afforded in the article by Renfrew.[17] His summarial plot shows that the greatest antiquity of bronze metallurgy lies in the very regions one would expect from the table of nations in Genesis 10. However I cannot accept Renfrew's ages, indicating the greatest ages of 6500 B. C. in the Hittite, Ararat and Ur regions.

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