

variations in the lifetimes of several long-lived isotopes.^{19, 20}

Conclusion

The many variables present in the radiocarbon dating technique rule out calibration of the method beyond the short-term possibly absolute dendrochronology of bristlecone pines. Nevertheless, the method is irrationally being pushed ever backward in time. Creationists thus have the continued challenge and responsibility of demythologizing the radiocarbon technique. Predictions concerning C-14 dating show that the future holds tremendous possibilities for evidence of a recent creation.

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RADIOCARBON CALIBRATION—REVISED

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Received October 26, 1977

The radiocarbon dating method has been claimed to provide considerable support for evolutionary theories of the past which conflict with the Biblical record of the Earth's early history. This paper seeks to answer the question: how can the radiocarbon activity measurements be understood in a way that is consistent with the Biblical framework of history? The evidences for the non-equilibrium theory of radiocarbon variations are discussed and are shown to give the theory a sound theoretical foundation. The prediction that atmospheric C-14 activities have increased with time has been tested by studying the results obtained from known-age samples. Consistency between theory and observation is found for the period of the last 2600 years, but not before this. It follows that either the non-equilibrium model is wrong, or that the chronologies of Ancient Egypt and of the tree-ring sequences are in need of major revision. Evidences from Biblical archaeology which strongly suggest the need of a revision are briefly discussed. Using a revised chronological scheme, the C-14 activities of the archaeological samples have been recalculated, and it is found that the results are consistent with the non-equilibrium prediction. Consequently, the theory is self-consistent, and this promotes confidence in the general approach. The form of a creationistic calibration curve for C-14 dates is suggested, so that use may be made of the dating system when re-evaluating the facts relevant to prehistory.

1. Introduction

From the Biblical account of the early history of the earth, a number of important events or periods can be identified: 1. the relatively recent Creation in six days; 2 the Fall of man into sin followed by God's curse on the Creation; 3. the Antediluvian period with its long-lived inhabitants and advanced culture; 4. the worldwide Flood and the preservation of land creatures in the Ark; and 5. the dispersal of the descendants of Noah from Babel to the different regions of the earth. Most modern archaeologists and prehistorians regard each

component of this history as mythical. Instead, they advocate a comparatively slow evolutionary development of man over hundreds of thousands of years as pre-human animals; tens of thousands of years as Palaeolithic man; and thousands of years as Neolithic man. More recently, the view that civilizations arose independently in different parts of the earth and that men did not disperse from a central region has gained wide acceptance. In the study of prehistory, the radiocarbon dating method has given considerable authority and impetus to the evolutionary views.

It is the purpose of this paper to show that the results of radiocarbon dating are dependent on the presuppositions incorporated into the theory of the method. Also,

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that with different presuppositions, an alternative theoretical approach is possible, which enables the same data to be interpreted in a way which is consistent with the Biblical framework of history.

This paper explains the principles underlying the revision and re-examines the radiocarbon data normally used for calibration purposes. One of the interesting aspects of this dating method is its interdisciplinary nature, and this is particularly relevant in the dating of samples from Dynastic Egypt. The validity of current thinking about Egyptian chronology is discussed, and is shown to have a crucial bearing on the validity of the proposed revision of the dating method.

The outcome of the discussion is a calibration curve for radiocarbon dates which radically changes their significance for prehistory. In the revised scheme, support for evolutionary ideas about man's origin is lacking, and the data are fully consistent with the Biblical record.

2. The Hypothesis of Non-Equilibrium

The earth's reservoirs of radiocarbon are popularly considered to be in a state of near-equilibrium, small variations in C-14 production in the upper atmosphere giving rise to comparatively minor fluctuations in the level of radiocarbon activity. There are, however, several evidences that such thinking is erroneous and that the C-14 reservoirs are far from being in a state of near-equilibrium. The presupposition of near-equilibrium has been repeatedly questioned by Creationists, and reference is made to some relevant papers in the following discussion.

2.1 The Biblical History

Evidence that the earth is young and that many C-14 ages are considerably older than the samples they are supposed to date is provided by the Biblical record of origins. There is only one realistic way to account for this situation: the atmospheric C-14 activity at the time of the sample's growth must have been considerably lower than its present value.¹ This interpretation of the data certainly requires there to have been a state of non-equilibrium in the past. Furthermore, since equilibrium is considered to be reached after about 30,000 years under present conditions, and since the earth is not as old as this, it is probable that the state of non-equilibrium still exists, although the situation will have been influenced by the intermediate conditions of C-14 generation and reservoir mixing.

2.2 Carbon-14 Generation and Decay Rates

Positive evidence for non-equilibrium has been found in the discrepancy between generation and decay rates of C-14.^{2, 3} The argument, as it stands at present, may be summarized as follows. The total natural radiocarbon content of the earth's carbon exchange reservoirs is fairly accurately known, and is about 2.16×10^{30} atoms.⁴ With a half-life of 5730 years, the decay rate is 8.28×10^{18} atoms/s for the whole earth, or 1.62×10^4 atoms/m²s, using the figure of 5.1×10^{14} m² for the surface area of the earth. The generation rate has been calculated in two ways. An analysis of atmospheric

neutron measurements has given a global average of $2.5 \times 10^4 \pm 0.5 \times 10^4$ C-14 atoms/m²s. Production rates have also been calculated from the measured energy spectra and nuclear abundances of the cosmic ray flux at the top of the atmosphere, and an average figure of $2.2 \times 10^4 \pm 0.4 \times 10^4$ C-14 atoms/m²s has resulted.⁶ A weighted mean of these values is $2.3 \times 10^4 \pm 0.3 \times 10^4$ C-14 atoms/m²s, and this should be compared with the decay rate. The generation rate is about 40% higher than the decay rate, and the discrepancy should be regarded as well-established.

In 1965, Libby attempted to account for the difference by postulating a large and irretrievable loss of carbon by sedimentation on to the ocean floors, and this idea has been incorporated into the calculations of Ramarty and Lingenfelter.⁶ Cook⁷ has shown that the postulated large sedimentation rate leads to geological absurdities. However, it could be argued that the Holocene sedimentation rates are abnormally high, and that uniformitarian principles for assessing sedimentation rates are not realistic.

An estimate of the contemporary sedimentation rate of carbon from ocean water may be made in the following way. Carbon is present in ocean water in the form of bicarbonate and carbonate ions. It has been found that the waters are approximately saturated with calcium carbonate near the surface, but not saturated at depths below a few hundred meters. Consequently, as the calcareous skeletons of dead organisms sink from the surface waters to the deep waters, they tend to dissolve. This information is summarized by Fyfe.⁸

Considerable amounts of carbon, in the form of carbonates, are added this oceanic system by the rivers. If the oceans are in an equilibrium condition with respect to calcium carbonate, the total sedimentation rate can hardly be much greater than the rate at which carbon is added by the rivers. If the oceans are not in equilibrium, and the deep waters are still approaching saturation, the sedimentation rate will be less than the above figure.

The information required to calculate the rate at which rivers carry carbon into the oceans is supplied by Mason.⁹ The total dissolved material carried out to sea each year is estimated to be 2.735×10^{13} kg, of which 35.13% is carbonate. This leads to an estimated annual sedimentation rate of carbon of 3.8×10^{-4} kg/m². The total carbon of the biosphere-atmosphere-hydrosphere reservoirs is estimated to be 4.2×10^{16} kg, and⁴ the number of C-14 atoms 2.16×10^{30} . Consequently, the sedimentation rate calculated above represents a loss of radiocarbon of about 0.062×10^4 atoms/m²s. This is too small by a factor of 10 to account for the discrepancy between the generation rate and the decay rate, and it indicates that the sedimentation loss explanation of the discrepancy does not deserve further consideration.

If the discrepancy cannot be explained from within the carbon cycle, it is necessary to look at the C-14 generation rate. Has the rate increased by about 40% in recent years? Natural C-14 generation is a result of cosmic rays interacting with atoms in the earth's atmosphere. The cosmic ray flux reaching the earth is influenced by the magnetic fields of both the earth and the sun. Abnormal changes of the earth's magnetic field have not been observed, but only a slow reduction in the

dipole field moment. Similarly, the sun is thought to be behaving quite normally at present. Historical records suggest an abnormal period between 1645 and 1715 A.D., during which sunspots were almost completely absent.¹⁰ Since that time the 11-year cycle of solar activity has predominated. There is no indication, therefore, from the earth or from the sun, of any factors which could account for the present discrepancy between the generation and decay rates of C-14, and this effectively eliminates them from further discussion.

The only other relevant parameter is the cosmic ray flux itself. The origin of cosmic rays continues to be a subject of controversy, but the most widely held view is that supernovas are primarily responsible for accelerating these particles to such high energies. Some calculations have been made to assess the possible influence that nearby supernovas could have on C-14 generation rates. With the four most recent supernovas observed with the naked eye, the largest estimate is about 0.5% increase.⁶ All the figures are small because these stellar explosions occurred at such great distances from the earth: the cosmic ray flux decreases with distance from its source, and it also is diffused by the magnetic field of the galaxy.

Nevertheless, if it is accepted that supernovas are a source of cosmic rays, and also that one occurred comparatively near to the earth (about 100-200 parsecs), it would be possible to account for the C-14 generation rate becoming abnormally high. Such a supernova would have become visible in the last few hundred years, and it would certainly have been of extraordinary brilliance. However, it is also certain that a nearby supernova has not been observed; and so it is necessary to conclude that there is no explanation of the C-14 generation and decay rate discrepancy from such a source.

Furthermore, for about the last 25 years, earth-based cosmic ray monitoring systems have recorded steady levels of flux, with only the normal solar cycle variations, and this experimental evidence, albeit of limited value, does not support the idea of recent large changes in cosmic ray flux.

The discrepancy remains, and the following statement by Fairhall and Young⁴ is indicative of the lack of other ideas to solve the problem. "We note in passing that the total natural C-14 inventory of 2.16×10^{30} atoms . . . corresponds to a C-14 decay rate of 1.63×10^4 disintegrations/m²s of the earth, considerably below the estimated production rate of C-14 atoms averaged over the last 10 solar cycles (111 years) of $2.5 \times 10^4 \pm 0.5 \times 10^4$ atoms/m²s. From a geophysical point of view it would be very surprising if the decay rate and the production rate of C-14 were out of balance as seriously as the difference between the above two numbers would suggest. It is difficult to reconcile this discrepancy by errors in computing the C-14 inventory since the bulk of the C-14 is in the sea, where the C-14 concentration relative to the terrestrial biosphere is known fairly well . . . The source of the discrepancy is therefore unknown unless the present day production rate is indeed significantly higher than the average production rate over the last 8000 years, the mean life of C-14."

The least that can be concluded from this evidence is

that radiocarbon generation and decay rates are not in equilibrium at the moment. Is it possible to say whether this situation has existed in the past? Whilst no definite conclusions can be drawn from this evidence, in the absence of any realistic explanation of the discrepancy, the hypothesis that the present situation is normal rather than abnormal is considerably strengthened.

2.3 Anomalous results from dendrochronological samples

The principle of globally uniform radiocarbon activity in the atmosphere has an excellent physical basis, and, if it is found to break down, the implications for the C-14 dating method are very far-reaching. Anomalous results have been obtained from some dendrochronological samples which do suggest a breakdown of the uniform activity principle, and a discussion of their significance has been included in reference 11. It is sufficient to say here that whilst these results are inconsistent with the equilibrium approach to radiocarbon variations, they are not necessarily so with the non-equilibrium model. This because imbalances in radiocarbon transport which result from non-equilibrium can override the effectiveness of the atmospheric mixing processes which tend to produce a uniform C-14 activity level throughout the world.

3. The Non-Equilibrium Model and Biblical History

Evidence which favors a serious examination of the non-equilibrium model of radiocarbon variations has been presented in section 2. As the next step, it is proposed to link the model more carefully with the Biblical record of the past. The two major discontinuities in the history of the earth are the Creation and the Flood. How are these particular events related to the non-equilibrium model? Creationists have differed on this matter. On the one hand, Whitcomb and Morris¹ suggest that, before the Flood, the troposphere was kept virtually free of radiocarbon. According to their view, finite C-14 dates are obtained only from post-Flood samples. On the other hand, Whitelaw¹² permits large quantities of C-14 to penetrate into the troposphere during the Antediluvian period, and, by the time of the Flood, he estimates that the radiocarbon activity was only about 12% lower than the normal contemporary level.

The easiest way to come to some conclusions about these alternative views is to consider the samples that have been dated by radiocarbon and to note their chronological place in the history of the earth. As a general rule, finite C-14 dates are obtained from samples representing the Late Pleistocene and Holocene periods, and most Creationists are agreed that these periods are to be placed subsequent to the Flood. "Infinite" dates are normally obtained from samples classified as geologically earlier. Consequently, as Whitcomb and Morris maintain, these are Pre-Flood samples, and they have C-14 activities which would appear to be so low as to be undetectable. This suggests the behavior which is schematically illustrated in Fig. 1.

The means whereby C-14 activities were maintained at a low level during the Antediluvian period are not known. However, there is no shortage of possible

explanations: the shielding influence of the suggested vapor canopy, to reduce both C-14 generation and the conversion of C-14 to radioactive carbon dioxide; a stronger magnetic field of the earth which would reduce the cosmic ray flux interacting with the atmosphere; a lower transport rate of C-14 from the upper atmosphere to the troposphere, because of the equable global climate; and a considerably greater quantity of carbon in the carbon exchange reservoirs, which would tend to give low C-14 : C-12 ratios.

In the technical literature, it is noticeable that radiocarbon activity levels are often reported to fluctuate with time, although the research workers are unable to offer satisfactory explanations of these variations. Nevertheless, this lack of understanding does not hinder them in their work on radiocarbon calibration, because the data are derived from measurements using known-age samples. Exactly the same principle is applicable to this study of radiocarbon variations. From the framework of Biblical history, Antediluvian samples are generally found to have "infinite" ages, and even though it is not clear why the activities are so low, this information may be legitimately incorporated into the calibration of radiocarbon dates.

4. Testing the Non-Equilibrium Model Using Samples of Known Age

Fig. 1 illustrates an inescapable prediction about radiocarbon variations in the past which follows from the non-equilibrium model. The prediction is that the atmospheric C-14 activity has been steadily increasing with time. To test this prediction, it is necessary to obtain samples of known age and to measure their C-14 activities. Then, a simple calculation determines the atmospheric C-14 activity at the time when the sample was living. Two types of known-age sample are available: tree-rings, primarily from Giant Sequoia and Bristlecone Pine trees; and archaeological samples from chronologically well-defined sites. The accuracy of the chronologies has been discussed in a previous paper,¹¹ and arguments were given for questioning their reliability before about 500 B.C. In this section, C-14 variations over the last 2600 years are considered, and

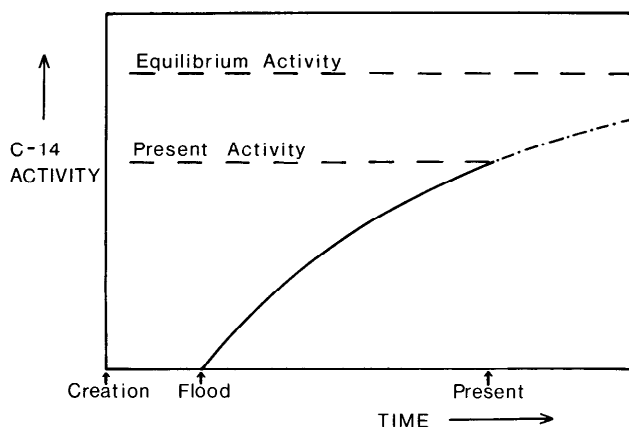


Figure 1. This shows the variation of radiocarbon activity with time according to the non-equilibrium model. The concentration is still building up and has not yet reached equilibrium.

particular attention is given to the trend predicted by the non-equilibrium model.

The radiocarbon activity of the atmosphere at the time when the sample was living is conveniently expressed by the term $\Delta\%$. This parameter expresses the activity as a per mil proportion of the "standard", which is considered to represent the atmospheric activity in the period 1860-1880 A.D. A 1% change in radiocarbon activity is a change of 10 in the parameter $\Delta\%$. In all calculations, the 5730 year half-life of C-14 has been used.

Fig. 2 plots the relevant data. Tree-ring dates are dots, and archaeological dates are closed circles. The data are taken from Refs. 18-22 of Reference 11; and in addition there are a few other archaeological dates taken from the journal *Radiocarbon*. The following notes and observations refer to Fig. 2. 1) In reference 11, tree-ring dates were considered to be suspect before about 500 B.C. After examination of the trends in more detail, it is found that the tree-ring data deviate from the archaeological data at about 250 B.C. Consequently, in Fig. 2, dendrochronological dates earlier than 250 B.C. are omitted.

2) Apart from the reduction since 1700 A.D., there has been a steady increase in atmospheric C-14 activity since 650 B.C. This increase is the basic prediction of the non-equilibrium model.

3) Whereas variations have been small for most of this period, this has not been the case over the last 500 years. The only trend that is widely accepted as having a satisfactory explanation has been the general decrease in activity since 1880 A.D., which is not clearly shown in Fig. 2. This decrease is known as the Suess Effect, and it is attributed to the large amounts of non-radiogenic carbon from fossil fuel that has been burned since the Industrial Revolution.

4) The baseline, $\Delta\%_0 = 0$, which has been chosen, is really rather arbitrary because of the variations that have occurred with time. As it happened, with this baseline, and with the C-14 half-life that was used for many years, the dating method did produce dates that agreed very well with historical dates. Consequently, the idea of "absolute" dating by radiocarbon measurement has entered the minds of the general public. This sense of "absoluteness" is still to be found, even though it is now known that atmospheric C-14 activity levels have not been constant and that C-14 dates must be calibrated. 5) The "anomalous" Egyptian dates of the Saite Period (of reference 11) are no longer anomalies in this presentation of the data. They continue the trend which is indicated in the graph and which is predicted by the non-equilibrium model.

To summarize, the observed trend over the last 2600 years is consistent with non-equilibrium. During this period, changes in C-14 in the atmosphere have not been very great, but nevertheless, a trend is clearly present.

This analysis of the data differs from that of Clementson,¹³ who has the C-14 activity decreasing, rather than increasing, during this period. The difference is primarily due to the limited data used by Clementson. However, according to the argument of this paper, a curve drawn through the three measurements at about

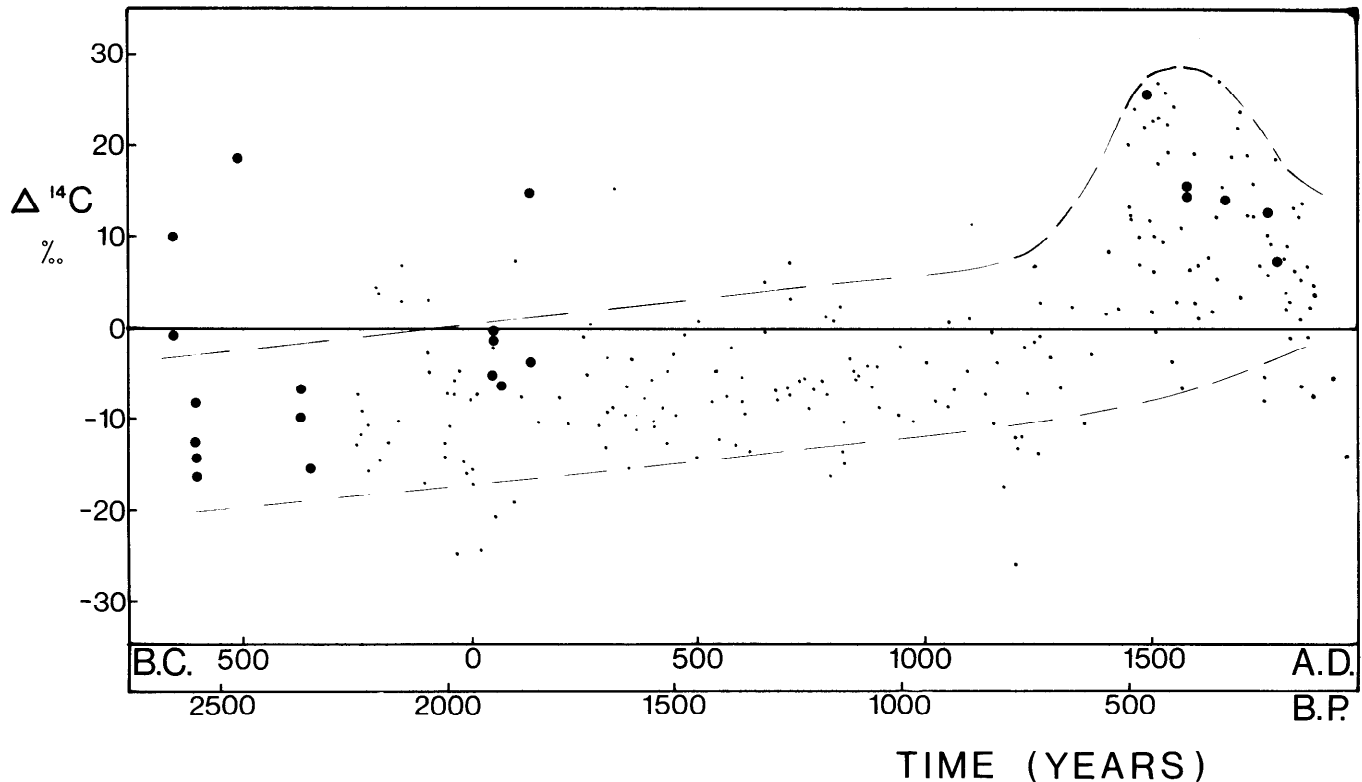


Figure 2. This shows the C-14 activity (proportional to the concentration) for the last 2600 years, as determined by tree rings and archaeological samples. The two curves may be considered to provide upper and lower limits.

2000 B.P., which are tabulated by Clementson but are not plotted on his Fig. 2, would give the trend more accurately than that which he suggests.

It has been shown that radiocarbon activity variations over the last 2600 years are consistent with the non-equilibrium model. It is now appropriate to consider the situation before 600 B.C. The trend is well-known to students of radiocarbon calibration, and it is illustrated in Fig. 1 of reference 11. The radiocarbon dates become younger than the historical ages assigned to the samples. If this is accepted, then the atmospheric C-14 activity before 500 B.C. was higher than the "standard" present activity, and this contradicts the prediction of the non-equilibrium model.

The observations bring the test of the model to a critical state. There are only two options. Either the non-equilibrium approach is wrong and it must be dropped; or, there are major errors in the currently accepted Egyptian and tree-ring chronologies before 600 B.C. In other words, if the observed trend is accepted, then the major prediction of the non-equilibrium model is found to be unreliable, and so the hypothesis is incorrect. Alternatively, the non-equilibrium approach can be sustained only if the real ages assigned to the samples are considerably younger than is generally accepted. It is not realistic to leave the verdict open for the time being, for the evidence is sufficiently strong to require that one of these two options be followed.

It is at this point that the argument of reference 11 becomes particularly relevant. The inconsistencies between the Egyptian and the dendrochronological results

suggest that there are errors in both chronologies. Therefore, before abandoning the non-equilibrium approach, it is of great importance to consider the second option in more detail. Since the difficulties of reinterpreting the dendrochronological data are immense, if not impossible, the discussion of section 5 is entirely devoted to the revision of Egyptian chronology.

5. A Revised Chronology of Ancient Egypt

The currently accepted absolute chronologies of the Near Eastern civilizations in the second and third millennia B.C. rely ultimately upon the Sothic dating method. Egyptian chronology stands alone as being "independently derived", and the other contemporary civilizations are dated by cross-reference to it. Powerful arguments against the validity of the Sothic dating method have been presented by Courville^{14, 15} and Velikovsky.¹⁶ In the light of the evidence these authors have amassed, it is likely that the main reason why the Sothic dating method continues to be accepted is that scholars are at a loss to find an alternative scheme. Their problem is: how is it possible to establish a reliable chronology without clear and accurate historical records?

Our approach to this difficulty is to turn to the chronological information provided in the Bible. The data are not meager and, since there are many points of contact between Israel and Egypt, it should be possible to tie Egyptian and Israelite history together. In this way, there is no need to have recourse to an unproven and doubtful scheme of astronomical dating. However,

most scholars have failed to use Biblical chronology as a guide. The tendency has nearly always been to work independently of the Biblical record, and then to examine the Bible in the "light" of the findings of archaeology. The result contributes to the so-called "higher criticism" of the Bible.

If there is a major error in Egyptian chronology, it is obvious that the archaeological record of Biblical history has been misinterpreted. A notable link between Egyptian and Israelite histories is at the time of the Exodus and, significantly, difficulties in interpreting the archaeological evidence have been recognized for years.

The Encyclopedia of Christianity has an article on "Biblical Archaeology"¹⁷ which indicates that the positive evidences of the Exodus and the settlement of the Israelites in Palestine are totally lacking. Summarizing the Egyptian evidence: "... we cannot be certain"; and "when we look at the evidence from Palestine, it is again inconclusive". Professor MacRae concludes this section of his article with these words: "Some new discovery may make the matter absolutely final, but up to the present, it must be considered a question on which we do not yet have sufficient light." However, this absence of any solid, positive evidence is incompatible

with the Biblical record. The Exodus was a catastrophe for Egypt: economically, politically and militarily. The Scriptures declare it to be a judgment upon that nation, and it was used as a warning to Israel not to ignore the word of God. (Genesis 15:14; Exodus 7:4, 11:2-4, 12:12; 1 Samuel 6:6; Amos 8:8, 9:5). Yet, this collapse of Egypt must have occurred, according to the conventional chronology, during the prosperous and powerful New Kingdom period. The extravagance and luxury of the New Kingdom rulers is well known, and illustrations of their treasures, their buildings and their statues may be found in profusion in popular histories of Ancient Egypt.

A study of the archaeological and historical problems associated with the Exodus has been made by Courville.¹⁴ He examines the most significant theories of the scholars, including the widely held view that Rameses II was the Paraoth of the oppression and of the Exodus, and concludes that these theories are woefully inadequate. The "evidences" might satisfy a scholar who thinks that there are exaggerations and errors in the Bible, but those who profess to believe in the divine inspiration and inerrancy of Scripture cannot accept this situation. They must conclude, as Courville has done, that there are significant errors in the chronology

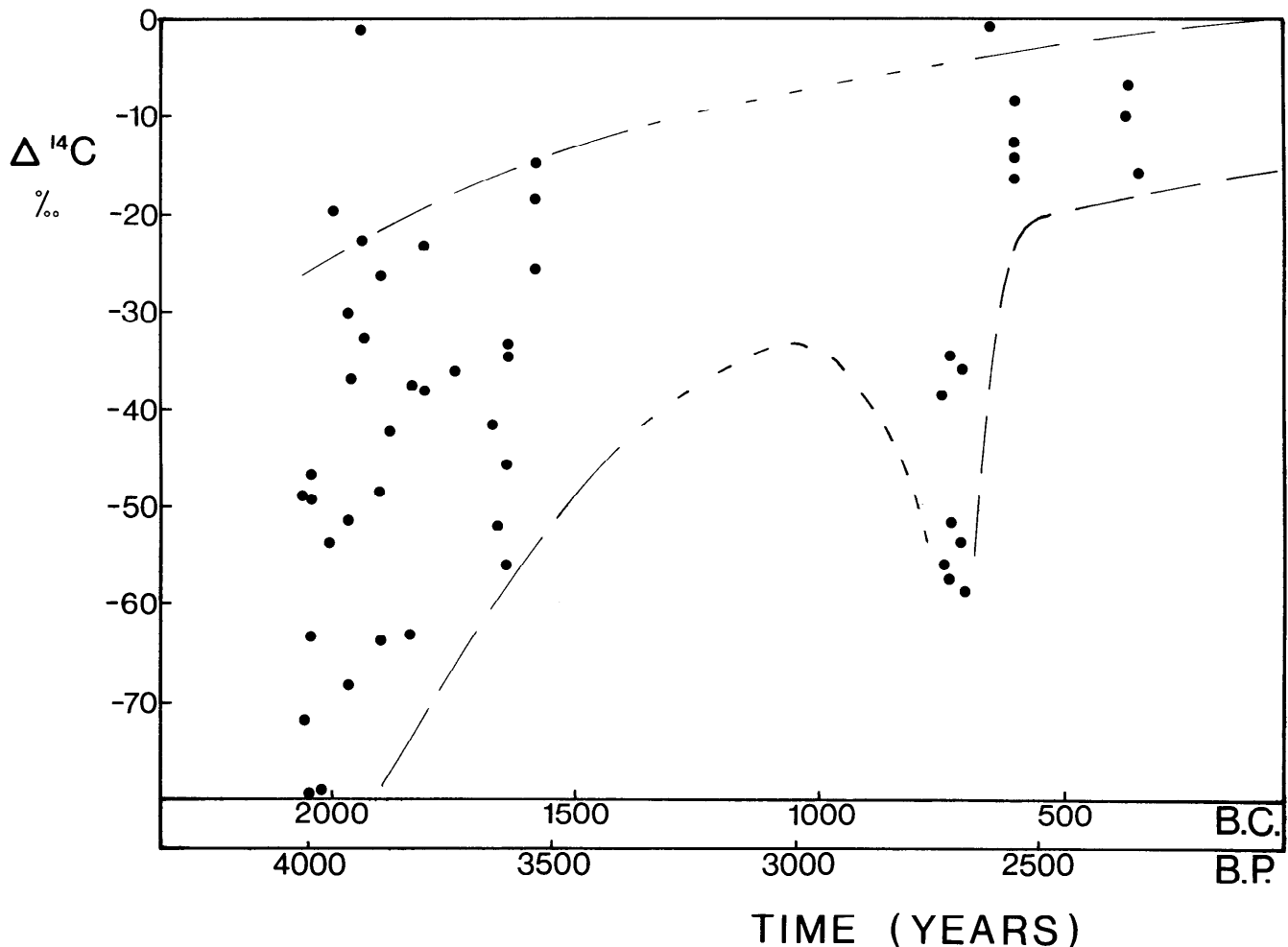


Figure 3. This shows the C-14 activity vs. time in the past as re-interpreted according to the revised chronology.

of Ancient Egypt, and that an attempt must be made to reinterpret the evidence.

The work of Courville¹⁴ should be consulted for a detailed discussion of chronological revision. Velikovsky¹⁸ has written a volume of major importance on the New Kingdom period. These works document many excellent synchronisms between Israelite and Egyptian history which are easily recognized once the conventional chronology is discarded. Close agreement is found between Courville and Velikovsky during the Hyksos and New Kingdom periods, but there are differences of view in the subsequent dynasties. Courville has also proposed a reconstructed chronology of the Old and Middle Kingdom periods. In my opinion, the scheme of Courville is linked, in all its essentials, to Biblical history, and so it provides a reliable chronology of Ancient Egypt.

It should be emphasized that the validity of the re-evaluation of the radiocarbon data, which follows in section 6, is totally dependent on the accuracy of the revised chronology. Although there is a good measure of agreement between Long¹⁹ and this paper, there are significant differences, and they should be evaluated on chronological grounds.

6. Radiocarbon Calibration and the Revised Chronology

Radiocarbon calibration makes use of C-14 activity measurements from samples of known age to determine the atmospheric activity at the time when the sample was living. This section reconsiders the Egyptian archaeological data (of reference 11) in the light of Courville's revised chronology.

The archaeological samples are associated with either a specific king or a dynastic period, and so each one can be assigned an age according to the revision. This age, together with the measured radiocarbon activity, enables the initial activity to be calculated. The result of this re-interpretation of the data is plotted in Fig. 3.

At 600 B.C. the C-14 activity level is about -10%. Before this, the atmospheric activity is observed to decrease in such a way that, by about 2000 B.C., it is of the order of -50%. Clearly, the trend for older samples to have progressively lower $\Delta\%$ levels is observed. In other words, the whole picture is now consistent with the non-equilibrium model.

Before 2160 B.C., there are no suitable materials available for calibration purposes, and so it is not possible to trace the curve back further in time. Nevertheless, from the non-equilibrium model illustrated in Fig. 1, it is predicted that the trend will continue, such that infinite ages correspond to the time of the Flood. The revised calibration curve, with an hypothetical extrapolation, is illustrated in Fig. 4. This curve has fluctuations in it at about 700 B.C. and 1700 A.D., but, as explained earlier, calibration merely records such variations, and it is not necessary to explain them.

This curve may now be used in the same way as any other calibration curve—to convert C-14 dates to calendar years. The major difference is that, whereas other C-14 calibration curves reckon C-14 dates to be too young before about 600 B.C., the curve of Fig. 4 shows them to be too old.

Conventional C-14 calibration has the effect of "stretching out" radiocarbon time, and slowing down, for example, the rate of man's cultural development. By contrast, this revised approach has the effect of "compressing" radiocarbon time, and speeding up the rate of man's cultural development. Thus, according to the revision, Palaeolithic and Neolithic Man may be considered to have existed for generations, rather than for millennia.

7. Summary and Conclusions

Creationists have repeatedly argued the case for the non-equilibrium model of radiocarbon variations. This paper has brought the evidence up to date, and has shown that the case for the non-equilibrium approach is as strong as, if not stronger than, it has ever been.

The Biblical record of the recent Creation implies that there must have been a time when plants grew in an atmosphere which was virtually free of C-14, and this is illustrated in the non-equilibrium model of section 3. A major geophysical evidence for non-equilibrium is the 40% discrepancy between the decay rate and the generation rate of C-14. This well-attested finding

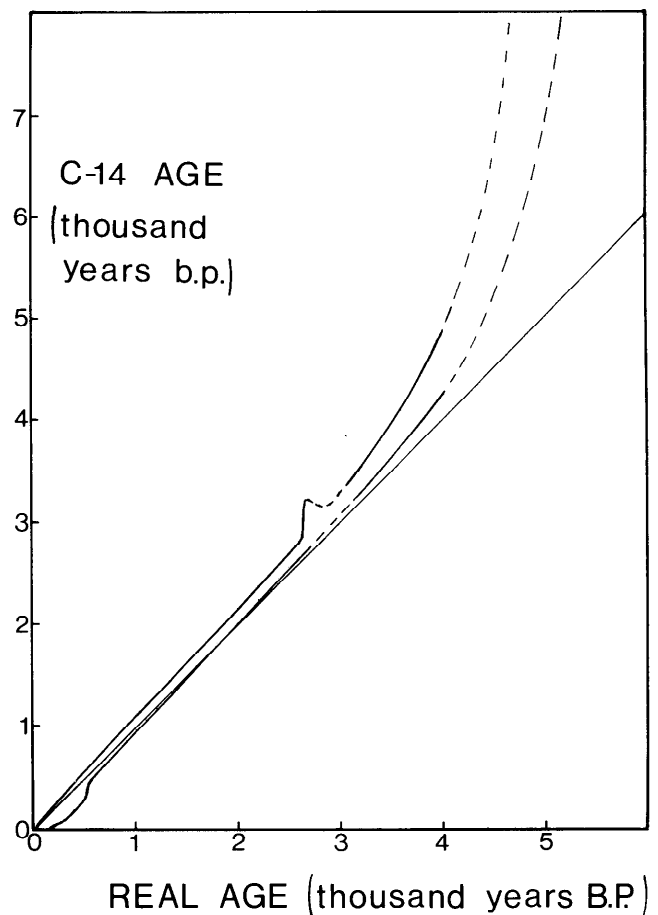


Figure 4. This is a revised calibration curve for C-14 dates, constructed in the light of the revised chronology and the principles discussed in this article. Note that very great C-14 ages indicate a real age of about four to five thousand years. Again, the two curves may be considered to provide upper and lower limits. The diagonal straight line merely shows what would be the case were the C-14 and real ages equal.

has not been explained by the research workers developing the radiocarbon dating method, although it is perfectly consistent with the non-equilibrium model. Furthermore, the breakdown of the principle of uniform atmospheric C-14 activity throughout the world is an indication of the need to revise the conventional theory, and these observations also can be understood within the framework of non-equilibrium.

The prediction of the non-equilibrium model, that radiocarbon activity levels have been rising with the passage of time, has been examined in two parts. With non-controversial known-age samples, covering the last 2600 years, the non-equilibrium theory is consistent with the facts. The activity variations are not large, but they do follow the predicted trend. Before 500 B.C., the postulate of non-equilibrium can only be sustained if the ages of Egyptian and dendrochronological samples are revised.

Evidence has been summarized to justify such an approach, for the testimony of Biblical archaeology virtually demands a radical revision. Courville's study of *The Exodus Problem* has provided the revision used in this work and, with this alternative chronology, all the relevant archaeological data have been found to be consistent with the non-equilibrium model.

Since the model has a substantial theoretical basis, and is consistent with the experimental data, a further step is justifiable. A calibration curve has been prepared to assist in the interpretation of radiocarbon dates, and to act as a Creationistic alternative to other calibration curves that have been published.

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CONTRARY AND CONTRADICTIONARY ARE DIFFERENT

In the days when logic was studied in earnest, "every schoolboy"—and the statement is about literally true—knew the difference between contrary and contradictory propositions or statements. But it would appear that nowadays many miss the distinction; at least, one might draw that conclusion upon reading the work of certain attackers of the doctrine of Creation.

For these people urge that Creation, being a supernatural notion, has no place in natural science. Indeed, there are reasons for disagreeing with such people even at that point. For suppose it firmly established—never mind how—that the world of nature came about, initially, by Creation. Do these people really mean that then one should sit on his hands, and refuse to study nature at all?

Again, surely to say that the world came about by Creation is analogous to saying that a certain building came about (first of all) by an architect's work of design. Of the workings of the architect's mind, while he was designing it, science may or may not have any account. But nobody would deny that it is possible to

grant that it was designed, and then to go on and study say the stresses in the various parts in a properly scientific way. If the case of the world not analogous?

However, return to the point, contrary vs. contradictory. First of all, what is meant by saying that something is natural? It seems hard to find a better explanation than the one which Aristotle (paraphrased a bit) gave. He said that the natural is that which happens always or for the most part (i.e., in given circumstances). And really, in practice, that is how it is judged.

Now Creation, being a unique thing, can not be said to happen always or for the most part. But neither could the alleged big bang happen always or for the most part. Even the most uniformitarian of uniformitarians would not claim that it happened more than once. So both Creation and the alleged big bang are not natural. As the logicians state it, the contradictory of natural is not-natural. Of two contradictory propositions, one must be false, one true. So both Creation and the big bang would be not-natural.

(Continued on page 26)