THE AGE OF MAN

DR. ROBERT W. WOOD

An Introduction to the Method of Archeological Dating by the Use of Radioactive Carbon

It is refreshing and encouraging when from the laboratories of the world's great scientists the end product of research turns out to be corroborative evidence for the faith which Christians have held in the inspired Word of God. Higher criticism has often rejected certain portions of the Word as of human origin, subject to human mistakes, but happily in many instances the later developments of science have revealed the harmony of factual evidence with the Word.

Archeology has played its part in this verification many times. Probably no single idea, however, has presented such a barrier to mutual understanding between scientists and religionists as the question of the origin of man on earth and the length of his terrestrial history.

Many methods have been employed in an attempt to date the origin of the earth. All of these methods have assumed the continuity of existing conditions extrapolated into the distant past, "Knowing this first, that there shall come in the last days scoffers . . . saying, Where is the promise of his coming? for since the fathers fell asleep, all things continue as they were from the beginning of the creation." II Peter 3:3, 4. Attempts of this sort which might be cited are the age of stalactites and stalagmites as determined by their present rate of formation; the uranium clock; the age of the Grand Canyon as determined by the present rate of erosion.

All of these methods of dating, however, have the common disadvantage, as far as dating the origin of man is concerned, that it is impossible to tie man in directly with the dating mechanisms. Even if we were to assume the validity of the conclusions by assuming the validity of the premises, the age of man is still undertermined, and if the premises are not valid, the conclusions derived from these faulty premises would be invalid.

Within the past few years, a method of dating archeological specimens has been developed which has the advantage of a direct tie-in with mankind. While the premises are of the same nature as has previously been universally accepted by scientists dealing with this question of origins, the conclusions are not as far from the dates given in the Word as has been true in other methods. In fact, the results of this later research are of the same order of magnitude as that given by revelation.

I refer to the dating of archeological specimens by the measurement of the radioactivity of a sample of carbon obtained from the charcoal of the fires of ancient man or from his artifacts. The same method has also been applied to samples of carbon obtained from peat beds to determine the date of the laying down of such beds. For the establishing of one's faith as well as to keep up with current research along these significant lines, it is profitable to study in some detail into the theory which leads to this so significant conclusion.

The premises that have been laid down by the scientists working in this area are:

(1) The rate of formation of radioactive carbon C_{14} is constant and has remained constant through past ages beyond the limitations of this method of measurement.

(2) Equilibrium was established ages ago, in the extremely distant past, between the rate of formation of C_{14} and its radioactive decomposition with the result that the radioactivity of a fresh sample of carbon has been constant during all the age of man.

(3) A sample of carbon may be removed from the reservoir of carbon in which this equilibrium is maintained constant by stirring, by being cut down from the parent tree so that there is no longer a possibility of replenishing the decomposing C_{14} with atoms freshly formed. This results in the dead sample of carbonaceous material following an exponential decay curve with respect to its radioactivity. By measuring the radioactivity of an old sample, therefore, and assuming that its radioactivity when it was fresh was the same as the fresh sample today, the age of the old sample may be calculated by reference to the exponential decay curve.

The rate of formation of C_{14} is known and the method is known. Neutron secondaries from cosmic radiation react with nitrogen of the air to from C_{14} and to liberate a proton. Practically all of these neutrons are absorbed in this way in the upper third of the atmosphere, the measured intensity being 8/10 of a neutron per second per square centimeter with an accuracy estimated at ±3 times.

Practically all of the C_{14} thus formed combines with the oxygen of the air to form carbon dioxide which is absorbed in the clouds and precipitated as rain or circulated in the atmosphere to be

taken up by the vegetation of the earth. The carbon in the atmosphere, in sea water and in the shells of living structures, in the carbonaceous material of living plants and animals constitutes, therefore, the reservoir in which the carbon is maintained at the equilibrium value.

Carbon fixed in the shells and bones of dead animals, and in the wood of trees which have been cut is undergoing radioactive decomposition of C_{14} but not replacement. Carbon obtained from anthracite coal, from petroleum, and from limestone shows very little if any radioactivity.

If we integrate over the surface of the earth, whose area is 5.1×10^{18} square centimeters, we find that the rate of formation over the entire surface of the earth is 4.08×10^{18} atoms per second,

The measured half-life of C_{14} is very close to 5,000 years. At the above rate of formation, the total amount of radioactive carbon in the earth may be calculated by assuming that, since the rate of formation is also the rate of decomposition, half of it would decompose in 5,000 years. This gives us a value of 22 metric tons for the total amount of C_{14} on the earth today. Since 5,000 years is a relatively long time, it is assumed, and this assumption has been verified by measurement, that even though the rate of formation is not uniform over the surface of the earth, the stirring by wind and ocean current distributes the C_{14} so uniformly that the concentration of C_{14} is uniform over the earth's surface.

It has been estimated by various investigators that the amount of carbon in the earth is distributed somewhat as follows: 5×10^{13} metric tons in the biosphere; 3×10^{13} metric tons in the hydrosphere; 6×10^{11} metric tons in the atmosphere; or a total of 8.1×10^{13} tons in the active reservoir. The accuracy of this estimate is probably ±2 times. Comparing this quantity with the amount of radioactive carbon, we see that there are $.3 \times 10^{-12}$ grams of radioactive carbon per gram of carbon, and from the half-life this should give 3 atoms decomposing for each gram of a fresh sample of carbon per minute.

It may be recalled that the accuracy of measuring of the rate of formation was ± 3 times, and the accuracy of measuring the carbon in the earth is also estimated to be about ± 2 times so that this final measure of 3 atoms per gram per minute should be accurate with ± 6 times, or the actual measured radioactive decomposition should lie somewhere between one-half of an atom per gram per minute and 18 atoms per gram per minute. Measurement shows that the activity of a fresh sample is actually 10½ atoms per gram per minute which is well within the limits established by this theoretical preview.

In order to measure rates of decomposition as low as 10½ atoms per gram per minute, it was necessary for the investigators to develop methods of shielding to lower the background count so that this background count would not obscure the true count. This was accomplished by shielding with 8 inches of steel and with a system of anti-coincidence counters.

Having developed the technique, investigators then checked to see whether fresh samples from all over the world would give the same value and they found that within the limits of experimental error the fresh samples checked. They then took samples whose age had been independently determined by other methods, e.g. by tree ring dating, historical dating, etc. The inner ring from a redwood tree and another inner ring from a Douglas fir tree were dated.

Other samples were selected whose independent dating was accomplished by historical connection of the sample, e.g. a piece from the coffin of Ptolemy; a sample from the floor of a Syrian palace; a piece from the deck of a ship (cedar of Lebanon) which was identified as belonging to Sesotris; cyprus from the tomb of Zozer; and acacia from the tomb of Sneferu. These samples were dated by the radioactive carbon method and the dates obtained checked with the independent dates with an accuracy of a century. The oldest samples dated in this way were the materials from the tombs of Zozer and Sesotris, approximately 4,500 years old.

The inaccuracy could have been due to experimental factors and possibly also to some theoretical ones, e.g. wood taken from the heart of a tree is quite evidently dead wood as has been suspected by biologists for some time, but the exact time at which it became dead wood may be in question. Undoubtedly, several of the outside rings are still subject to carbon exchange through live connection with the tree. One may see this very clearly in the hollow sycamores of the Midwest.

A sample taken from a timber in the deck of a ship or in a palace floor might have been taken from inner rings of a tree or from near the surface. The measured date, therefore, would vary from the date of its use as a timber by the time which had elapsed since it lost connection with the living part of the tree. The remarkable aspect of these measurements is therefore not that there is a variation of a century from the historical date but that there is as good agreement as actually exists. It would seem that this method of dating is quite an accurate method.

Having thus established the accuracy of the method, the experimenters turned to unknowns and they have published a list of some 160 dates, some of which are dates for the formation of peat beds and some of which are from the arti-

facts and campfires of ancient man. Even assuming the premises of continuity, some remarkable points stand out; (1) Peat beds and glacial moraine deposits were laid down some 10,000 to 11,000 years ago. (2) Man seems to have appeared in various parts of the world almost at the same time, approximately 9,000 to 10,000 years ago (according to this method of dating). Except for the time elapsed, this fact is in remarkable agreement with the idea of the dispersion following the flood.

Not enough work has been done as yet in order to determine the place on the earth's surface where man first originated. The oldest date is from the Picture Cave of Europe, 15,000 years. Since this date stands alone, it needs verification or explanation. Possibly the fire was built of antediluvian wood. Surprisingly, Folsom man of the United States, commonly thought to exist about 25,000 years ago, is dated about 4,000 years ago, This date for Folsom man is, of course, within the range experimentally measured for accuracy, whereas dates of 10,000 years and 15,000 years, being dates outside of the range experimentally tested, may be subject to error.

Some of the possible sources of error are: (1) If we assume the Biblical account of the flood to be a true picture, the conditions before the flood must have been very different from those following the flood. The water which the Bible says was above the firmament, whether in the form of clouds, vapor, or suspended by centrifugal force might have acted to have absorbed the primary cosmic rays and to turn the direction of such absorption into channels other than the formation of C_{14}.

(2) If the magnetic field of the earth was different before the flood, the number of cosmic rays reaching the earth's surface would have been different.

(3) Even assuming the rate of formation of C_{14} to have been constant, the carbon dioxide thus formed might have remained dissolved in the clouds and vapors of the upper atmosphere and thus have failed to reach the earth's surface so that carbon formed during the antediluvian era would show little or no radioactivity.

If coal, limestone and petroleum were formed by the flood, these ideas are born out by the fact that coal, limestone, and petroleum are relatively non-radioactive. Thus the campfire of the men of the Lascaux Picture Cave immediately after the flood may have been built with some antediluvian wood and would naturally show an extreme age. Artifacts made at that time likewise would appear to be very old.

Equilibrium must have been established very soon after the flood which might have been accomplished by the bringing down to the earth's surface of the dissolved radioactive carbon previously stored in the water above the firmament. The fact that man seems to have appeared in Oregon, Chile, the Orient, and Europe at the same time is quite significant in view of the Biblical account of the dispersion. Much more work needs to be done to trace the development of the ancient civilizations.

It came as a surprise to the writer to know of the discovery in Oregon of a cave filled with 300 pairs of 9,000-year-old (?) sandals–a regular antediluvian shoe store. The spread of ancient man across North America from Oregon to the east and south into Mexico has already been revealed by the measured dates, but much more needs to be done not only about the U.S.A. but about the other continents of the world as well. Undoubtedly many such remains will be dated from various places in the world which, properly interpreted, will throw much light on ancient man.

The question naturally arises at this point– how can this method of dating be harmonized with Biblical account? To find this harmony one must examine the premises. A curve (Figure 1) will illustrate the problem.

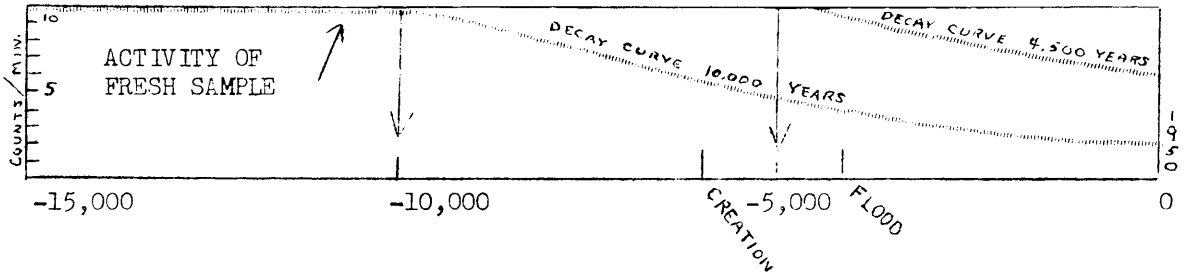
If the activity of a fresh sample of carbon has been the same for ages past, the age of a sample is determined by tracing an exponential decay curve back to its intersection with a horizontal line at the level of the activity of a fresh sample. Figure l-A.

On the other hand if the activity of a fresh sample has not been constant through past ages, for example, if the activity was very low before the flood as indicated by the inactivity of coal and petroleum, the date, while still located at the intersection of the decay curve and the curve of fresh sample activity, will fall at a very different place. (Figure l-B.)

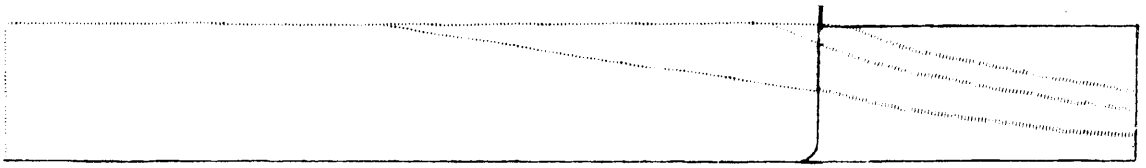
According to this reasoning, the dates for glacial moraine deposits "11,000" years ago, for formation of peat bogs "10,000" years ago, for the dispersion of man over the earth's surface "9,000" years ago, would all occur at or immediately after the flood (in harmony with the Scriptures). This reasoning is based on an assumption not generally accepted by scientists—the theory of a universal flood as reported in the Scriptures. However, the resulting conclusions are not only self-consistent but are consistent with the Biblical account.

Research on dating of archeological specimens is being prosecuted with vigor. Many dates are being determined. As more and more dates come to light, much can be determined about the movements of population, and the original location of the progenitor of the race as well as the time of his appearance on the earth.

Figure 1



1-A Curve of radioactive carbon dating if no break in continuity caused by the Flood.



1-B Effect of the Flood, changing low radioactive carbon activity before the Flood to present activity gives a false effect of age for antediluvian samples.

Possibly nothing can be determined beyond the flood, but even so, if man can be demonstrated to have existed on earth for only 10,000 years or less, antiquarians must revise their thinking and their theories.

Bibliography

W. F. Libby, "Atmospheric Helium Three and Radiocarbon from Cosmic Radiation," *Physical Review,* Vol. 69, Nos. 11 and 12, pp. 671, 672, June 1 and 15, 1946.

W. F. Libby, "Measurement of Radioactive Tracers," *Industrial and Engineering Chemistry,* Analytical Edition, Vol. 19, p. 2, Jan 15, 1947.

E. C. Anderson, W. F. Libby, S. Weinhouse, A. F. Reid, A. D. Kirshenbaum, and A. V. Grosse, "Natural Radiocarbon from Cosmic Radiation," *Physical Review,* Vol. 72, No. 10, pp. 931-936, Nov. 15, 1947.

W. F. Libby, E. C. Anderson, J. R. Arnold, "Age Determination by Radiocarbon Content: Worldwide Assay of Natural Radiocarbon," Science, Vol. 109, No. 2827, pp. 227, 228, March 4, 1949.

J. R. Arnold and W. F. Libby, "Age Determinations by Radiocarbon Content: Checks with Samples of Known Age," Science, Vol. 110, No. 2869, pp. 678-680 ,Dec. 23, 1949.

J. R. Arnold and W, F. Libby, "Radiocarbon Dates," Science, Vol. 113, No. 2927, pp. 111-120, February 2, 1951.