Archaeology, The Bible, & Radiocarbon Dating

(appropriate for Mid Schoolers and older)

Michael R. Daily, April 2022

Other youth bible studies by Michael Daily available at: http://gciweb.org/2011/04/youth-bible-study-materials-michael-r-daily/

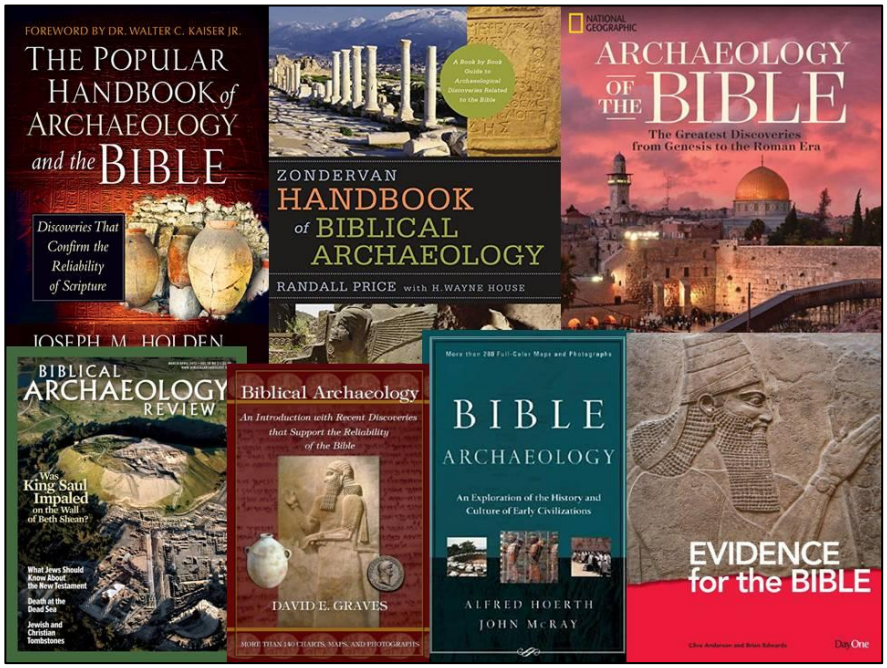
Reference: https://reformationtestimony.wordpress.com/2018/09/23/doesnt-carbon-14-dating-disprove-the-bible-mike-riddle/

The evidence from archaeology that supports the Bible is overwhelming!

There are numerous publications you can review to examine the details of all of the evidence that has been found.

Everything from magazine subscriptions to very large, thick books with lots of pictures and detailed descriptions.

Many have tried to criticize the Bible over the last few hundred years by claiming the Bible mentions things that no archaeological evidence has been found for. Everything from Pontius Pilate to King David to Sodom and Gomorrah to Jericho's walls. In every case evidence for these was eventually found (in some cases decades later).



For more information on this topic please see the study, "Observational Science Compared To The Bible" at: http://gciweb.org/2011/04/youth-bible-study-materials-michael-r-daily/

As a result, critics of the Bible have learned that using this approach to attack the Bible is not particularly effective. So, tonight we will study a more challenging type of attack you might run into about the Bible from the field of archaeology.

Welcome to College!

You are attending the State University and have signed up for a course in Archaeology. The first day of class the professor says that he will be focusing the course on applying radiocarbon dating to determine the age of ancient excavated specimens.

He starts the course by detailing the outstanding performance of radiocarbon dating and describes how it is so good you can determine if a painting is a forgery or not! In fact, it is so good "cold case" detectives can determine, by radiocarbon dating the human remains, the year the person was born as well as the year of death!

He talks about how the radiocarbon measurements are made by the best scientists in the world at Lawrence Livermore National Laboratory using a multi-million dollar Accelerator Mass Spectrometer the size of a room. And a class field trip to LLNL has been planned so you can see the equipment in action and talk to the scientists yourself!

The professor finishes his lecture with this statement:

"The good thing about science is that it's true whether or not you believe in it."

A Few Months Later The Class Studies This Event ….

During an excavation in Israel the ancient remains of a certain type of animal have been discovered for the first time. The Old Testament of the Bible clearly states that these types of animals did not come into Israel until the time of a particular king, who (based on historical records) is known to have lived around 3,200 BC.

Lawrence Livermore National Laboratory analyzes the sample using its Accelerator Mass Spectrometer and the latest in radiocarbon dating methods. The laboratory analysis reveals that the estimated date of the sample is 18,000 BC.

After the technical article is published at the International Conference for the Society of American Archaeology, the press issues a general news article with the following title:

"Recent archaeological discovery puts reliability of the Bible in doubt!"

How are you going to address this?

How does Radiocarbon Dating Work?

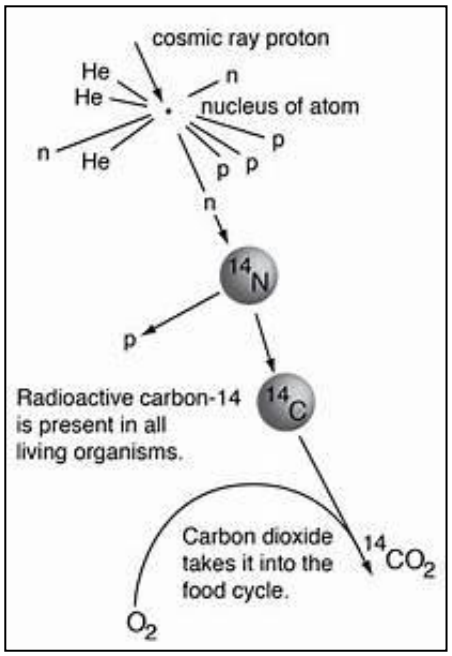
Carbon (^{12}C) is a common element found in the Earth's atmosphere (in carbon dioxide, for example) and is in the soil, the oceans, and in all other organic matter (including every living creature such as animals and plants).

But, in today's environment, one part per trillion (ppt) of carbon is radioactive carbon (^{14}C) – which, by the way, is harmless at such small concentrations.

^{14}C is created when cosmic radiation from space (90% is protons from the Sun and 9% is helium nuclei from the Sun) hit atoms in the Earth's upper atmosphere generating secondary particles, some of which are neutrons.

The neutrons interact with nitrogen atoms (^{14}N) in the upper atmosphere and the neutron causes a proton to be displaced from the ^{14}N nucleus. The stable ^{14}N then becomes unstable, radioactive ^{14}C.

Since Earth's atmosphere is 78% nitrogen this effect is significant enough that it can be measured.



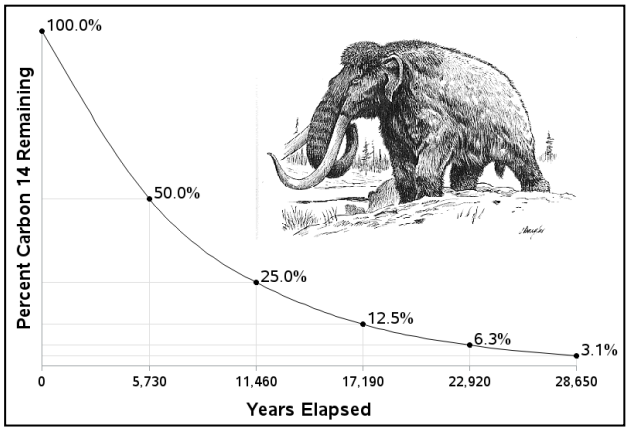
http://hyperphysics.phy-astr.gsu.edu/hbase/Nuclear/cardat.html

(side note: The term "cosmic ray" was coined before scientists actually knew what they were. They assumed cosmic rays were electromagnetic waves of some type. In reality, 99% of the "cosmic rays" that hit Earth's atmosphere come from our Sun and are charged particles (protons and helium nuclei). Nevertheless the original name, "cosmic ray" is still used).

^{14}C, like all radioactive materials, will decay to a stable state, in this case ^{14}N. The decay rate for radioactive materials is described using a "half-life" descriptor. For ^{14}C the half-life is about 5,730 years.

So, if you start with a sample of pure ^{14}C, after 5,730 years half of the material will have become ^{14}N. If you wait another 5,730 years, half of the remaining sample (3/4 of the original amount) will have become ^{14}N and so on.

Therefore, if at any time we measure the amount of ^{14}C in a sample we can project forward in time or backward in time to get a theoretical estimate of how much ^{14}C we had (in the past) or will have (in the future) at any point in time.



https://i0.wp.com/rosieresearch.com/wp-content/uploads/2015/07/graph.png

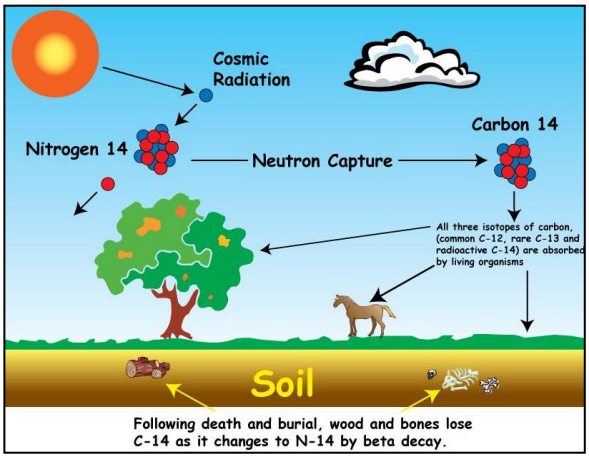
This is purely a mathematical construct for the past since we don't know how much ^{14}C we actually started with in the past and we can project backwards mathematically in time to infinity, which we know is not realistic.

Based on old Earth assumptions, the farthest back radiocarbon dating might be workable is 57,300 years ago. Anything supposedly older than this should not have any detectable ^{14}C in it.

While they are alive, plants and animals, through breathing, eating, and other natural processes, have the same ratio of ^{14}C to ^{12}C in them that is in the atmosphere they live in.

When they die they stop taking in carbon (including ^{14}C) and the ^{14}C that is in them decays radioactively without being replenished. As time continues on after their death, the ratio of ^{14}C to ^{12}C in their remains will get smaller and smaller following the half-life curve.

Keep in mind that this can only be applied to organic materials such as bone, flesh, wood, etc. It can't be used to date rocks directly (the exception might be diamond which is made up of carbon).

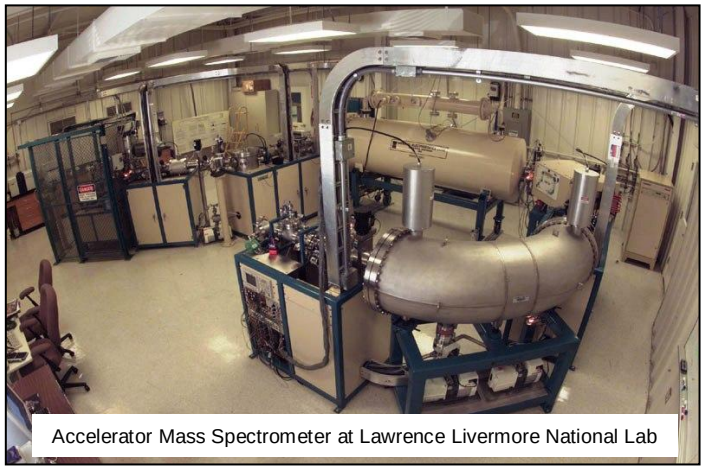


https://link.springer.com/referenceworkentry/10.1007%2F978-90-481-2639-2_127

For Radiocarbon Dating to work we need to know three things:

1) The ratio of ^{14}C to ^{12}C currently in the specimen (can be measured by a laboratory using an Accelerator Mass Spectrometer). This is an observational science measurement that we can have high confidence in.

2) The half-life rate that ^{14}C decays into ^{14}N (this has been measured and found to be stable for the last 100 years or so and an assumption is made that the decay rate has been constant throughout all of history which may or may not be true). This is an observational science measurement that is clearly valid for the last 100 years but it also includes an assumption for periods longer than that.

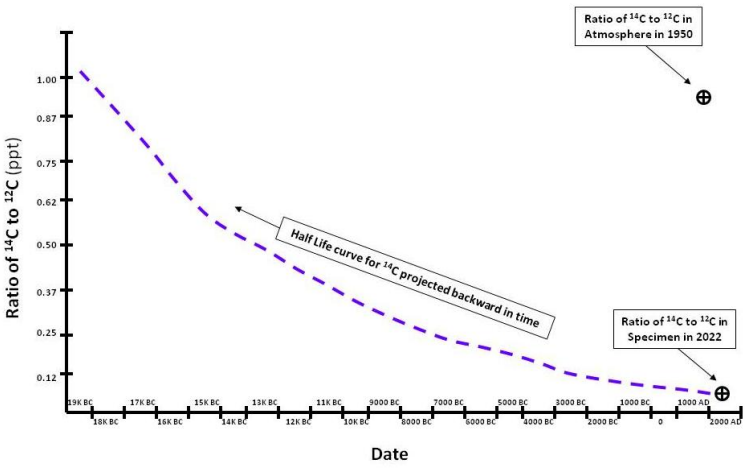

Accelerator Mass Spectrometer at Lawrence Livermore National Lab

https://en.wikipedia.org/wiki/Accelerator_mass_spectrometry

3) The ratio of ^{14}C to ^{12}C in the atmosphere on the day that the specimen died (this is not knowable for items more than 100 years old, an assumption or assertion would have to be made).

Let's Start with the Observational Science

The graph shows the observational data that we have to start with. We have a measurement of the ratio of ^{14}C to ^{12}C in the specimen shortly after it was excavated. We also have a measurement of the ratio of ^{14}C to ^{12}C in the atmosphere around 1950 that was easy to measure but is not directly applicable to the problem at hand. And we have a mathematical projection back in time of the half-life curve for ^{14}C that runs through our specimen's measurement point. Both atheists and Christians agree on these three things. But we still need to know the ratio of ^{14}C to ^{12}C in the atmosphere the day the specimen died!



Two Scenarios: Old Earth Scenario and Young Earth Scenario

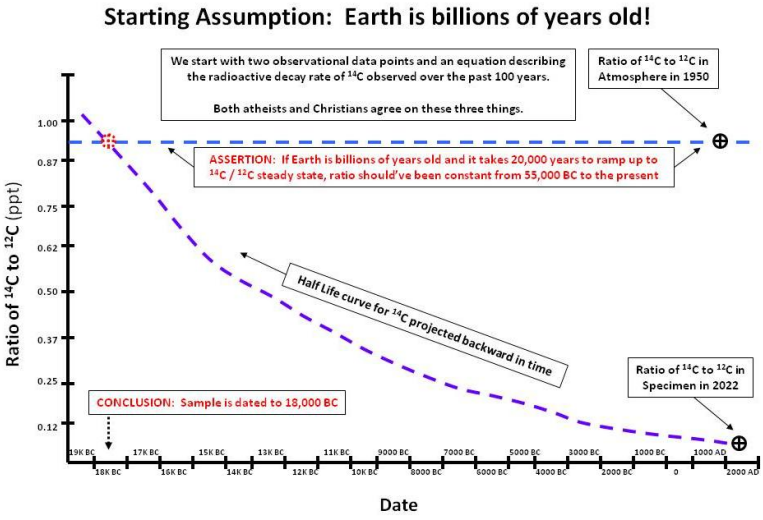
Now that we have the ratio of ^{14}C to ^{12}C currently in the specimen and the half-life rate that ^{14}C decays into ^{14}N, the only thing that we still need is the ratio of ^{14}C to ^{12}C that was in the atmosphere on the day the specimen died. Unfortunately, the ability and knowledge to make these measurements were not available in ancient times. As a result, we cannot move forward with an age estimate unless we make some kind of assertion or assumption. Unfortunately, when we rely on assertions and assumptions we are moving out of the realm of observational science and into philosophy!

assert: *to state or declare positively and often forcefully or aggressively, without providing evidence*

Assumption: Earth is Billions of Years Old

Dr. Willard Libby, inventor of the carbon-14 (i.e. radiocarbon) dating method, calculated that if the Earth started with no ^{14}C in the atmosphere, it would take 20,000 to 30,000 years to build up to a steady state equilibrium.

He also assumed that the Earth must be billions of years old. If that is true then the ratio of ^{14}C to ^{12}C in the Earth's atmosphere would have reached equilibrium billions of years ago and should have remained constant up until his time (circa 1950).

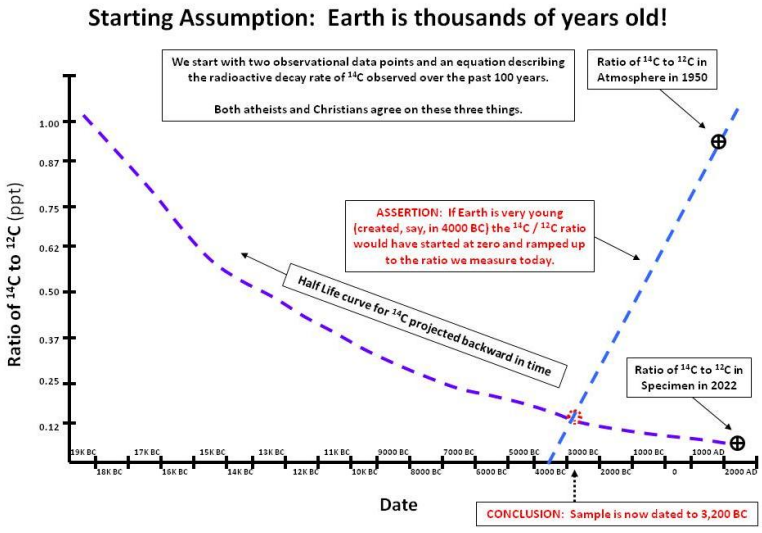


As a result Dr. Libby asserted that the ratio of ^{14}C to ^{12}C in the Earth's atmosphere (circa 1950) was the same as it had been throughout all of human history. Therefore, we can draw a straight line from the 1950 measurement across the top of the graph and see where it intersects the half-life curve.

Conclusion based on Old Earth assertion: specimen dated to 18,000 BC.

Assumption: Earth is Thousands of Years Old

But what if we use the same observational science but we change the assertion. Instead we assert that the Earth is not billions of years old, but only thousands of years old. After all, if assertions are allowed then I can make them too! For example, what happens to our radiocarbon date estimate if I assume the Earth was created in 4,000 BC?



Now the line representing the ratio of ^{14}C to ^{12}C in the Earth's atmosphere is tilted down. We start with zero ^{14}C in the atmosphere in 4,000 BC. We also have the measurement made in 1950. So, we know that the ratio of ^{14}C to ^{12}C in the Earth's atmosphere would be ramping up from zero to the 1950 level and we assume or assert that the ramp up was a straight line between the two points.

Now we look at where the ratio line intersects with the half-life curve.

Conclusion based on Young Earth assertion: specimen dated to 3,200 BC (which agrees with the Bible).

Key Point: *If you build a model with the assumption that the Earth is very old built into it, and then you ask the model questions, it will tell you the Earth is very old!*

Problems with Radiocarbon Dating

1) The ratio of ^{14}C to ^{12}C in Earth's atmosphere is now known to not be in steady state. In Dr. Libby's original work, he noted that the atmosphere did not appear to be in equilibrium but he chose to ignore this discrepancy and attributed it to experimental error. But the discrepancy has turned out to be real. The Production Rate of ^{14}C is known to be 18.8 atoms per gram of total carbon per minute. The Decay Rate is known to be only 16.1 disintegrations per gram per minute. The ratio of ^{14}C to ^{12}C has been measured over the last 80 years. It continues to climb, which is consistent with a young Earth.

2) Carl Friedrich Gauss started measuring Earth's magnetic field in 1845. Over the last 175 years the Earth's magnetic field has decreased in strength by about 10%. This hints that the Earth's magnetic field may have been much stronger in the past. A stronger magnetic field would deflect more of the cosmic rays (i.e. protons from the Sun) meaning less ^{14}C being generated in the past. Less ^{14}C being generated in the past (if not corrected for) would make samples measured today appear to be much older.

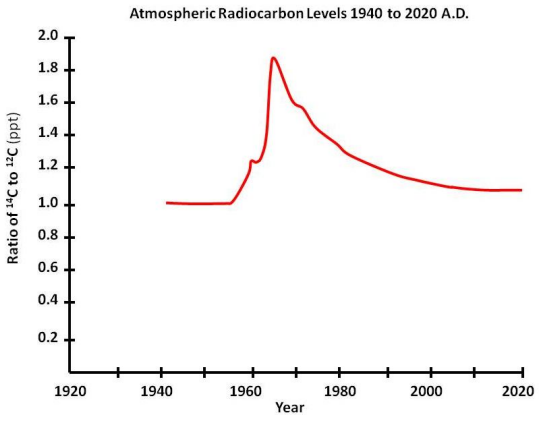
3) Volcanoes spew out large amounts of CO_2 which would lower the ^{14}C to ^{12}C ratio making a sample measured today appear to be much older, if not corrected for. The flood of Noah's time, with the associated movement of the continents, likely created a large amount of worldwide volcanic activity (enough to set up the conditions for an Ice Age to follow) that is not accounted for by secular scientists.

Key Point: *Radiocarbon dating is not very good at determining the age of ancient things*

But Radiocarbon Dating Works Very Well On Young Things!

From 1950 to 1963 the nuclear powers of the world (US, Russia, China, France, UK, etc.) detonated hundreds of atomic bombs in or above the Earth's atmosphere. Nuclear detonations release X-rays (which quickly convert to heat in Earth's atmosphere), gamma rays, and neutrons. Like cosmic rays, the neutrons hit ^{14}N atoms and create radioactive ^{14}C.

The above ground testing ended in 1963 with the signing of the Limited Test Ban Treaty but the testing caused the amount of ^{14}C in the atmosphere to double to about 2 ppt. This is commonly referred to by scientists as the Carbon-14 "bomb pulse".



https://forensiccarbondating.weebly.com/uploads/5/2/6/5/52656173/3791049.png?239

The "Bomb Pulse" enables scientists to use radiocarbon testing for forensics.

forensic: *relating to or dealing with the application of scientific knowledge to legal problems*

Detecting Forged Artwork

For example, radiocarbon dating can be used very effectively to determine if paintings and other organic artwork are forgeries or not. What if someone came to you with what appears to be an ancient painting by one of the Masters of the High Renaissance, such as Leonardo da Vinci, and offered to sell it to you for a only a few million dollars? You hire some painting experts to examine the painting. After examining the materials and brush strokes, the use of color and lighting, and the style of the painting, the experts have to admit it does look a lot like a da Vinci original! But before you transfer your Bitcoin you decide to have a sample of the materials radiocarbon dated and some of the materials used in the painting are dated to the early 1960s. Would you buy the painting? No. It is an obvious forgery!
https://www.chemistryworld.com/news/dawn-of-the-atomic-age-helps-carbon-dating-detect-forged-art/3010593.article

Determining Year of Birth and Death for Human Remains

Adult teeth are formed at known intervals during childhood. Researchers found that if they assumed tooth enamel radiocarbon content to be determined by the atmospheric level at the time the tooth was formed, then they could deduce the year of birth. The year of death could be determined by radiocarbon dating of soft tissue. The accuracy is plus or minus one year for human remains of people born after 1950.
https://nij.ojp.gov/topics/articles/applying-carbon-14-dating-recent-human-remains

Why Does Radiocarbon Dating work well for things less than 80 years old but not for ancient things?

Radiocarbon dating is not an inherently bad idea. In fact, it works very well if you know exactly what the ratio of ^{14}C to ^{12}C in the Earth's atmosphere was when the specimen died.

We have been measuring this ratio very precisely since the 1950's. And the "Bomb Pulse" provided a large, time-stamped signal that aids in this precision. Therefore, radiocarbon dating is very good for determining the age of organic things (or things created from organic things) that died sometime after 1950. Unfortunately, radiocarbon dating is unreliable for things older than 1950 because the ratio of ^{14}C to ^{12}C was not measured and is unknown for those years.

Since the ^{14}C to ^{12}C ratio was unknown in ancient times, assumptions and assertions have been made about what the ratio might have been based on ideology or dogma rather than observational science.

ideology: *the integrated assertions and theories that constitute a sociopolitical program*
dogma: *a point of view put forth as authoritative without adequate grounds*

Conclusion: Radiocarbon dating is not reliable enough to cast any doubt on the Bible!

Appendix: The RATE Group Findings

Reference: https://reformationtestimony.wordpress.com/2018/09/23/doesnt-carbon-14-dating-disprove-the-bible-mike-riddle/

In 1997 an eight-year research project was started to investigate the age of the earth. The group was called the RATE group (Radioisotopes and the Age of The Earth). The basic approach, regarding the radiocarbon dating portion of the work, was to compare the ratio of ^{14}C to ^{12}C in an organic sample (and the associated radiocarbon date given to it) to the assumed secular age of the rock layer or other material that it was found in.

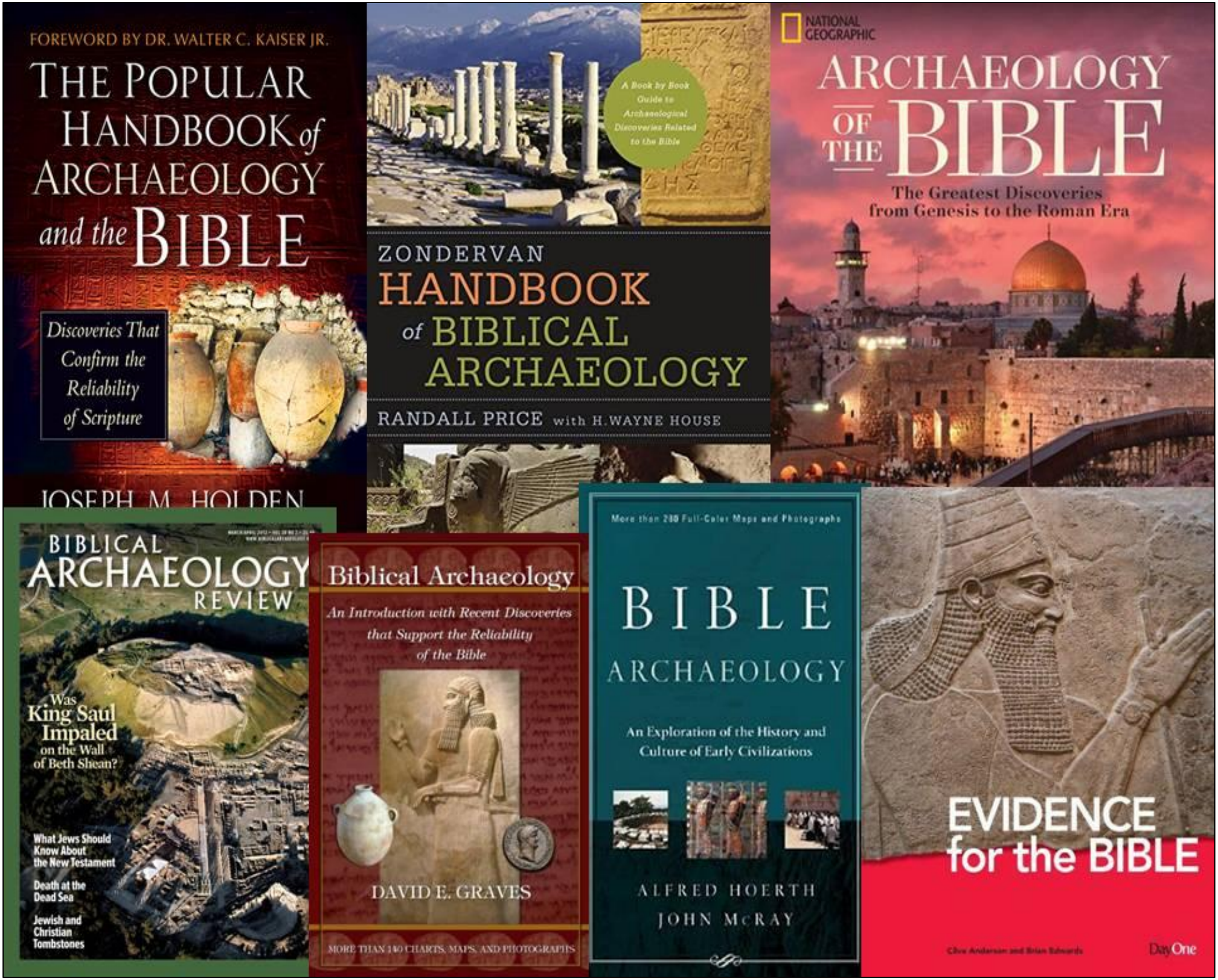
The results of the carbon-14 dating study demonstrated serious problems for long geologic ages. For example, a series of fossilized wood samples that conventionally have been dated according to their host strata rock formations to be from Tertiary to Permian (40-250 million years old) all yielded significant, detectable levels of carbon-14 that would conventionally equate to only 30,000-45,000 years old for the original trees. Similarly, a survey of the conventional radiocarbon journals resulted in more than forty examples of supposedly ancient organic materials, including limestones, that contained carbon-14, as reported by leading laboratories.

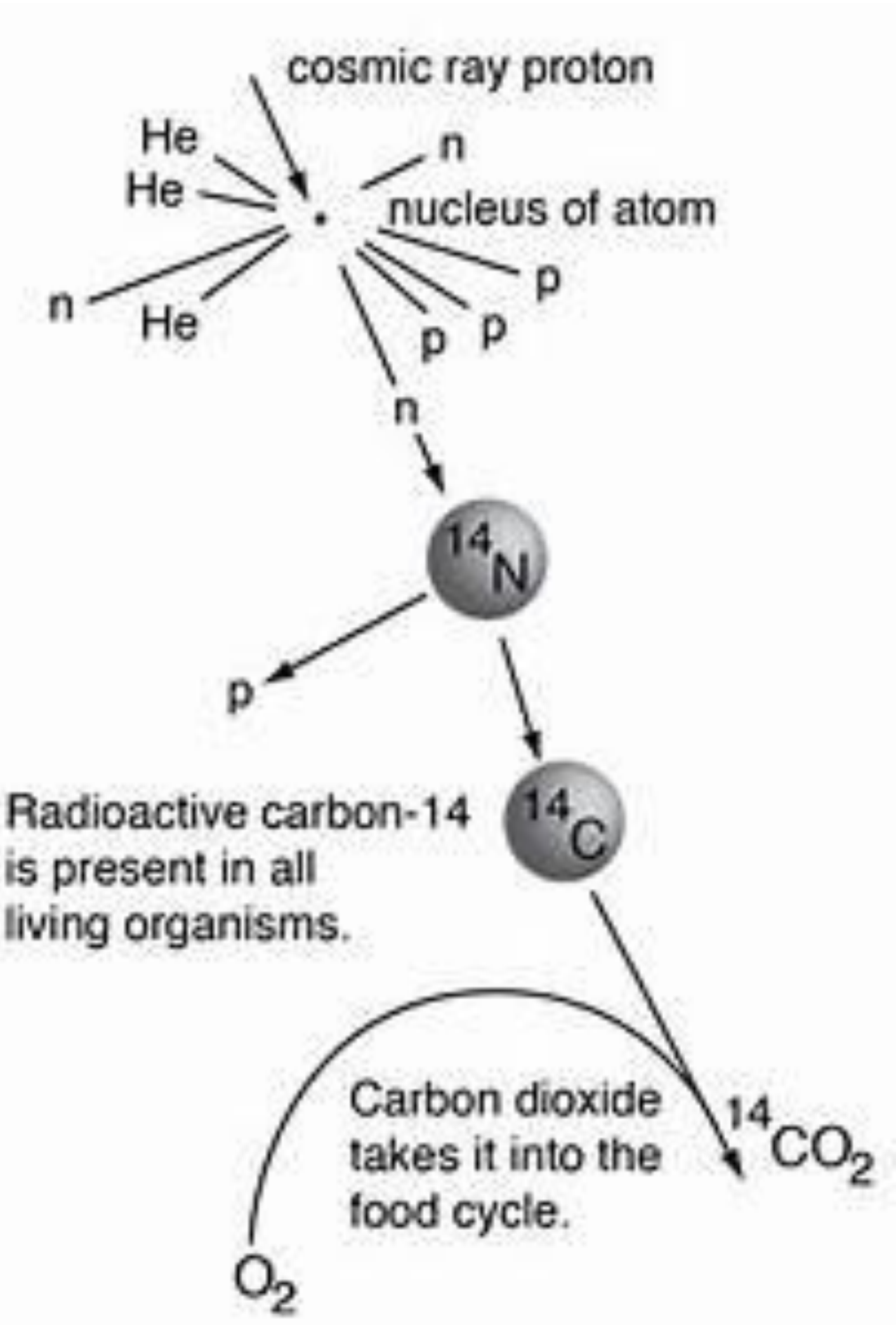
Samples were then taken from ten different coal layers that, according to evolutionists, represent different time periods in the geologic column (Cenozoic, Mesozoic, and Paleozoic). The RATE group obtained these samples from the U.S. Department of Energy Coal Sample Bank, collected from major coalfields across the United States. The chosen coal samples, which dated millions to hundreds of millions of years old based on standard evolutionary time estimates, all contained measurable amounts of ^{14}C. Samples, in all three "time periods", displayed significant amounts of ^{14}C. This is a significant discovery since the half-life of ^{14}C is relatively short (5,730 years) and there should be no detectable ^{14}C left after 100,000 years. The average ^{14}C estimated age for all the layers from these three time periods was approximately 50,000 years. However, using a more realistic pre-Flood ^{14}C /^{12}C ratio reduces that age to about 5,000 years.

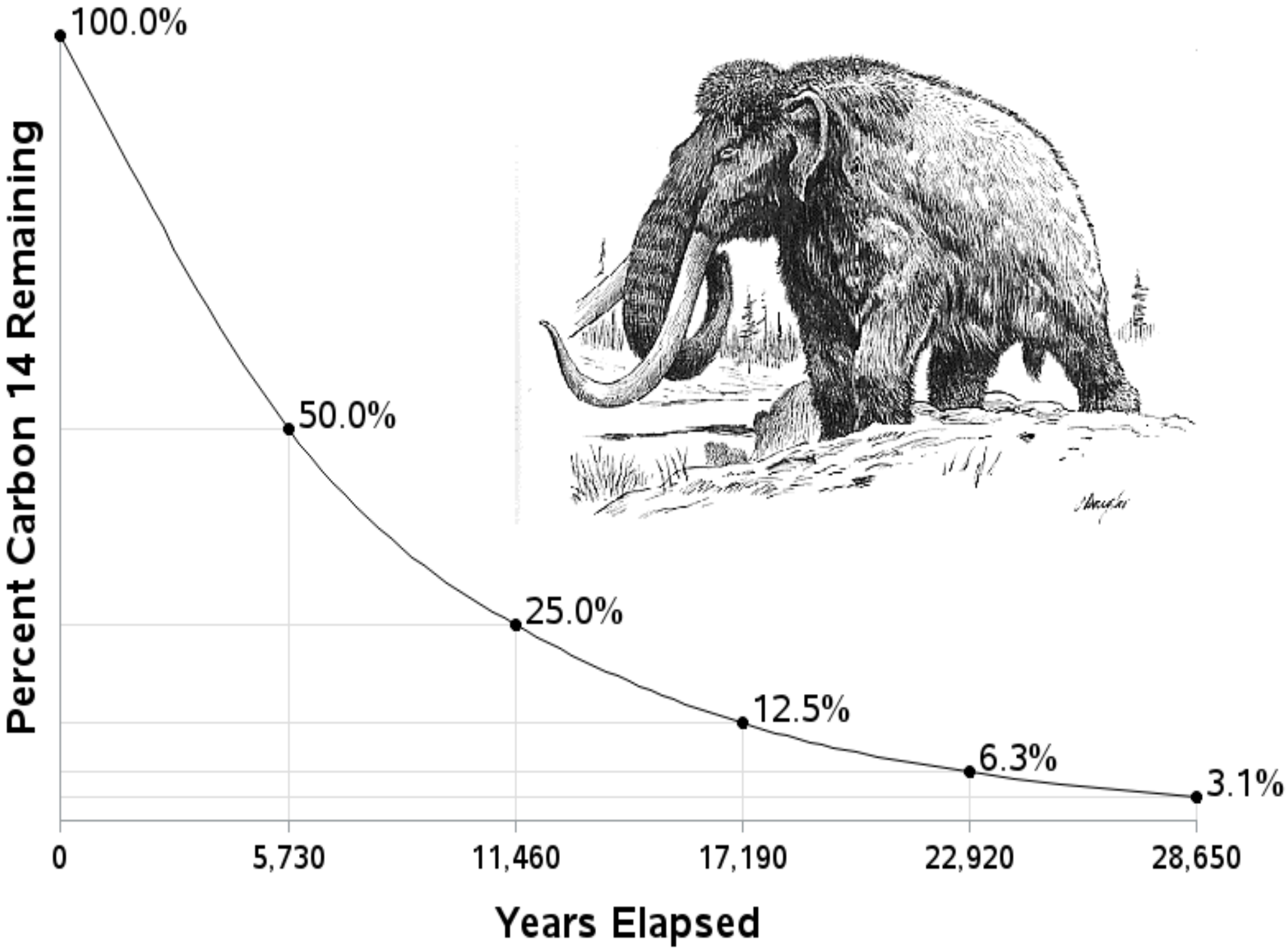
These results indicate that the entire geologic column is less than 100,000 years old—and could be much younger. Because the lifetime of ^{14}C is so brief, these AMS [Accelerator Mass Spectrometer] measurements pose an obvious challenge to the standard geological timescale that assigns millions to hundreds of millions of years to the rock layers associated with the organic samples.

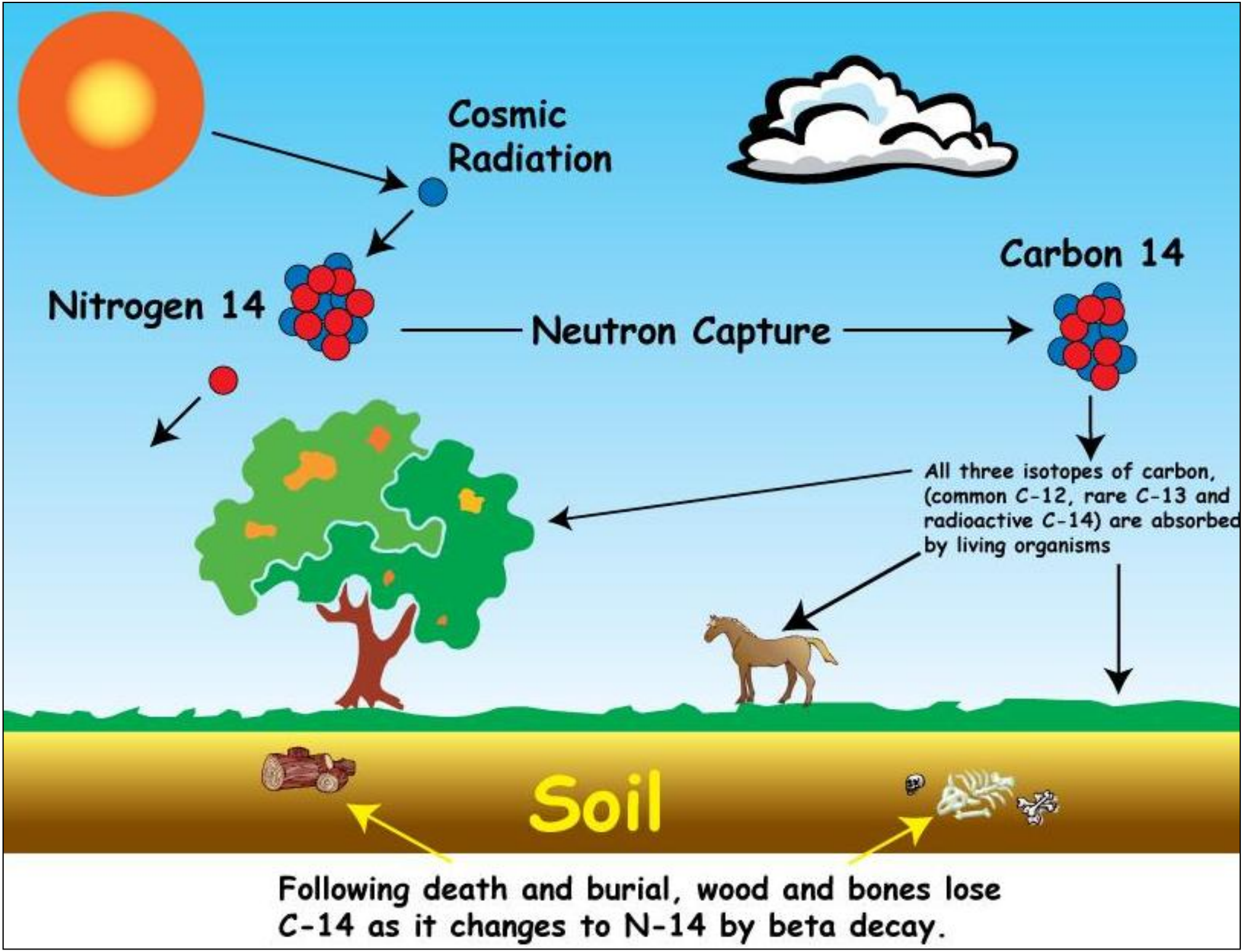
Another noteworthy observation from the RATE group was the amount of ^{14}C found in diamonds. Secular scientists have estimated the ages of diamonds to be millions to billions of years old using other radiometric dating methods. These methods are also based on questionable assumptions. Because of their hardness, diamonds (the hardest known substance) are extremely resistant to contamination through chemical exchange. Since diamonds are considered to be so old by evolutionary standards, finding any ^{14}C in them would be strong support for a recent creation.

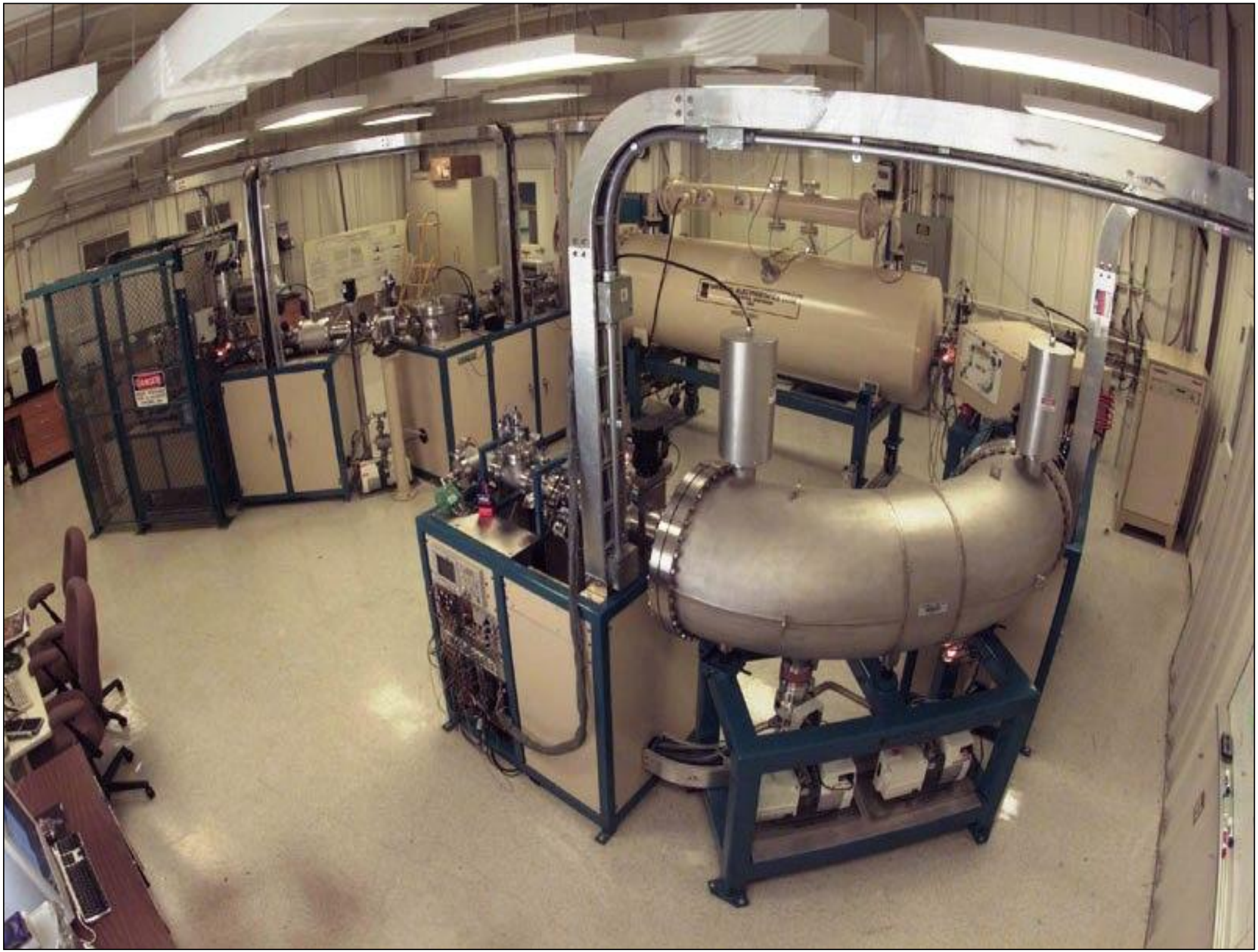
The RATE group analyzed twelve diamond samples for possible carbon-14 content. Similar to the coal results, all twelve diamond samples contained detectable levels of ^{14}C. These findings are powerful evidence that coal and diamonds cannot be millions or billions of years old. Carbon-14 found in fossils at all layers of the geologic column, in coal and in diamonds, is evidence which confirms the biblical timescale of thousands of years and not billions.

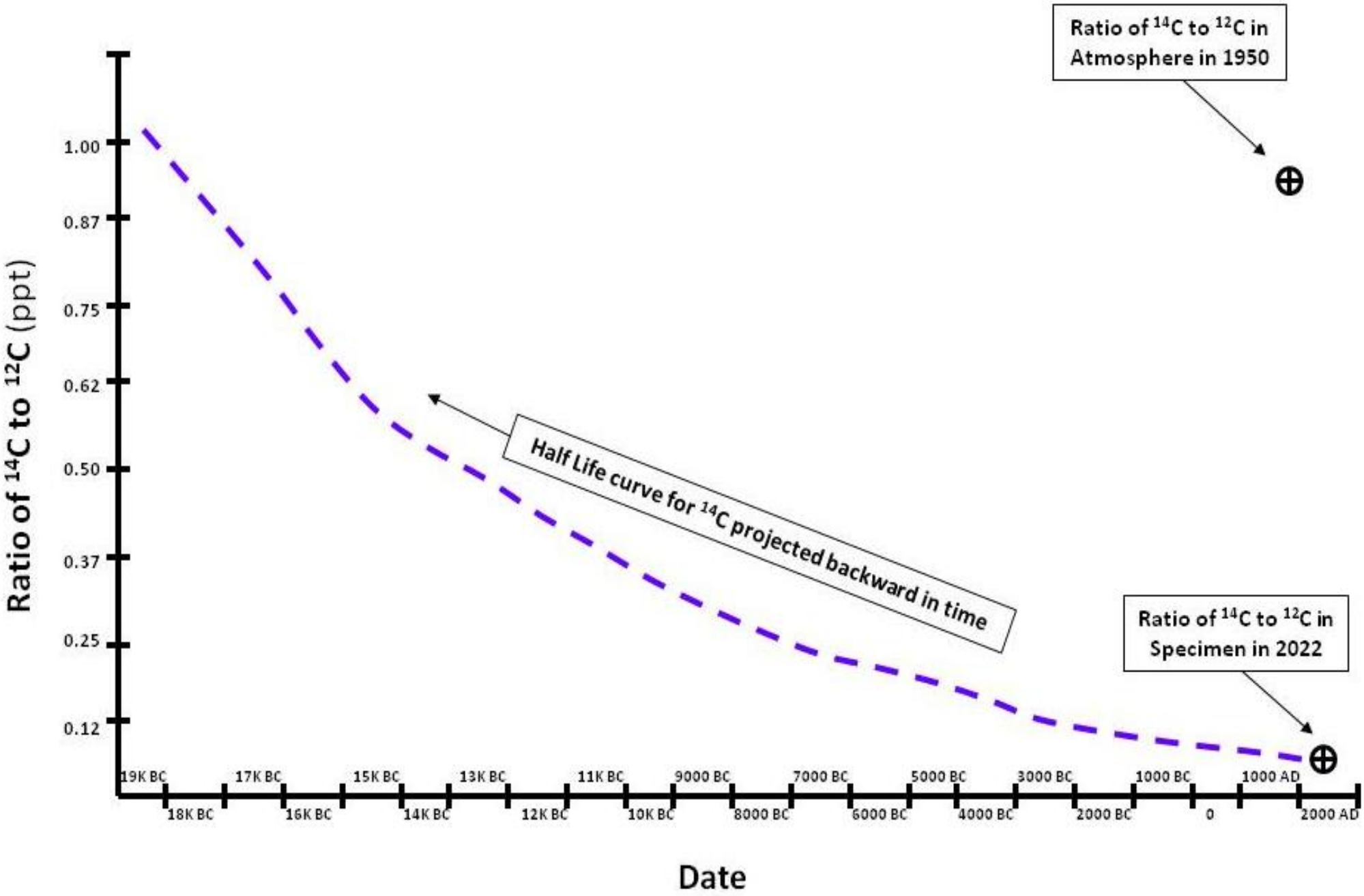

FOREWORD BY DR. WALTER C. KAISER JR.
THE POPULAR HANDBOOK of ARCHAEOLOGY and the BIBLE
Discoveries That Confirm the Reliability of Scripture
JOSEPH M. HOLDEN
A Book by Book Guide to Archaeological Discoveries Related to the Bible
ZONDERVAN
HANDBOOK of BIBLICAL ARCHAEOLOGY
RANDALL PRICE with H. WAYNE HOUSE
NATIONAL GEOGRAPHIC
ARCHAEOLOGY OF THE BIBLE
The Greatest Discoveries from Genesis to the Roman Era
BIBLICAL ARCHAEOLOGY REVIEW
Was King Saul Impaled on the Wall of Beth Shean?
What Jews Should Know About the New Testament
Death at the Dead Sea
Jewish and Christian Tombstones
Biblical Archaeology
An Introduction with Recent Discoveries that Support the Reliability of the Bible
DAVID E. GRAVES
MORE THAN 140 CHARTS, MAPS, AND PHOTOGRAPHS
More than 200 Full-Color Maps and Photographs
BIBLE ARCHAEOLOGY
An Exploration of the History and Culture of Early Civilizations
ALFRED HOERTH
JOHN McRAY
EVIDENCE for the BIBLE
Clive Anderson and Brian Edwards
Day One


cosmic ray proton
He
He
n
nucleus of atom
p
n
He
p
p
n
^{14}N
p
^{14}C
Radioactive carbon-14
is present in all
living organisms.
Carbon dioxide
takes it into the
food cycle.
$^{14}CO_2$
O_2


100.0%
50.0%
25.0%
12.5%
6.3%
3.1%
Percent Carbon 14 Remaining
0
5,730
11,460
17,190
22,920
28,650
Years Elapsed


Cosmic Radiation
Carbon 14
Nitrogen 14
Neutron Capture
All three isotopes of carbon, (common C-12, rare C-13 and radioactive C-14) are absorbed by living organisms
Soil
Following death and burial, wood and bones lose C-14 as it changes to N-14 by beta decay.




Ratio of ^{14}C to ^{12}C in Atmosphere in 1950
Half Life curve for ^{14}C projected backward in time
Ratio of ^{14}C to ^{12}C in Specimen in 2022
Ratio of ^{14}C to ^{12}C (ppt)
1.00
0.87
0.75
0.62
0.50
0.37
0.25
0.12
19K BC
18K BC
17K BC
16K BC
15K BC
14K BC
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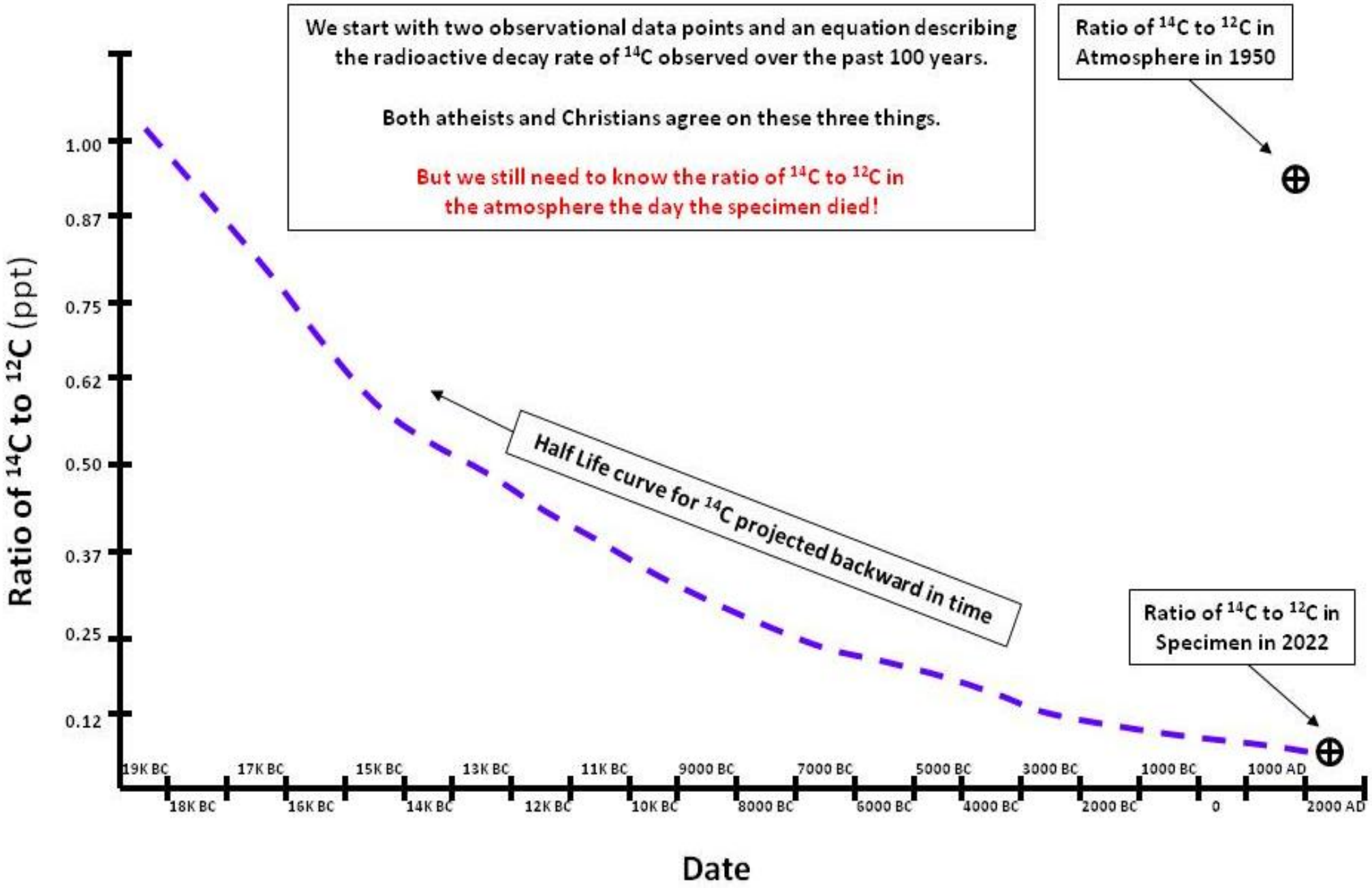
2000 AD
Date


We start with two observational data points and an equation describing the radioactive decay rate of ^{14}C observed over the past 100 years.
Both atheists and Christians agree on these three things.
But we still need to know the ratio of ^{14}C to ^{12}C in the atmosphere the day the specimen died!
Ratio of ^{14}C to ^{12}C in Atmosphere in 1950
Half Life curve for ^{14}C projected backward in time
Ratio of ^{14}C to ^{12}C in Specimen in 2022
Ratio of ^{14}C to ^{12}C (ppt)
1.00
0.87
0.75
0.62
0.50
0.37
0.25
0.12
19K BC
18K BC
17K BC
16K BC
15K BC
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12K BC
11K BC
10K BC
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3000 BC
2000 BC
1000 BC
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1000 AD
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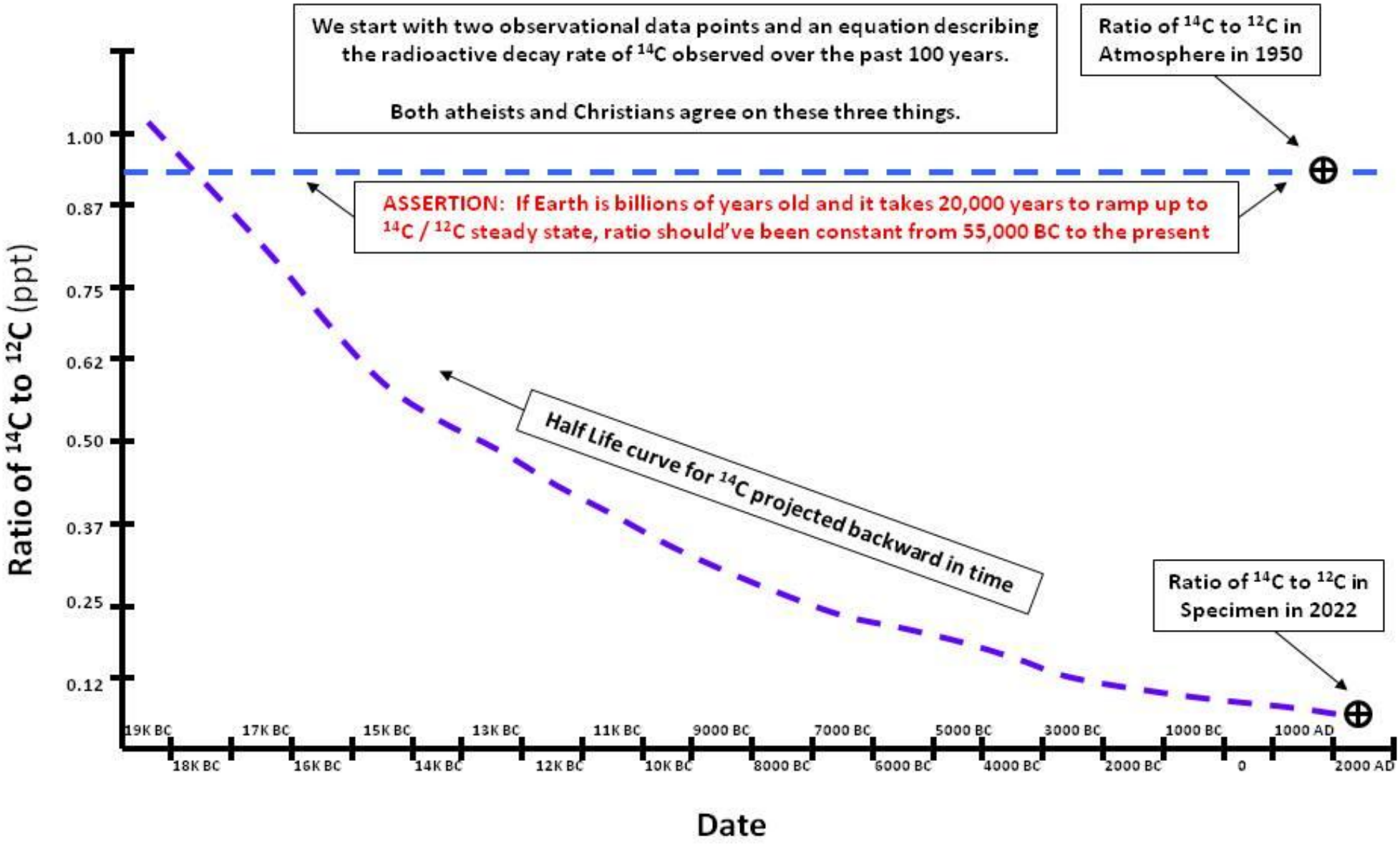
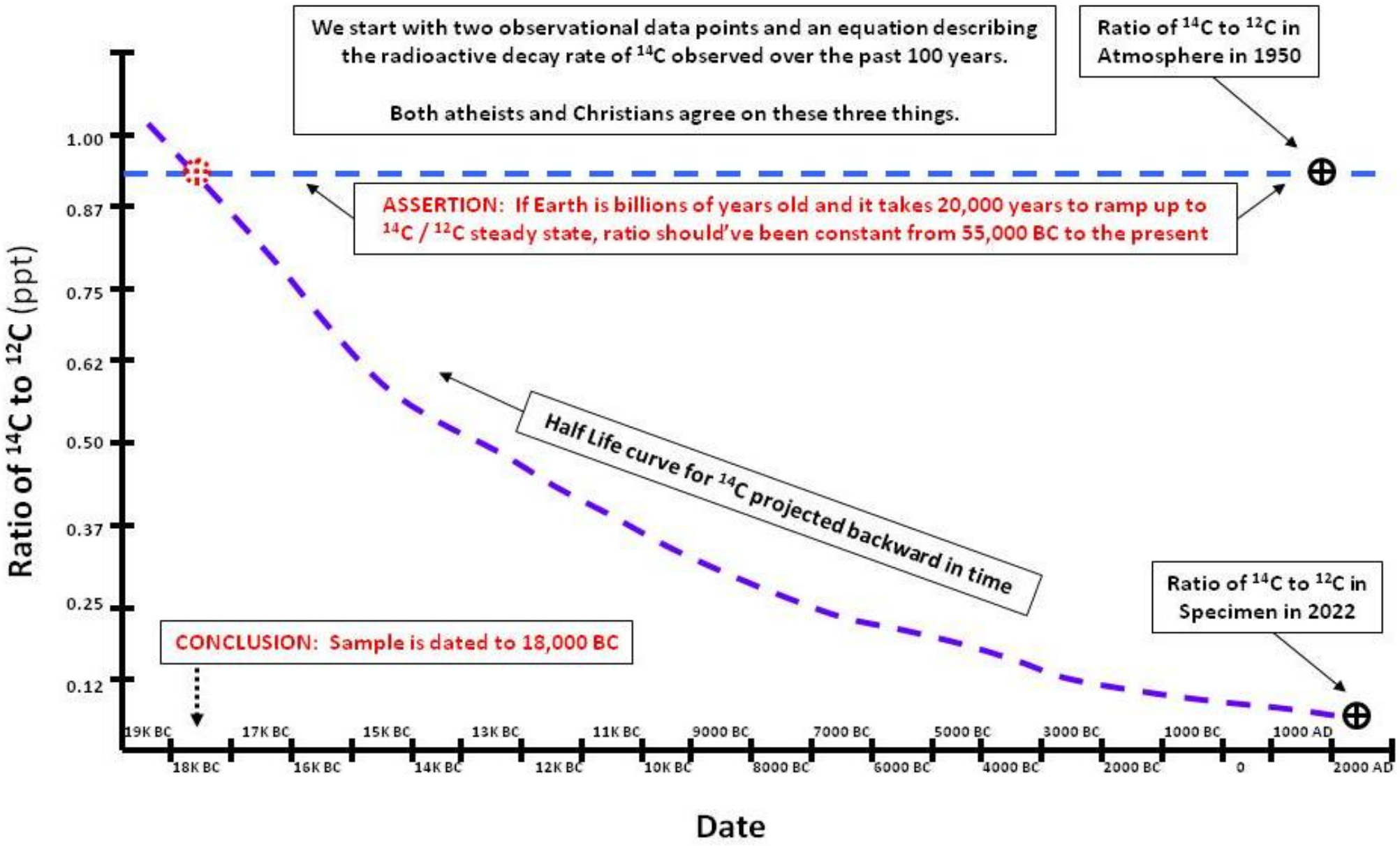
Date

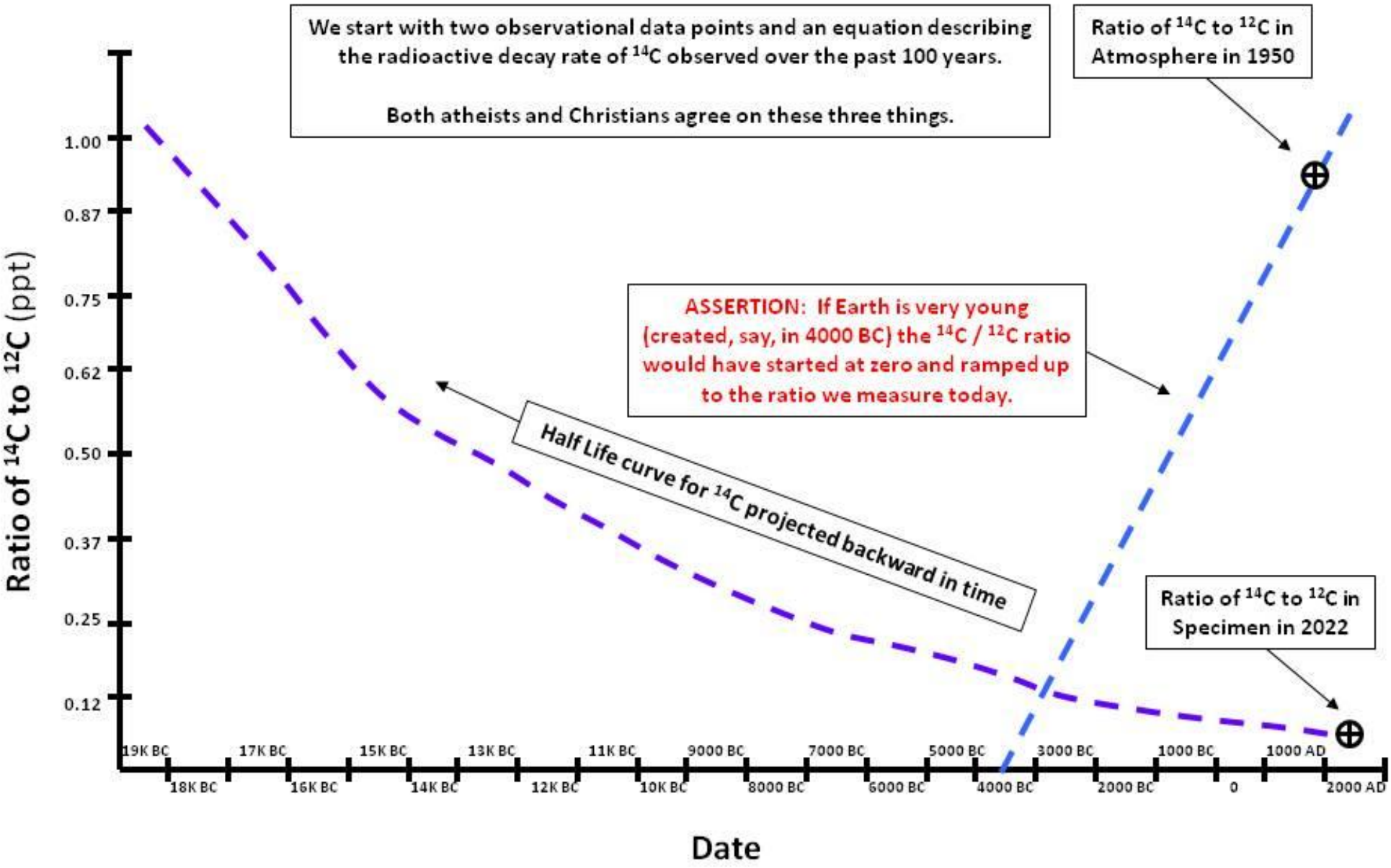
Old Earth Starting Assumption: Earth is billions of years old!



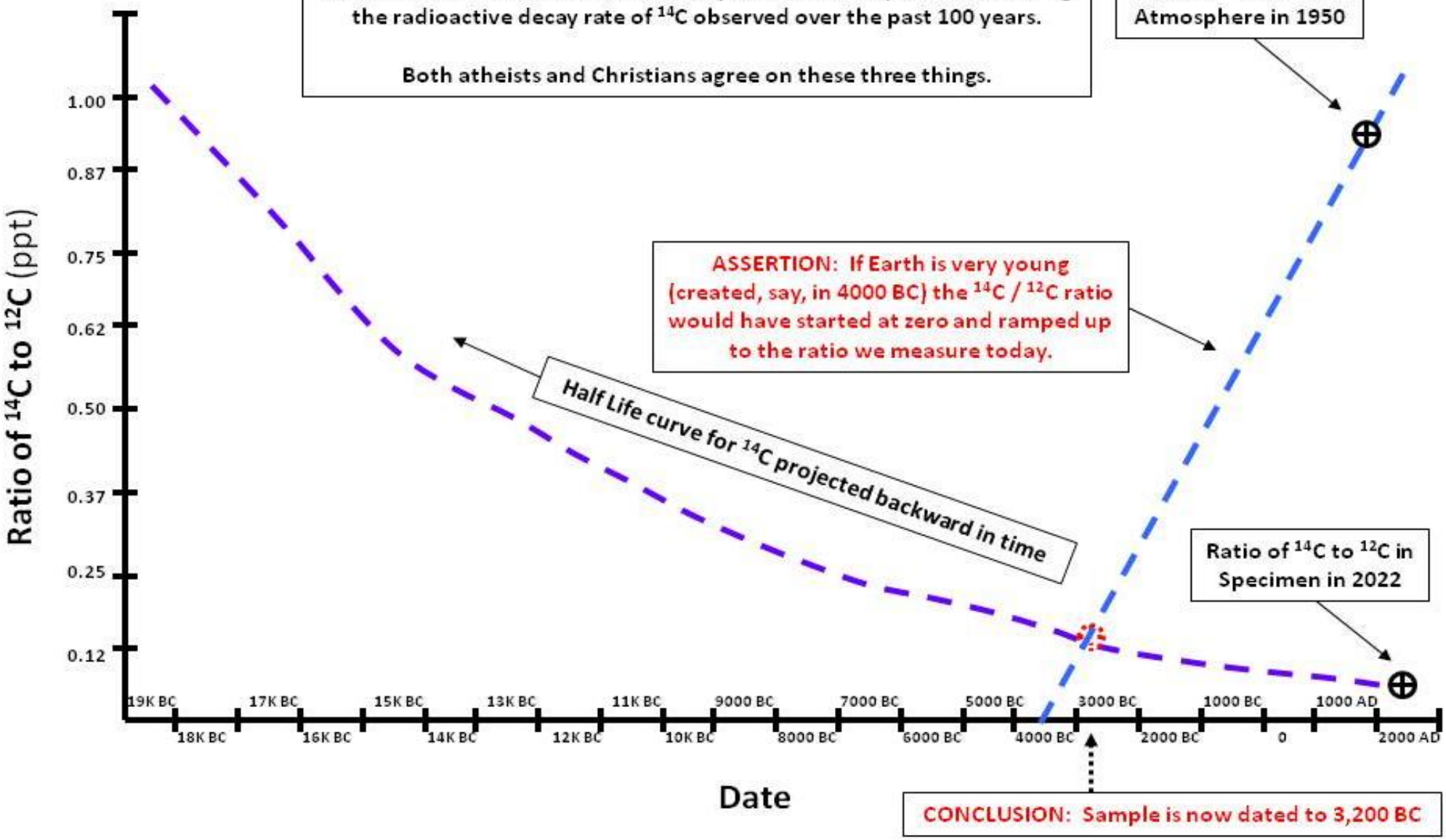
Starting Assumption: Earth is billions of years old!

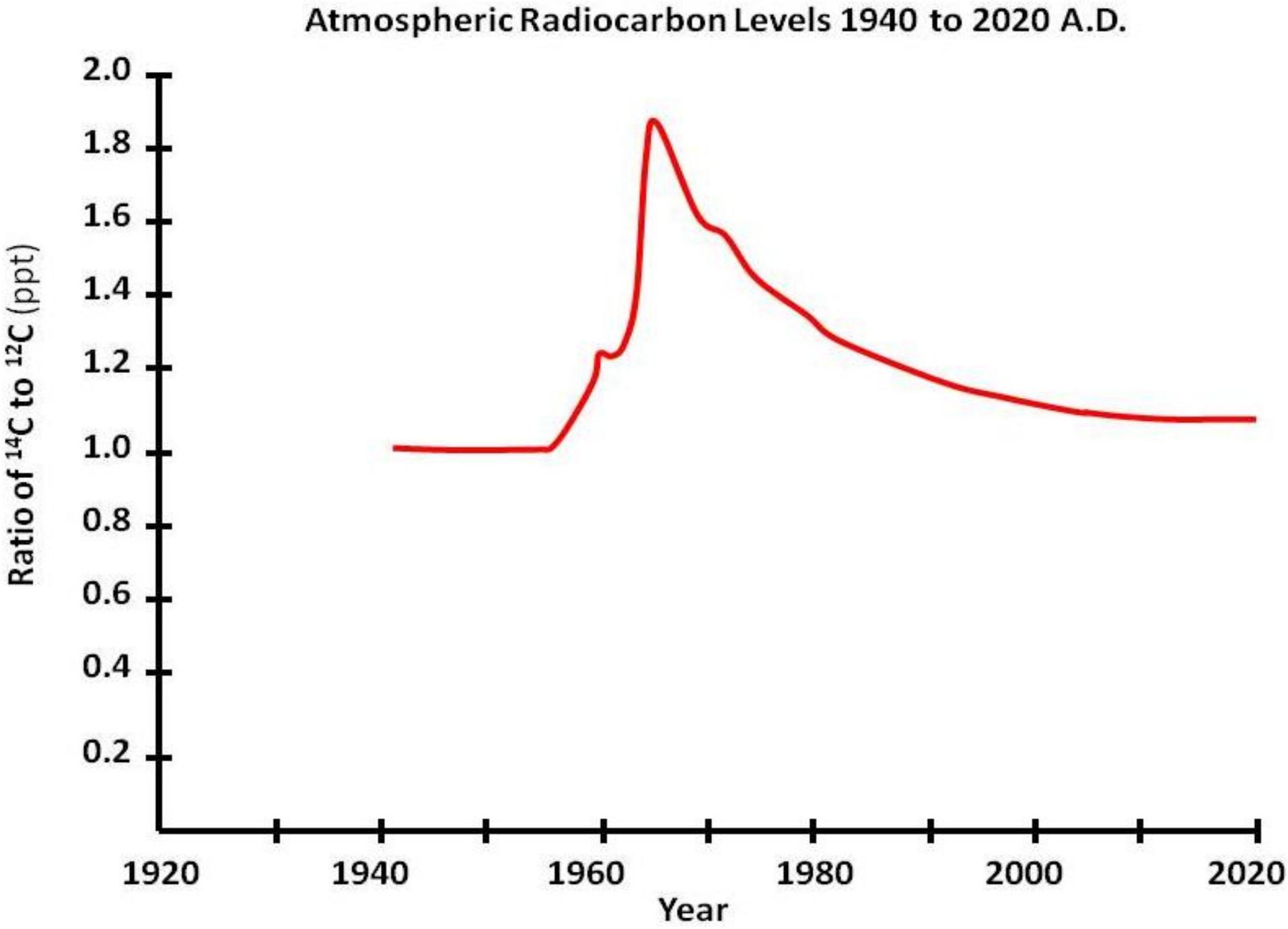


Starting Assumption: Earth is thousands of years old!



Starting Assumption: Earth is thousands of years old!




Atmospheric Radiocarbon Levels 1940 to 2020 A.D.
Ratio of ^{14}C to ^{12}C (ppt)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1920
1940
1960
1980
2000
2020
Year

QUIET TIMES ALONE WITH GOD
JEREMIAH 15:16
THEME: ***Archaeology, The Bible, & Radiocarbon Dating***

PASSAGE FOR MEDITATION: ***Genesis 5***
How does this passage relate to the theme?

When I reflect on this passage, does it primarily convict, encourage or challenge me? Explain why:

How will I apply this passage to my life in the coming week and is there anything I can do today to make this passage a part of my Christian life?

PASSAGE FOR MEDITATION: ***Genesis 10***
How does this passage relate to the theme?

When I reflect on this passage, does it primarily convict, encourage or challenge me? Explain why:

How will I apply this passage to my life in the coming week and is there anything I can do today to make this passage a part of my Christian life?

PASSAGE FOR MEDITATION: ***Genesis 11***
How does this passage relate to the theme?

When I reflect on this passage, does it primarily convict, encourage or challenge me? Explain why:

How will I apply this passage to my life in the coming week and is there anything I can do today to make this passage a part of my Christian life?