

The Biblical Chronologist

WHAT HAS BEEN IS REMOTE AND EXCEEDINGLY MYSTERIOUS. WHO CAN DISCOVER IT?

(Ecclesiastes 7:24)

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The Depth of Noah's Flood

How many feet above the surface of the modern oceans did the water rise at the time of the Flood? Did the water cover Mount Everest, with its peak some five and a half miles above mean sea level today? What effect would the Flood have had on the great ice sheet that presently covers most of Greenland? Was the water deep enough to cause this massive ice sheet to float? At what rate did the water rise, and at what rate did it fall? How long was the maximum depth maintained? These are a few of the questions which have been raised by recent Biblical chronology research into the date of Noah's Flood.

In this article I seek to provide some quantitative answers to questions regarding the depth of the Flood. I discuss how the depth of the water at various times throughout the Flood can be determined, and I display a graph of the depth of the water of the Flood versus time.

The need for such a graph arose several months ago following the discovery of an anomalously thick sedimentary layer at Elk Lake in Minnesota.¹ This anomalous layer was found to have been deposited within secular dating uncertainties of the Biblical date of Noah's Flood which results when an accidentally dropped millennium is included in 1 Kings 6:1 (i.e., 3520±21 B.C.).²

This discovery immediately appeared to corroborate a global Flood, but it refuted the idea that the Flood was a great, geologic cataclysm.³ The

¹Gerald E. Aardsma, "Noah's Flood at Elk Lake," *The Biblical Chronologist* 2.6 (November/December 1996): 1-13.

²Gerald E. Aardsma, *A New Approach to the Chronology of Biblical History from Abraham to Samuel*, 2nd ed. (Loda IL: Aardsma Research and Publishing, 1993). Gerald E. Aardsma, "Chronology of the Bible: 5000-3000 B.C.," *The Biblical Chronologist* 2.4 (July/August 1996): 2-3.

³Gerald E. Aardsma, "Noah's Flood at Elk Lake," *The Biblical Chronologist* 2.6 (November/December 1996): 1-13.

obvious question following the Elk Lake discovery was whether it could be corroborated from other natural reservoirs having well controlled chronologies covering the period of interest. Might evidence of the Flood be expected in the stratified Greenland ice cores which have been drilled during the past several decades, or in long tree-ring sequences, for example? Preliminary consideration of such questions rapidly revealed that a knowledge of the depth of the Flood versus time was needed to aid in answering them.

The time axis for a graph of the depth of the Flood is simply the chronology of the Flood itself. This can be obtained from the Genesis account of the Flood.⁴ Depth of the Flood data can also be obtained from the Genesis narrative, providing the mountain the ark came to rest upon can be determined. A comprehensive search of modern mountains in the Ararat region was reported on in the previous issue.⁵ It revealed that Mount Cilo, a mountain to the southeast of Lake Van, best fulfilled the requirements of the Biblical text. It was singled out from over 1,400 competing mountains using a quantitative, probabilistic analysis. Mount Cilo was found to be over sixty times more likely to be the mountain the ark landed on than the traditional Mount Ararat, the next most likely candidate. The present study proceeds from and builds upon this basis.

Flood Models

It is normal in science for there to be an interaction between theory and experiment as new discover-

Gerald E. Aardsma, "Research in Progress," *The Biblical Chronologist* 2.4 (July/August 1996): 9-14.

⁴Gerald E. Aardsma, "Chronology of Noah's Flood," *The Biblical Chronologist* 3.1 (January/February 1997): 1-8.

⁵Gerald E. Aardsma, "The Ark on Ararat?," *The Biblical Chronologist* 3.2 (March/April 1997): 1-12.

ies about God's creation are made. Experimental evidence which does not fit within an existing theoretical framework is usually the first indication that some new discovery may be just around the corner. This experimental evidence prompts new theoretical studies and ideas. These, in turn, prompt further experimental investigations. Thus theory and experiment grow up together, side by side.

This is the process we are currently involved in with the Flood.

The ruling theory of the Flood in modern academia is that the Biblical "story" of the Flood is largely or wholly mythological. This theory is rejected by conservative Christians because Christ treated the Flood as an historically factual event.⁶ Furthermore, Christians from the time of Christ on have consistently understood the Biblical Flood narrative to be simple, sober history.

The reigning theory of the Flood among conservative Christians at present is the cataclysmic Flood model made popular by Whitcomb and Morris in their book *The Genesis Flood*.⁷ This theory pictures the Flood as a highly energetic geologic cataclysm, responsible for the deposition of most of the geologic column, and accompanied by great earthquakes, tidal waves, unprecedented volcanism, movements up and down and around of whole continents and ocean floors, and general titanic upheaval of the crust of the earth.

This theory has been beset by severe chronological difficulties from its inception.⁸ For example, radiometric dating methods belie the claim that the geologic column was laid down all at one time a few thousand years ago. Such difficulties have been avoided by proponents of the theory by denying the cogency of radiometric dating methods and other chronological data—they have never been solved. Indeed, from the vantage point of several decades of research it seems fair to say that this model's chronological problems are unsolvable. This is just another way of saying that this theory is false—it does not correspond to what actually happened at

the time of the Flood.

Perhaps the most telling failure of the cataclysmic Flood model for the conservative Christian is its inability to satisfy Biblical chronology. Continuous series of annual tree-rings, ice-layers, and lake sediments exist, each independently extending some ten thousand years into the past. Each of these series shows that a cataclysmic Flood is impossible to accommodate in earth history certainly any more recently than about ten thousand years ago.⁹ Meanwhile, even the most cavalier modern Bible chronology must place the Flood certainly within one thousand years of 3000 B.C.—only six thousand years ago at best. Thus a discrepancy of at least four millennia exists between the cataclysmic Flood model and Biblical chronology. This large failure is another evidence that this model is simply not correct.

The existence of an archaeologically revealed hiatus in human populations in the Near East roughly 3500 B.C., coupled with evidence of intense sedimentation at Elk Lake in Minnesota at this same date recently prompted me to advance a new theory of the Flood, called the pelagic Flood model.¹⁰ "Pelagic" means relating to the open sea. I adopted this adjective to convey the idea of a Flood which is characterized by the existence of a universal ocean over the globe of the earth. Tidal waves and other cataclysmic phenomena are, so far, foreign to this model. And just as the oceans are not tearing up and redepositing the sea floor as miles-deep sediments each year at present, so no such activity is anticipated over the surface of the ground during the year of the Flood in the pelagic Flood model.

The pelagic Flood model is not dominated by tectonics (i.e., deformations of the crust of the earth) as the cataclysmic Flood model is. For example, it does not picture the kind of mountain building that the cataclysmic model does at the time of the Flood.¹¹

⁶Luke 17:26–30.

⁷John C. Whitcomb, Jr. and Henry M. Morris, *The Genesis Flood* (Philadelphia: The Presbyterian and Reformed Publishing Company, 1961).

⁸John C. Whitcomb, Jr. and Henry M. Morris, *The Genesis Flood* (Philadelphia: The Presbyterian and Reformed Publishing Company, 1961), 332.

⁹See, for example, Gerald E. Aardsma, "Research in Progress," *The Biblical Chronologist* 2.4 (July/August 1996): 9–14.

¹⁰Gerald E. Aardsma, "Noah's Flood at Elk Lake," *The Biblical Chronologist* 2.6 (November/December 1996): 10.

¹¹John C. Whitcomb, Jr. and Henry M. Morris, *The Genesis Flood* (Philadelphia: The Presbyterian and Reformed Publishing Company, 1961), 127–128.

But the pelagic Flood model does not eschew tectonics either. For example, upward flexure of the sea floors would seem one possible way to get the water of the oceans to cover the land during the Flood. Further experimental evidence (similar to the Elk Lake data) is necessary to refine our understanding of the role of tectonics in this theory.

But the silence of the Biblical narrative regarding any of the sorts of phenomena that would surely accompany large-scale, rapid tectonics seems at present to relegate tectonics to a minor role at best during the Flood. It seems most appropriate, at least during this early stage in the development of this model, to approximate the tectonic contribution to the Flood as being zero. This means we picture the Flood, in first approximation, as characterized by mobile water over a static landscape and lithosphere. This has the disadvantage of leaving the question of what impelled the water to move out of the oceans and onto the land without an obvious, immediate answer. But it seems likely that the mechanism of the Flood (i.e., what impelled the water) will clarify as greater familiarity is gained with the empirical data pertaining to the Flood. Meanwhile, this procedure has the great advantage of keeping the discussion centered on the sort of Flood the Bible actually describes, rather than plunging it immediately into imaginative and speculative tectonic scenarios. It allows Noah's Flood to be Noah's *Flood*, rather than Noah's Great Tectonic Event.

Psalm 104:5–9

I am aware that some may think this approach to the problem unbiblical. They may feel it is blatantly contradicted by Psalm 104:5–9. Those who adhere to the cataclysmic Flood model often point to this passage to support the idea that the continents rose and the ocean basins sank following the Flood. Whitcomb and Morris write, for example:¹²

Very likely, in order to accommodate the great mass of waters and permit the land to appear again, great tectonic movements and isostatic adjustments would have to take place, forming the deep

ocean basins and troughs and elevating the continents. This seems to be specifically implied in the poetic reflection of the Deluge in Psalm 104:5–9.

The passage in question reads (NASB):

5. He established the earth upon its foundations,
So that it will not totter forever and ever.
6. Thou didst cover it with the deep as with a garment;
The waters were standing above the mountains.
7. At Thy rebuke they fled;
At the sound of Thy thunder they hurried away.
8. The mountains rose; the valleys sank down
To the place which Thou didst establish for them.
9. Thou didst set a boundary that they may not pass over;
That they may not return to cover the earth.

This passage does seem to be referring to the Flood, but its interpretation in terms of tectonics seems to me to be questionable for a number of reasons.

Notice, first of all, that it is not this whole section of five verses which can be appealed to for support of rising continents and sinking ocean basins (i.e., tectonics), but just one half of one verse. Specifically, the first half of verse 8, which says "The mountains rose; the valleys sank down" is what is utilized. But even this phrase does not say the *continents* rose and the *ocean basins* sank down. It says the *mountains* rose and the *valleys* sank down. Obviously, it is a rather large leap to change what the text calls "mountains" into continents, and "valleys" into ocean basins. But I recognize that one must be careful about how literally a phrase from poetic verse should be taken, so I will not press this point.

Of greater concern is the fact that the context doesn't seem to support a tectonic interpretation of this passage. The subject of verses 6, 7 and 9 is the water of the Flood, not the mountains or the valleys. The Bible reader is watching the Flood

¹²John C. Whitcomb, Jr. and Henry M. Morris, *The Genesis Flood* (Philadelphia: The Presbyterian and Reformed Publishing Company, 1961), 121–122.

waters in these verses. He is watching the waters in action as they respond to the sovereign voice and will of God. In verse 6 the waters are covering the earth. In verse 7 they are fleeing. In verse 9 they are restrained. It seems foreign to interject moving mountains and valleys in the middle of this focus on the waters, and I believe the psalmist did not intend that we should.

I suggest that the psalmist is not talking about any absolute motion of the mountains and valleys at all here. I suggest that he is simply carrying on with his theme of the waters in motion in response to the will of God. What the poet is describing in verse 8 is not what the mountains and valleys are doing, which would be a change of subject and foreign to the theme of the passage. Rather, he is describing what one sees as a result of what the waters are doing.

Looking out from the ark, one would have seen the mountains emerging from the surface of the retreating waters. The mountains would have appeared to those aboard the ark to be rising up out of the water. Similarly, one would have seen the valleys between the mountains deepening day by day as the surface of the water, which defined the visible bottoms of the valleys at that time, sank lower and lower. They would have appeared to be sinking down.

I suggest that it is this concept which underlies verse 8, rather than any absolute motion of mountains and valleys. The psalmist has already made it clear in verses 6 and 7 that it is the waters which are doing the moving. That the waters have not been set aside as the subject in verse 8 is clear by the fact that they are still the subject of verse 9. Thus the action of the waters should still be regarded as the subject of verse 8, not the action of the mountains and the valleys.

In verse 8 the psalmist is simply using the language of appearance. The action of the waters causes the mountains to *appear* to be rising up out of the water, and the valleys between the mountains to *appear* to be deepening. The use of the language of appearance at this point should not cause us any difficulty. Psalm 104 is poetry, after all, not historical narrative, and the use of the language of appearance is, in fact, a very effective poetic technique in this instance.

I suggest that this understanding best fits the context and the poetic nature of the passage, and that it is all the psalmist ever intended.

In any event, it is clear that Psalm 104:5–9 does not lend unequivocal support to the assertion that the Flood was accompanied by rapid, large-scale tectonics by any means, and that it does not demand that we include a tectonic component in the pelagic Flood model.

The Data

Day 0

The first point of interest for constructing a graph of the depth of the Flood versus time is Day 0, immediately preceding the start of the Flood. The depth which we need to know to be able to graph this point is simply the mean sea level back at that time.

Richard G. Fairbanks displays a graph of mean sea level which includes the period in question.¹³ It is based on radiocarbon dated corals. It shows that the sea level was 5 ± 1 meters (1σ) below the present mean sea level 5,500 years ago. Thus the depth of the Flood water on Day 0 can be given as -15 ± 3 feet.

Day 150

The single most major piece of quantitative data regarding the depth obtained by the Flood is found in Genesis 8:4. There we learn that “the ark rested upon the mountains of Ararat”. My previous work, mentioned above, leads me to understand this as recording the grounding of the ark near the summit of Mount Cilo on Day 150 of the Flood. The implication is that the water of the Flood was just deep enough to barely cover Mount Cilo on Day 150.

Mount Cilo’s summit presently stands at $13,566\pm 33$ feet (1σ) above mean sea level.¹⁴ One cannot simply assume that this was its height at the time of the Flood, however. I have previously pointed out that a mountain which erodes as little

¹³See Figure 2 (p. 639) of: Richard G. Fairbanks, “A 17,000-year glacio-eustatic sea level record: influence of glacial melting rates on the Younger Dryas event and deep-ocean circulation,” *Nature* 342 (7 December 1989): 637–642.

¹⁴Map TPC G-4B, Defense Mapping Agency Aerospace Center, St. Louis, Missouri.

as one inch per year will have lost over 450 feet in 5500 years, the time which has elapsed since the Flood. Additional uncertainties on this order in the absolute depth of the Flood on Day 150 arise from questions of the possible subsidence or elevation of the Ararat plateau since the Flood. Such considerations suggest that the depth of the Flood on Day 150 should probably be regarded as uncertain to within 500 or 600 feet (3σ) of the present height of Mount Cilo. I therefore estimate a 1σ uncertainty of ± 200 feet. Rounding the measured elevation to the nearest 100 feet in conformity to this uncertainty yields $13,600 \pm 200$ feet above mean sea level as the depth of the Flood on Day 150.

Day 222

Genesis 8:5 records that the water decreased steadily after the ark had grounded, and that on Day 222 the tops of neighboring mountains became visible.

Mount Cilo is surrounded by tall mountains. The tallest near neighbor is located about 25 miles (40 km) to the northeast. Its elevation is given on TPC map G-4B as $12,493 \pm 100$ feet (3σ).¹⁵ By the time the water of the Flood had decreased to this depth, the summit of Mount Cilo would have been ($13,566 - 12,493 =$) 1,073 feet (327 m) out of water. According to Equation 1 of the previous issue¹⁶ the horizon would have been out at

$$r = 6371 \times \arccos[6371 / (6371 + 0.327)]$$

which equals 65 kilometers (about 40 miles) by that point. Thus this tallest neighboring peak would have been inside the horizon as viewed from Mount Cilo on Day 222 when it first breached the surface of the water. Therefore the depth of the water on that day would have been just equal to the height of the peak of this neighboring mountain. When the uncertainties mentioned above are taken into consideration one obtains a depth of water on Day 222 of $12,500 \pm 200$ feet.

¹⁵Map TPC G-4B, Defense Mapping Agency Aerospace Center, St. Louis, Missouri.

¹⁶Gerald E. Aardsma, "The Ark on Ararat?," *The Biblical Chronologist* 3.2 (March/April 1997): 8.

Day 310

The determination of the depth of the Flood on Day 310 is more dependent on interpretation of the Genesis narrative than the previous data points have been. We learn from Genesis 8:13 that "the water was dried up from the earth" on this day. The interpretive question arises over whether this is intended to be understood in an absolute or a relative sense. Did Noah intend to convey that the region around the mountain over which he looked after he had removed the covering of the ark on Day 310 had come to a terminal state of dryness (similar to what one would see there today), or did Noah mean that the scene was dominated by dry land rather than by water?

Genesis 8:7 may offer some help with this interpretive difficulty. It informs us that the raven which Noah had sent out of the ark "flew here and there until the water was dried up from the earth". Whitcomb and Morris make an interesting connection between Genesis 8:7 and Genesis 8:13, which describes the state of dryness on Day 310, in their Figure 2.¹⁷ The phrase "the water was dried up from the earth" appears in both verses. Apparently, then, the raven was seen flying about until about Day 310.

I am not an expert on the behavior of ravens, but it is clear that the raven is not a sea-going bird. It seems reasonable to suppose that the water surrounding Mount Cilo would constitute somewhat of a barrier to the raven, holding the raven in the vicinity of the ark as long as it was high enough. As the depth of the water decreased and neighboring mountains began to appear, it seems likely the raven could have flown away from Mount Cilo to these other mountains if it had wished to do so. But there is no obvious reason why it would have wished to do so as long as its food supply around Mount Cilo was adequate—which seems likely following such a Flood. Once the water had decreased to the point that a flight of several miles over open water was no longer required for the raven to leave the vicinity of the ark, however, it seems probable that the raven would have strayed away from that vicinity in its daily search for food.

¹⁷John C. Whitcomb, Jr. and Henry M. Morris, *The Genesis Flood* (Philadelphia: The Presbyterian and Reformed Publishing Company, 1961), 8.

If this speculation on the probable behavior of the raven is reasonably accurate, then it suggests that the raven would certainly have wandered away by the time the water had decreased to 5,750 feet. At that depth Mount Cilo would no longer have been an island. A person would have been able to walk the 25 miles to the first neighbor which had appeared several months previously, completely on dry ground by this point, for example. But the raven was probably still confronted by somewhat of a water barrier when the depth of the water was 7,000 feet. At that depth the raven would still have had to cross a two or three mile stretch of water at the narrowest point to leave the vicinity of Mount Cilo.

These considerations lead me to propose a probable depth of $6,500 \pm 200$ feet (1σ) on Day 310.

Day 365

Genesis 8:14 records simply that on Day 365 “the earth was dry”. At this point Noah and the other occupants of the ark disembarked. One gets the impression that things were pretty much back to normal around Mount Cilo by this point. This suggests a water depth no greater than about 3,500 feet. This is the approximate altitude of the river valleys in the vicinity of Mount Cilo today.

The text does not rule out the possibility that the water had receded much further than this by this point, however. It seems possible that the water may even have returned to its normal, pre-Flood state by Day 365.

An estimate which takes both of these extremes into account is $1,750 \pm 600$ feet (1σ).

The Graph

The five data points discussed above are shown in Table 1. Figure 1 displays a graph of these points.

It would be very nice if a theoretical functional form could be fit to these data points. Unfortunately, our present ignorance of the mechanism of the Flood leaves us without the necessary physical basis for such an attempt. But two observations on the nature of such a function seem in order at this time.

First, it appears that the water rose more rapidly than it receded. We know from the Biblical account that the water decreased steadily

Table 1: Depth of the Flood data.

Day	depth (feet)	uncertainty (1σ)
0	-15	± 1
150	13,600	± 200
222	12,500	± 200
310	6,500	± 200
365	1,750	± 600

from Day 150 onward. Thus the Flood must have reached maximum depth on or before Day 150. For the water to have receded as quickly as it rose, the depth would have had to reach zero by Day 300. But in actual fact the water was still over a mile deep by Day 310. Thus the mathematical function describing the depth of the water of the Flood will not be symmetric about any vertical axis.

Second, it seems clear that the rate of recession of the water accelerated with time following attainment of maximum depth. Notice that the rate of recession was more rapid from Day 222 to Day 310 than it was from Day 150 to Day 222. This observation has important consequences for the mechanism of the Flood. For example, if one fills a pail which has a small hole in the bottom of it with water, the rate of recession of water in the pail will decelerate with time. Thus, a “leaky pail” model does not seem an appropriate analog for the mechanism of the Flood.

The Maximum Depth of the Flood

This second observation also allows an absolute upper limit to be set on the maximum depth achieved by the Flood. This can be obtained by extrapolating the known rate of recession of the water between Day 150 and Day 222 backward in time. Since the rate of recession increased with time, it could not have been any greater before Day 150 than it was observed to be after Day 150.

Unfortunately, it is not clear from the Biblical narrative just how far back one should extrapolate. This depends upon when the Flood reached its maximum depth. I find it impossible to determine this with complete confidence from the Biblical narrative.

The text repeatedly mentions the initial forty

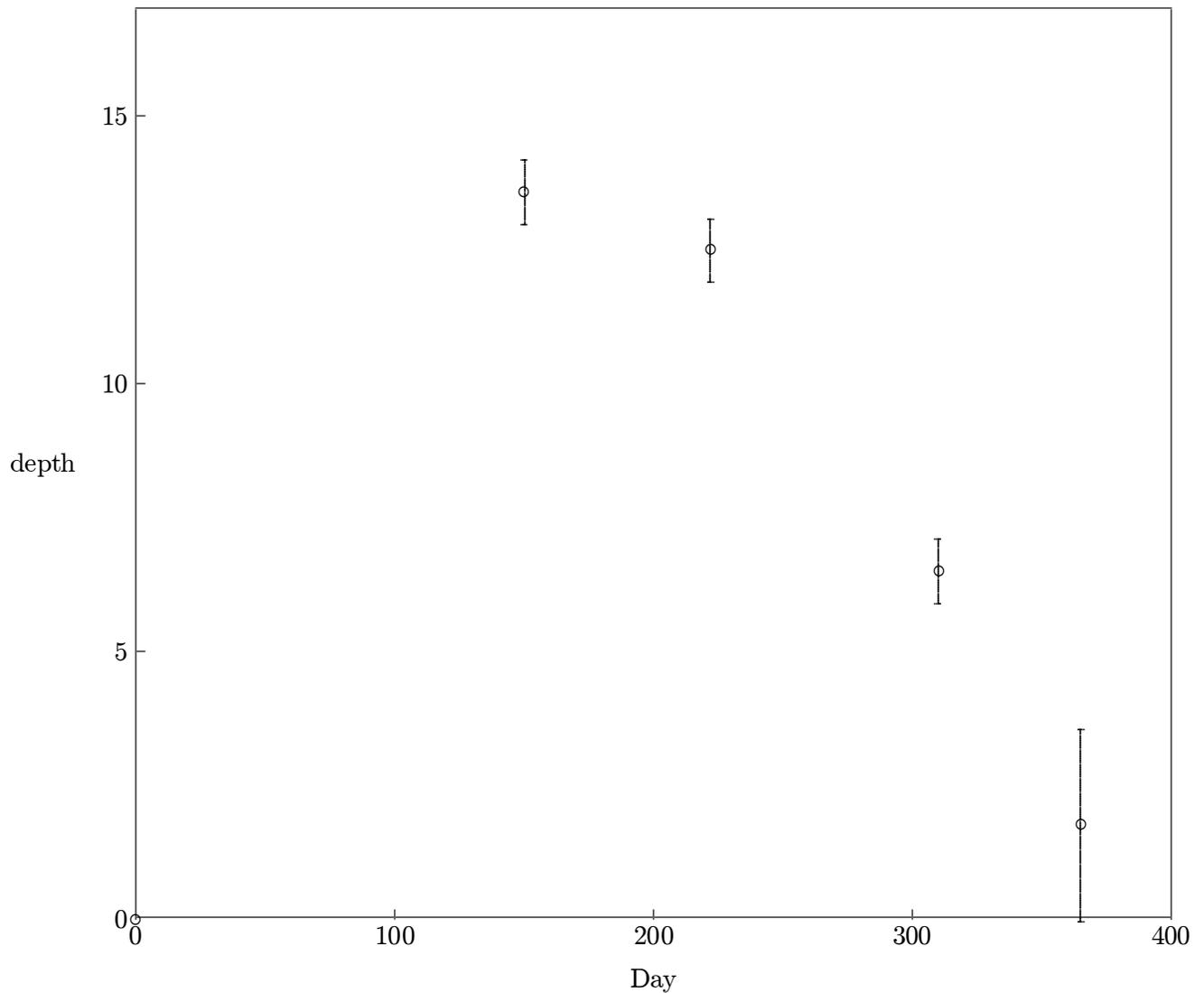


Figure 1: Depth of the water of the Flood, in thousands of feet, versus time. Error bars are $\pm 3\sigma$.

days and nights of rain.¹⁸ This period seems certainly to have been one of rapidly increasing water depth. But it is not clear whether the Flood reached maximum depth on Day 40 or whether it went on increasing at a somewhat slower rate after Day 40.

The text is explicit that the water decreased from Day 150 onward.¹⁹ So it is certain that the Flood obtained its maximum depth sometime before Day 150. But it seems possible, from the information given in the Genesis narrative, for maximum depth to have been achieved anywhere between Day 40 and Day 150.

¹⁸Genesis 7:4,12,17.

¹⁹Genesis 8:3.

This uncertainty seems to me to merely reflect Noah's inability to determine when the Flood had reached maximum depth. Once the ark had grounded, on Day 150, Noah would have been able to tell that the water was receding by direct observation. The ark would have settled into place as the water lowered, the horizon would have grown more distant, and the line of the horizon would have sunk ever lower below the horizontal plane.

But prior to Day 150, once all visible land had been submerged, Noah would have had no way of telling whether the Flood was increasing or decreasing. Even if he had been able to take soundings, a ship adrift over mountainous terrain would not have yielded systematic results.

There seems no way to remove this uncertainty,

so we must work with it. What seems reasonably clear, in any case, is that the Flood did not reach its maximum depth prior to Day 40. So an absolute greatest maximum depth can be calculated by extrapolating the absolute maximum depths on Day 150 and Day 222 back to Day 40. (Notice that the uncertainties in the depth of the Flood on these two days are correlated, not independent. They are due to factors such as erosion and uplift which should behave in a similar fashion for Mount Cilo and its near neighbors, from which these points are determined.) Such an extrapolation leads to the conclusion that the water did not exceed 15,900 feet above today's mean sea level at any point during the Flood.

Coverage of the Flood

I have previously discussed the fact that two different points of view exist, leading to two different interpretations of the Flood account in Genesis.²⁰ One view interprets much of the narrative from a global frame of reference. In this view the narrative is seen as a record of God's observations during the Flood. The other view interprets most of the narrative from a local frame of reference. In this view the narrative is seen as a record of Noah's observations during the Flood.

Genesis 7:19 says (NASB), "And the water prevailed more and more upon the earth, so that all the high mountains everywhere under the heavens were covered." To those who adopt the first viewpoint, this seems to guarantee that the waters of the Flood covered every square inch of land over the entire earth. In the second viewpoint, no such guarantee exists. If Genesis 7 is a record of Noah's observations, then verse 19 merely records that every mountain within Noah's visible horizon had been covered by water. Thus, the second viewpoint admits the possibility that, though the Flood was a global phenomenon rather than just a local or regional event, some very tall mountains or other high elevations, outside of Noah's visible horizon, may still have remained above the level of the water throughout the Flood.

As I have stated previously, I am of the persuasion that the Flood narrative should be inter-

preted from the second viewpoint. I have worked consistently within this framework throughout this entire study of the Flood. We have now reached the point where the question of the coverage of the Flood which arises within this framework can be addressed for the first time.

We feel confident that the Flood obtained a depth of at least 13,000 feet above mean sea level, and we have concluded that it may have reached as much as 15,900 feet. There are very few places on Earth which reach such elevations. There are some mountains scattered about the globe which do so, and there is one region which does so. The mountains include, for example, Everest in Asia (29,000 feet), McKinly in Alaska (20,300 feet), El'brus in Europe (18,500 feet), Kilimanjaro in Africa (19,300 feet), Aconcagua in South America (23,000 feet), and Vinson Massif in Antarctica (16,900 feet). The one region is the Tibetan Plateau in Asia, the "roof of the world", which is believed to have an average elevation of about 16,000 feet. Because of the extreme elevations involved, all of these places are cold and barren and otherwise not conducive to human occupation.

The Tibetan Plateau occupies about 0.4% of the surface area of the earth. If the 40 days and nights of rain which Noah observed were a global phenomenon, then it is possible that this plateau also experienced extensive flooding at the time of the Flood. This would have been a fresh-water flooding however, in contrast to the salt-water flooding experienced by the rest of the globe.

Be that as it may, 0.4% seems to be a reasonable upper limit on the surface area of the earth left exposed by the Flood. This means that in the pelagic Flood model Noah's Flood seems to have covered at least 99.6% of the earth's total surface area.

Greenland Ice Sheet

Was the Flood deep enough to cause the Greenland ice sheet to float? The answer now appears to be yes.

The Greenland ice sheet covers 708,000 square miles today. The average elevation of the ice appears to be about 7,000 feet. The ice was drilled completely through to bedrock at the Dye 3 site, yielding a measured ice thickness of 2,037 meters

²⁰Gerald E. Aardsma, "Chronology of Noah's Flood," *The Biblical Chronologist* 3.1 (January/February 1997): 6.

(6,683 feet).²¹

If we take the present elevation as representative of this ice sheet at the time of the Flood, it is clear that the water of the Flood would have lifted the entire ice sheet at least (13,600-7,000=) 6,600 feet above its bed, since ice is less dense than water.

The fact that the deepest ice within the Greenland ice sheet today considerably predates the Flood shows that the pre-Flood Greenland ice sheet did not simply drift away from Greenland at the time of the Flood. This is not too surprising. In addition to the immense inertia involved, the low inland plateau on which the ice sheet rests is surrounded by a strip of coastal mountains, the highest of which is 12,139 feet. Apparently these acted to keep the pre-Flood ice sheet anchored to Greenland throughout the Flood.

This is somewhat unfortunate as far as finding evidence of the Flood in the Greenland ice sheet is concerned. If the ice sheet had drifted away at the time of the Flood, the present ice sheet would only have begun to accumulate after the Flood. The age of the ice at the bottom of the modern ice sheet would, in that case, have simply corresponded to the date of the Flood.

How Much Water?

One of the most basic calculations which can be made at this point is to determine the percentage of the water in the modern oceans which is required to cover the continents to 13,600 feet. Such a calculation should help provide some additional insight into the mechanism of the Flood.

George D. Garland gives the mean depth of the oceans as 3,800 meters, and their surface area as 3.61×10^{14} square meters.²² This yields a present volume of water in the oceans of 1.37×10^{18} cubic meters.

Garland gives the mean height of the continents as 840 meters, and their surface area as 1.49×10^{14} square meters. To cover this surface area (i.e., just the continents) with water to a depth of 13,600

feet (4,145 meters) would require 4.92×10^{17} cubic meters of water. This is 36% of the volume of the water in the oceans today.

To cover the entire globe with water to an altitude of 13,600 feet above mean sea level today would require an additional 1.50×10^{18} cubic meters of water, or 1.99×10^{18} cubic meters total. This requires 45% more water than exists in the oceans today.

To get a feel for what this means, it is helpful to make a brief excursion into the world of tectonics. Let us imagine for a moment (I am **not** proposing this as a theory) that the Flood was caused by the ocean floors simultaneously and uniformly rising up all over the globe. (More or less equivalently, one can imagine the continents sinking down instead if one prefers.) The numbers say that even if the ocean floors were everywhere raised to the height of the surface of the oceans today, the water would still not cover the continents to 13,600 feet. To get the water to 13,600 feet over the continents, one would need the ocean floors to stand some 870 meters (2900 feet) above the mean height of the continents today. This means the ocean floors would need to be raised (or the continents would need to sink down) 5,500 meters (18,000 feet or 3.4 miles!) above their present level.

It is clear that a lot of water was somehow displaced from the oceans at the time of the Flood. How this was accomplished is presently a most fascinating mystery. Until this mystery is solved we cannot claim to have an accurate conception of the Flood. I point this out here mainly to emphasize that the pelagic Flood model is still at an early stage in its development. Though we have made some astonishing progress in understanding what the Flood was like, we have yet much to learn.

Impact of the Flood

Figure 2 attempts to portray the impact that the Flood must have had on the population of Noah's day by comparing the depth of the Flood to the altitude of a few modern population centers. It is apparent that had New York city been around at that time, for example, it would have been under water for essentially the entire year. The water would have covered it to a depth greater than *two miles* for probably more than half of the year. Even

²¹H. B. Clausen and C. C. Langway, Jr., "The Ionic Deposits in Polar Ice," *The Environmental Record in Glaciers and Ice Sheets*, ed. H. Oeschger and C. C. Langway, Jr. (New York: John Wiley & Sons, 1989), 226.

²²George D. Garland, *Introduction to Geophysics*, (Toronto: W. B. Saunders Company, 1979), inside front cover.

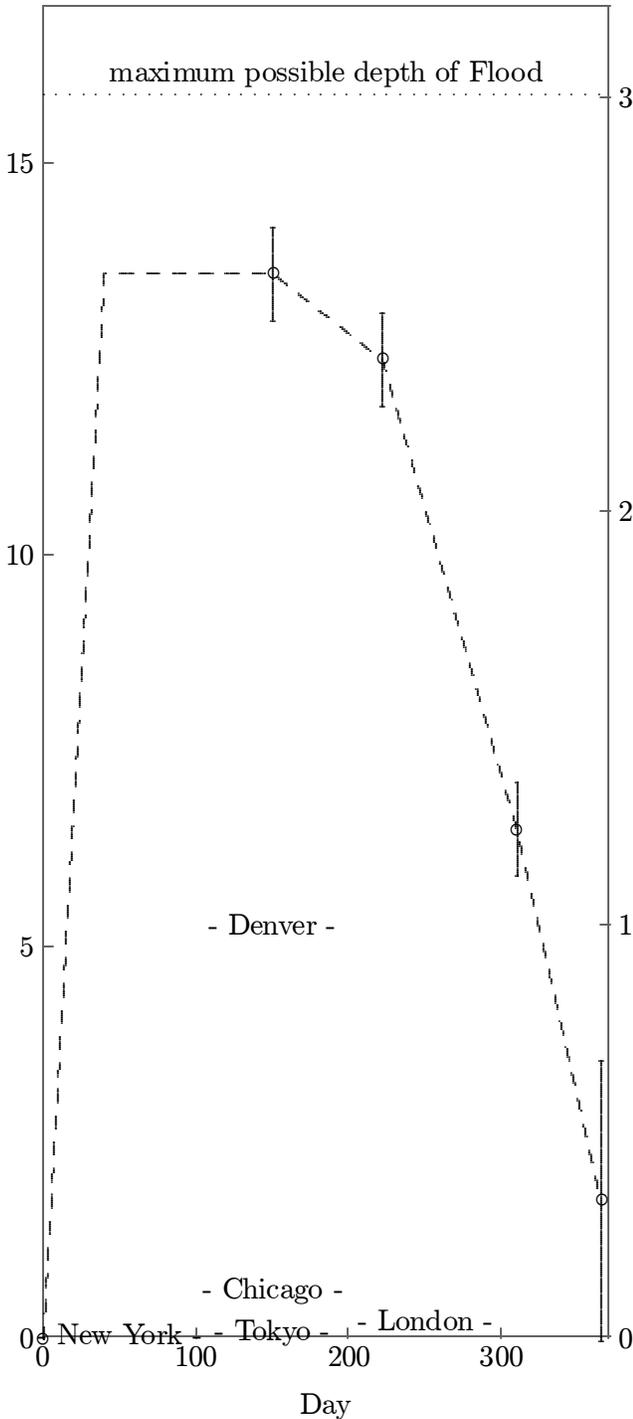


Figure 2: Altitudes at which a few modern cities are situated relative to the depth of the Flood. The depth of the Flood is indicated by the dashed line through the data points discussed in the article, assuming the Flood reached maximum depth on Day 40. Cities are placed on the graph at their appropriate altitudes. The altitude/depth scale is given in thousands of feet to the left of the graph and in miles to the right.

Denver, Colorado, at its unusually high altitude, would have been covered by over a mile of water for much of the year.

Clearly, the Flood would have had an absolutely catastrophic impact on human civilization. Indeed, there is every reason to believe that the existence of humans on Earth would have been terminated completely had it not been for God’s forewarning and Noah’s obedience. ◊

Biblical Chronology 101

On “Putting Science Above the Bible”

I received a letter recently from an obviously irate Christian brother. This brother serves on the faculty of a theological institute. He was upset because he felt, as another brother once put it, that I was “putting science above the Bible”. He wrote, “Scripture is to hold sway. Science, whether radiometry or dendrochronology must serve Scripture, not vice-versa as in your method and principles”.

Is my application of scientific data to problems in the field of Biblical chronology “putting science above the Bible”?

Let me state clearly that I hold to the inerrancy of Scripture in the autographs and to the authority of Scripture in all areas of life, including history and chronology. That is not at issue here. Let me also state clearly that I do not hold to any doctrine of the infallibility or authority of science. So it should be perfectly clear that I am not, in fact, “putting science above the Bible”. What I *am* doing—what conservative Christians have always done—is insisting that science has a legitimate role to play in exposing faulty *interpretations* of the Bible.

Christians face the very real problem that the Bible can be made to say many things that God never intended it to say. Well-intentioned theologians can study the same Scripture passages and arrive at opposite conclusions regarding what these passages mean. Evidently it is possible to honestly believe the Bible teaches some things that it, in fact, doesn’t teach. How is one to separate mistaken interpretations from correct ones?

This same problem has been faced throughout history. The ancient Israelites, for example, en-

countered the problem in regard to prophets. How were they to know whether a prophet was actually speaking for God, or whether he was merely claiming in God's name that which God had not spoken?

Moses raised this problem and gave its solution in Deuteronomy 18:21–22.

And you may say in your heart, "How shall we know the word which the Lord has not spoken?" When a prophet speaks in the name of the Lord, if the thing does not come about or come true, that is the thing which the Lord has not spoken. The prophet has spoken it presumptuously; you shall not be afraid of him.

Notice how this test works. Notice that what actually happens in the physical world is used as the means of determining whether the prophet has faithfully spoken for God or not.

To the Christian, therefore, the evidence from the physical world (i.e., the scientific data) has an important role to play in weeding out error. God has graciously given us the physical world as a check on our thinking about the Bible, to keep us from being misled by erroneous interpretations of Scripture.

In my experience, those who make the "putting science above the Bible" charge do so because they hold a particular interpretation of the Bible which they wish to protect from examination or correction. The "prophecies" about the nature and history of the world which they have made from their interpretation of Scripture have been called into question by data from the physical world. But they refuse to allow that they may have "spoken it presumptuously". So they declare that those who apply the test of Deuteronomy 18:21–22 are impious. They insist on submission to their interpretation regardless.

Please note the following very important principle. Since God is the Author of the Word and also the Creator of the world, these two sources of knowledge—the Bible and the scientific data—will harmonize when both have been properly understood. Correct Biblical exegesis has nothing to fear from correctly performed science, and vice versa. There is no legitimate reason to mute the testimony of either the Bible or science. Those

who genuinely wish to know the truth will want to hear both, without distortion or censure of either.

Bringing the data of science to bear on Biblical matters is not "putting science above the Bible". It is merely applying a procedure to the problem of sifting truth from error which the Bible itself prescribes and has endorsed for a very long time.

◇

Readers Write

My purpose in publishing letters in this column is generally pedagogical. I try to address common questions so everybody benefits from the answer. I also try to correct misunderstandings so we can all move forward in harmony.

I realize that this purpose can lead readers to mistakenly conclude that everybody who writes to me either questions my research or misunderstands it! Such a perception is far from the truth. I get many letters which are just appreciative expressions of encouragement, which never show up here. (I am much more concerned that my readers have answers to their questions, and that misunderstandings be put right, than I am that everybody see how appreciated The Biblical Chronologist is by its readers.) So please don't read this column to try to get a feel for what everybody is thinking—the sample is severely biased. Read it to gain a better understanding of Biblical chronology today. That's why it is here.

Of Fact or Fiction

In the Volume 2, Number 3 issue of The Biblical Chronologist I presented three criteria which can be used to separate fact from fiction in the matter of attempting to harmonize Biblical and secular chronologies of earth history. My advice there was:²³

So before you bother to wade into yet another supposed synthesis of Biblical and secular historical data, ask yourself these simple questions:

²³Gerald E. Aardsma, "Biblical Chronology 101," *The Biblical Chronologist* 2.3 (May/June 1996): 10.

1. Does this author have a positive and respectful attitude toward Biblical, secular historical, and physical (such as radiocarbon) chronological data?
2. Does this author give chronological data, of all sorts, precedence in his reconstruction of history (as opposed to the presentation of a mass of historical facts)?
3. Does this author exhibit knowledge of and competence in handling chronological data of all sorts?

If the answer to any of these questions is no, wade in only if you enjoy reading historical fiction.

*Two issues later I used these three criteria in my review of a new book written by David M. Rohl called *Pharaohs and Kings: A Biblical Quest*.²⁴ *Pharaohs and Kings* presented the radical chronological thesis that the late second millennium B.C. chronology of Egypt should be reduced by some 300 to 350 years. It claimed that such a reduction would bring the secular history of this period into better harmony with Biblical history.*

I didn't give the book very high marks at the time—and still don't. I showed that the book failed to satisfy any of the three criteria above. My conclusion was, and is, "Pharaohs and Kings is a fine example of the historical delusions one is easily made prey to when legitimate chronological constraints are removed from any discussion of historical facts and archaeological artifacts".²⁵

Unfortunately, Rohl's book said some things which some conservative Christians would very much like to be true. It offered the easy thesis (for conservative lay Christians, that is) that traditional Biblical chronological scholarship has all been more or less sound, while secular chronological scholarship is all messed up. So I have not been surprised to see a number of reviews of Rohl's book by conservatives ranging in tone from happy

²⁴Gerald E. Aardsma, " 'Pharaohs and Kings' A Biblical Quest?" *The Biblical Chronologist* 2.5 (September/October 1996): 1–10.

²⁵Gerald E. Aardsma, " 'Pharaohs and Kings' A Biblical Quest?" *The Biblical Chronologist* 2.5 (September/October 1996): 4.

applause to adulation—none of the reviewers being chronologists, of course.

Subsequent to my review a friend and subscriber, who was not altogether happy with my appraisal of Rohl's book, sent me a letter containing the following paragraph.

Dear Dr. Aardsma,

Concerning your three guidelines on page 3 of Volume 2 Number 5 for evaluating a book, please forgive me for having trouble with them. All three seem to have an underlying message that "chronological data" must have precedence. Number 1 says an author should have a positive attitude toward this data, 2 says he should give it precedence over a mass of historical facts, and 3 says he should be competent in handling it. Thus I see these three guidelines as one: rely on "chronological data," whatever that is. It's not clear to me what you mean by this term. I have a hard time understanding it as separate from a "mass of historical facts" or archaeological facts or any other knowledge, for that matter. My best guess as to your definition of the term is: the results of radiocarbon dating. I am not ready to hang my conclusions on such dating methods above all other considerations.

Ruth Beechick
Golden, CO

Dear Ruth,

You are right that all three criteria have the same basis, and you are correct in identifying that basis as " 'chronological data' must have precedence". You will recall that discussion of this basis was the central thrust of the "Biblical Chronology 101" article in which the three criteria were initially advanced.²⁶ There I called this basic principle *Rule #1* to stress its importance. Recall:

Rule # 1 *Chronology must precede history.*

By this rule I mean one must get the chronology of events right before any attempt is made to reconstruct history from those events. The three criteria are simply three independent ways of evaluating whether an author is likely to have violated this important rule. They ask: 1) Does the author *want* to give chronological data proper prece-

²⁶Gerald E. Aardsma, "Biblical Chronology 101," *The Biblical Chronologist* 2.3 (May/June 1996): 9–10.

dence?, 2) Does the author *try* to give chronological data proper precedence?, and 3) Is the author *able* to give chronological data proper precedence?

So we agree on the cladistics of my three criteria; your confusion over the distinction between “chronological data” and “a mass of historical facts” is where the problem really lies. This is an important distinction which I have evidently gone over too quickly. Let me attempt to redress this fault by using the following example as a brief review.

Here are some historical facts:

1. On a stormy winter’s night Washington crossed the Delaware, surprised the British at Trenton, and captured 1,000 prisoners.
2. Lincoln’s presidency was marked by bloody conflicts on American soil.
3. In the Emancipation Proclamation Lincoln declared that all slaves in states, or parts of states, that were in rebellion would be free.
4. Kennedy took rapid, strong measures when he learned of a military threat to American cities by a foreign power.
5. Kennedy was shot to death by an assassin as he rode through the streets of Dallas, Texas.
6. Kennedy, Washington, and Lincoln were Presidents of the United States.

Now let me play the role of pseudo-harmonizer’s advocate briefly. Assume we are living about 3,000 years in the future and much of American history has been lost and forgotten, but the truth of the few statements enumerated above has been unequivocally established. Let me reconstruct a little “American history” from these facts. I will indent my effort below to make it clear that it is intended as an example only. (I beg forbearance on the part of my British readers, whom I regard with high esteem and with no admixture of malice.)

Kennedy, Washington, and Lincoln were Presidents of the United States. They took office one after the other in rapid succession. Professor X has suggested that their administrations were dominated by conflict with Britain over the issue of American Independence. Kennedy

was the first to come to power. He took rapid, strong measures when he learned of a military threat to American cities by a foreign power. He was shot to death by an assassin—presumably an agent of the British crown—as he rode through the streets of Dallas, Texas. Britain appears to have taken advantage of the chaos which naturally follows loss of national leadership to flood the country with troops. But in a move which demanded great courage, Washington, Kennedy’s eventual successor, crossed the Delaware, surprised the British at Trenton, and captured 1,000 prisoners—all on a stormy winter’s night. Washington’s vigorous action against the British was evidently insufficient to dislodge them, however, for the tenure of the next President, Lincoln, is also marked by many bloody conflicts on American soil. Indeed, in the Emancipation Proclamation Lincoln declared that all slaves in states, or parts of states, that were in rebellion would be free. This shows that the British had, by Lincoln’s administration, enslaved many Americans. Lincoln’s proclamation was a strong political move—an assertion that the brave people of states which continued in rebellion against the British oppression would ultimately win their freedom.

The normal human reaction to absurdities is to laugh. I hope you have laughed at my reconstruction of “American history” above.

What is it that makes this reconstruction absurd? Please note that it is not a lack of historical facts. Notice that I have included all six of the factual statements enumerated above in my brief, twelve sentence reconstruction. What leads to its absurdity is only that the chronology is all wrong.

Chronological data are definitely different from historical facts. Historical facts deal only with *what* happened. Chronological data deal with *when* things happened.

The recitation of historical facts is not enough to guarantee a factual recitation of history. One can create an infinite number of false histories using historical facts. With so many possibilities to

choose from, it is inevitable that some of these false histories will seem very persuasive. It is hopeless to try to find the truth by picking the “historical reconstruction” that we feel is most persuasive. Only chronological data can accurately unlock the mystery of the past and separate the one, lone, factual reconstruction of history from the infinite number of false histories which can be devised from any assemblage of historical facts.

The chronological data which are needed in the above example can be supplied in a variety of ways: from dated letters written by these Presidents, or contemporary newspaper reports of the actual events, or radiocarbon dates on personal items such as shoes or canes belonging to these Presidents.

Chronological data from written records exist in relative abundance today for these three Presidents. These data quickly reveal that Washington crossed the Delaware on the night of December 25–26 in A.D. 1776; that the Emancipation Proclamation was officially made by Lincoln on January 1, 1863; and that Kennedy was shot on November 22, 1963.

When these chronological data are added to the historical facts enumerated above, my reconstruction of American history quickly collapses. They show that these Presidents did not hold office in the sequence stated, and that they were not contemporaries.

This is the way it always is. Chronological data are death to false reconstructions of history—which is why they are eschewed by so many purveyors of reconstructed “histories”.

You say you do not trust radiocarbon dating. Neither once did I. But I have spent several decades investigating the matter, and I have found that my distrust was misplaced. Modern tree-ring calibrated radiocarbon dates, such as I applied to Rohl’s thesis, have proven themselves to be reliable repeatedly. I hold radiocarbon dating to be a gift from God to those who are really seeking to understand the truth about the past. I believe that any careful, honest study of the facts will ultimately arrive at the same conclusion.

But I have not asked you to put your trust in my experience or evaluation. Nor have I asked you to exercise blind faith in regard to radiocarbon. Note how I applied radiocarbon to Rohl’s

thesis. I did not use it to derive the secular chronology of Egypt. The Egyptologists had already done that using written records entirely independent of radiocarbon. Rohl said the Egyptologists were wrong—that the secular chronology of Egypt should be rearranged to suit his particular reconstruction of the history of Egypt. I used radiocarbon data merely as an independent test of these different chronologies. I found that radiocarbon repeatedly confirmed the chronology the Egyptologists had worked out from their written sources, and refuted the chronology Rohl’s reconstruction required. If radiocarbon was an unreliable dating method, it should not have given clear testimony to either chronology. Yet, in fact, it sided repeatedly and unequivocally with the Egyptologists and against Rohl.

I created a laughable absurdity from American history by making Kennedy a contemporary of Washington. Note that this is a chronological error of only 200 years. Rohl has made Ramesses II to be a contemporary of Rehoboam—a chronological error of over 300 years. Should conservative Christians applaud?

Gerald E. Aardsma, Ph.D.

Loda, IL

The Biblical Chronologist is a bimonthly subscription newsletter about Biblical chronology. It is written and edited by Gerald E. Aardsma, a Ph.D. scientist (nuclear physics) with special background in radioisotopic dating methods such as radiocarbon. *The Biblical Chronologist* has a threefold purpose:

1. to encourage, enrich, and strengthen the faith of conservative Christians through instruction in Biblical chronology,
2. to foster informed, up-to-date, scholarly research in this vital field within the conservative Christian community, and
3. to communicate current developments and discoveries in Biblical chronology in an easily understood manner.

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