A Reassessment of Scientific Evidence for the Exodus and Conquest

Alan Dickin

Abstract: Archaeological evidence records the sacking of the city of Jericho, but radiocarbon dating of this event puts it much earlier than the generally accepted dates for the exodus of the Israelites from Egypt. Since the Bible claims that Jericho was destroyed forty years after the exodus, this discrepancy has led most scholars to question the historicity of the biblical account. Many have concluded that the exodus from Egypt and the Israelite conquest of Canaan were not real events. Surprisingly, radiocarbon dating of the Late Bronze Age is also in question, because at several critical sites such as Akrotiri, Avaris, and Jericho, radiocarbon ages are consistently older than dates from pottery stratigraphy. These discrepancies are a huge problem for both biblical and secular archaeology. On the one hand, there is a lack of evidence to support the historicity of the biblical account; on the other hand, secular archaeologists have failed to explain the Middle Bronze Age "collapse" in Canaan, of which the fall of Jericho was a part. This paper reviews radiocarbon constraints for several important sites, and concludes that the coherence of biblical and archaeological accounts would be greatly improved by adopting an early sixteenth-century date for the biblical exodus.

Keywords: Avaris; Jericho; Middle Bronze Age; radiocarbon dating; Thera

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The exodus of the Israelites from Egypt is one of the most important narratives of the Old Testament. It is pivotal to Jewish faith, since the Law itself was given at Sinai, shortly after the exodus. The event is also pivotal for Christian faith, since Jesus identified himself as the Passover Lamb whose sacrifice would save all believers. Traditionally, the biblical exodus was regarded as a historical event, but according to the Documentary Hypothesis the book of Exodus was not assembled until the Jewish exile in Babylon at the earliest.[1] This has led many scholars to wonder how much of a historical nucleus in the Exodus account might actually be original.[2]

With the development of scientific archaeology in the early twentieth century, William F. Albright saw the opportunity to test and hopefully verify the Old Testament as a largely historical account of the origins of Israel.[3] Hence, the discipline of Biblical Archaeology was conceived, and for a while it appeared to deliver on Albright's expectations.[4] However, as scientific evidence accumulated, conflicts with the biblical record began to appear, and one of the main areas of disagreement was the biblical account of the exodus and conquest.[5] These difficulties have now become so great that many scholars doubt that the exodus occurred in the form described in the Bible, and even those who believe it happened disagree about its timing.[6]

Amongst those who believe in a real historical exodus there are two main scholarly camps, arguing for either an early or a late exodus.[7] One faction argues for an early exodus, at about 1450 BC, during the

1 Thomas B. Dozeman, *Exodus* (Grand Rapids, MI: Wm. B. Eerdmans Publishing, 2009), 25–30.

2 Terence E. Fretheim, *Exodus: A Bible Commentary for Teaching and Preaching* (Louisville, KY: John Knox Press, 1991), 6–9.

3 Thomas W. Davis, *Shifting Sands: The Rise and Fall of Biblical Archaeology* (Oxford University Press, 2004), 85.

4 Davis, *Shifting Sands*, 95–122.

5 William G. Dever, "Biblical Theology and Biblical Archaeology: An Appreciation of G. Ernest Wright," *Harvard Theological Review* 73:1–2 (1980): 1–15.

6 Graham I. Davies, "Was There an Exodus?" in *In Search of Pre-Exilic Israel*, ed. John Day (London: Bloomsbury, 2004): 23–40.

7 Lawrence T. Geraty, "Exodus Dates and Theories," in *Israel's Exodus in Transdisciplinary Perspective: Text, Archaeology, Culture, and Geoscience*, ed. Thomas E. Levy et al. (New York: Springer, 2015): 55–64.

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Egyptian eighteenth dynasty. The other argues for a later one, at about 1250 BC, during the nineteenth dynasty.[8]

According to the biblical books of Exodus and Joshua, the Israelites invaded Canaan forty years after the exodus from Egypt, and by far the most important of the early conquests was the battle of Jericho. Joshua 6 claims that the walls of Jericho fell down after the Israelites marched round them for seven days, and having taken the city they burned it to the ground. Joshua then cursed the city, saying that its rebuilder would pay with his sons' lives. Hence, this account should provide an ideal archaeological dating target: evidence for the collapse of the city walls, followed by the burning of the whole city, and a long period of abandonment.

When major archaeological excavations were carried out at Jericho in the 1930s, the evidence initially appeared consistent with the biblical account based on an early exodus. Thus, it appeared that the city walls had indeed fallen down, followed by the burning of the city, and this event was dated to around 1400 BC based on pottery stratigraphy.[9] However, when Kathleen Kenyon excavated Jericho in the 1950s, she reinterpreted the pottery dating evidence, arguing that the destruction occurred about 150 years earlier, around 1550 BC.[10]

Some evangelical authors have attempted to rescue the situation by arguing that the Israelite conquest of Jericho does not correspond to the destruction event excavated by Kenyon, but to a much later event (in the late thirteenth century BC), following the late exodus mentioned above. For example, Kenneth Kitchen argued that the Israelites destroyed a Late Bronze Age city, but the debris was removed by erosion. He even suggested that the remains might be buried under the modern road.[11] However, Kenyon excavated 20m upslope from the

8 Mark D. Janzen et al., *Five Views on the Exodus: Historicity, Chronology, and Theological Implications* (Grand Rapids, MI: Zondervan Academic, 2021).

9 John Garstang, "A Third Season at Jericho: City and Necropolis," *Palestine Exploration Quarterly* 64:3 (1932): 149–153.

10 Kathleen M. Kenyon, *Digging Up Jericho: The Results of the Jericho Excavations, 1952–1956* (London: Praeger and Benn, 1957), 261–262.

11 Kenneth A. Kitchen, *On the Reliability of the Old Testament* (Grand Rapids, MI: Eerdmans, 2003), 187.

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road (inside the city), and found that Iron Age deposits lay directly on eroded Middle Bronze Age levels, revealing no evidence for Kitchen's proposed Late Bronze Age destruction layer.[12] Alternatively, others have argued that Late Bronze Age Jericho was not a city at all, since the Hebrew word used to describe Jericho as a city (*iyr*) can also mean a military fort. As an example of such usage, Richard Hess argued that the "City of David" is equated with the "fortress of Zion" in 2 Samuel 5:7–9.[13] However this is misleading because the City of David was a real city, not just a fortress, as spelled out by Josephus.[14] In fact, there are 1089 usages of the Hebrew word *iyr* in the Old Testament, the great majority of which are translated as "city" or "town," so this argument is actually quite weak.

Further serious problems with the late date exodus arise from the poor fit of the biblical account to the history of the nineteenth dynasty. For example, if the Israelites were enslaved for many years to build the store city of Rameses (Exodus 1:11), it could have been during the long reign of Rameses II. But the exodus reportedly occurred *after* the death of the pharaoh of the enslavement (Exodus 2:23), implying that it occurred during the reign of his son Merneptah (= Merenptah). However, the "stele of Merneptah" describes the Israelites as being already in Canaan by the fifth year of Merneptah's reign, so this chronology does not work.[15]

These contradictions represent a huge problem for the historicity of early Israel, and a major embarrassment for the discipline of Biblical Archaeology. In fact, the problem is so bad that most scholars of Middle Eastern archaeology no longer believe the biblical account of the exodus and conquest, whereas many Bible believers have given

12 Kathleen M. Kenyon, "Excavations at Jericho, 1957–58," *Palestine Exploration Quarterly* 92:2 (1960): 88–113.

13 Ricard S. Hess, "The Jericho and Ai of the Book of Joshua," in *Critical Issues in Early Israelite History*, ed. Richard S. Hess et al. (Winona Lake, IN: Eisenbrauns, 2008), 33–46.

14 Flavius Josephus, *Antiquities of the Jews* 7.3.2, in *The Works of Josephus*, trans. William Whiston (Peabody, MA: Hendrickson Publishers, 1987).

15 Michael G. Hasel, "Israel in the Merneptah Stela," *Bulletin of the American Schools of Oriental Research* 296:1 (1994): 45–61.

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up trying to solve the scientific problem and have fallen back on justifications of the exodus from a faith basis alone.[16]

An alternative solution to the problem of the exodus was proposed by Hendrik Bruins and Johannes Van Der Plicht,[17] but although their paper has been cited more than fifty times in the scholarly literature, it has been given little credence by archaeologists. Bruins and Van Der Plicht argued that the Israelite exodus actually occurred around 150 years before the so-called early date discussed above, and coincided with the eruption of Thera volcano (Santorini). This eruption arguably created such a thick dust cloud that it led to “darkness that could be felt” in Egypt for three days (Exodus 10:21). Bruins and Van Der Plicht argued that this event dates the exodus to around 1630 BC, so that after a forty-year period in the wilderness the Israelites would have sacked Jericho around 1590 BC. This age agreed with preliminary radiocarbon dating of the Jericho destruction layer to the early sixteenth century BC.[18] However, radiocarbon dating of the Thera eruption is in considerable doubt, because a date nearly a hundred years later has also been proposed. This younger date is based on correlations between Late Minoan pottery buried under the ash at Akrotiri and pottery from the palace of Knossos in Crete.[19] This Cretan pottery was itself correlated with the eighteenth dynasty in Egypt, beginning after 1550 BC.[20]

Archaeological excavations at the ancient Egyptian city of Avaris (modern Tell el-Daba) in the Nile Delta may also constrain the date of the exodus, since Avaris was the capital of the Semitic Hyksos dynasty, and has been associated with the Israelite sojourn in Egypt since the

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16 William G. Dever, “Is There Any Archaeological Evidence for the Exodus?” in *Exodus: The Egyptian Evidence,* ed. Ernest S. Frerichs and Leonard H. Lesko (Winona Lake, IN: Eisenbrauns, 1997): 67–86.

17 Hendrik J. Bruins and Johannes Van Der Plicht, “The Exodus Enigma,” *Nature* 382:6588 (1996): 213–214.

18 Hendrik J. Bruins and Johannes Van Der Plicht, “Tell es-Sultan (Jericho): Radiocarbon Results of Short-Lived Cereal and Multiyear Charcoal Samples from the End of the Middle Bronze Age,” *Radiocarbon* 37:2 (1995): 213–220.

19 Denys L. Page, *The Santorini Volcano and the Desolation of Minoan Crete* (London: Society for the Promotion of Hellenic Studies, 1970), 1–44.

20 Vronwy Hankey and Peter Warren, “The Absolute Chronology of the Aegean Late Bronze Age,” *Bulletin of the Institute of Classical Studies* 21 (1974): 142–152.

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time of Josephus.[21] This theory is based on the location of Avaris in the immediate vicinity of the later city of Rameses mentioned in Exodus. Avaris suffered an "abandonment" event around the same time as the Thera eruption, which might be correlated with the departure of the Israelites. However, the chronology of the Avaris archaeological section is also disputed.[22]

Part of the background to this problem is a perceived (or real) lack of reliability of radiocarbon dating in the period in question, which is generally described as the transition from the Middle to Late Bronze Age, around 1550 BC. However, recent improvements in the radiocarbon calibration curve during this period should dispel these uncertainties. They are the justification for revisiting this problem here, with the hope of resolving some of the dating issues.

Radiocarbon Dating in the Mid/Late Bronze Age

Radiocarbon dating is a mature technology, and normally we expect the results to be consistent (within analytical error) with other well-dated material contexts in the archaeological record. Unfortunately, there are several instances in the Mid/Late Bronze age where this is apparently not the case. The problem arises from two principal considerations. The first is that within this period, other dating methods (such as those based on king lists) appear sufficiently precise to challenge radiocarbon dating, but not sufficiently accurate to allow dating certainty (as we might claim for many dates AD). The second factor arises from the process of radiocarbon age calibration, which leads to variable and uncertain degrees of historical accuracy, even for analytically precise dates. This problem needs to be carefully understood before we can evaluate radiocarbon dates critically.

It is a fundamental premise of modern radiocarbon analysis that the dating procedure is done in two stages: a first analytical stage to

21 Flavius Josephus, *Antiquities of the Jews* 2.15:2.

22 Walter Kutschera et al. "The Chronology of Tell el-Daba: A Crucial Meeting Point of ^{14}C Dating, Archaeology, and Egyptology in the 2nd Millennium BC," *Radiocarbon* 54:3–4 (2012): 407–422.

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determine a "conventional" age "before present" (BP), and a second calibration stage where the conventional age is translated into a calibrated age, usually expressed as BC or AD. The calibration stage is not a simple process, because the past production of atmospheric radiocarbon (the starting point for the dating procedure) varied through time.[23] Radiocarbon production is from the flux of galactic cosmic rays reaching the earth and colliding with air molecules to produce neutrons. After being slowed by collisions, these neutrons can be absorbed by atmospheric nitrogen atoms to produce radiocarbon (C–14). Although the flux of galactic cosmic rays is expected to be constant, it is modulated by variable deflection away from the earth by the solar wind.

Two separate processes control the solar modulation of galactic cosmic rays. The first is the variable activity of the sun itself, which is inversely related to the number of sunspots. The second is the earth's geomagnetic field, which partially deflects the solar wind and therefore affects the penetration of galactic cosmic rays. The solar intensity cycle follows the well-known eleven-year sunspot cycle, but this cycle is superimposed on longer-term changes in solar activity lasting for tens to hundreds of years. In turn, geomagnetic field variations occur over hundreds to thousands of years. The combined result is the complex curve seen in Figure 1, which shows past atmospheric C–14 activity relative to 1950s wood, expressed as the delta function (parts per thousand deviations).

Although Figure 1 displays the actual variation of atmospheric C–14 activity through time, for dating purposes it is more useful to plot the same data on a graph of conventional radiocarbon age versus calendar age (Figure 2). If there were no atmospheric C–14 variations, the result would be a smooth curve with negative slope. On the other hand, the wiggles are caused by atmospheric C–14 activity variations through time, as discussed above.

23 Alan P. Dickin, *Radiogenic Isotope Geology* (Cambridge University Press, 2018), 366.

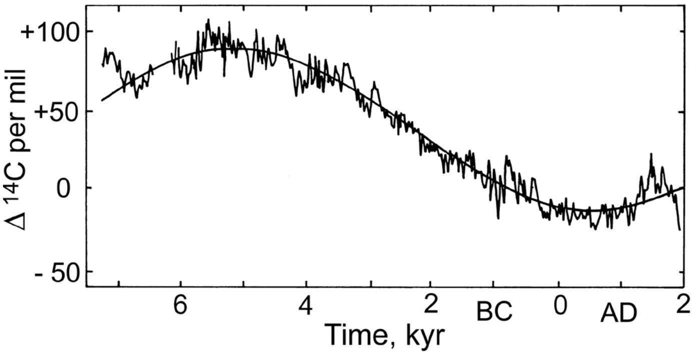

Figure 1. Changes in atmospheric C–14 activity in the last 9000 years, presented in the form of isotopic fractionation per mil, based on Bristlecone Pine and European Oak chronologies. (The smooth sine wave was an approximation later proved wrong). After Bruns et al.[24]

Some of these wiggles reinforce the effect from radiocarbon decay, increasing the negative slope. For example, a conventional radiocarbon age of 3250 years BP intersects a steep segment of the curve (see arrow in Figure 2). Because it intersects a steep section, the calibrated age for this sample would be precise, yielding a reliable result with a small error. However, a conventional age of 3350 years BP yields a very different result.

This age intersects a section of the calibration curve with several wiggles in a sub-horizontal segment. Bearing in mind the analytical uncertainty represented by the Poisson distribution on the left, the probability function for the calibrated age is complex (black distribution), with a large uncertainty from ca 1530 to 1690 BC.

24 Michael Bruns et al., "The atmospheric ^{14}C level in the 7th Millennium BC," in *Proceedings of the First International Symposium* ^{14}C *and Archaeology, Groningen, 1981*, vol. 8 (1983): 511–516.

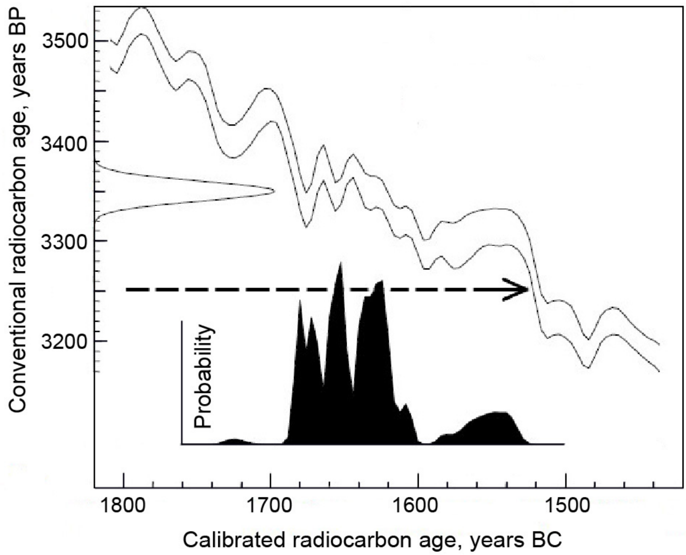

Figure 2. Plot of the IntCal 1998 radiocarbon calibration curve for the Mid/Late Bronze Age, showing the effect of wiggles on C–14 age calibration. Modified after Bronk Ramsey et al.[25]

To help solve the complex nonlinear process of radiocarbon age calibration, Bayesian analysis was introduced into radiocarbon dating.[26] As well as handling the nonlinear calibration process, Bayesian analysis also allows the use of additional dating constraints to reduce the uncertainties of calibrated ages. These additional constraints, called "priors," are particularly important for calibrating stratigraphic sequences of dated objects. By insisting that the resulting radiocarbon ages must be in chronological order, the procedure allows good quality calibrated ages to be determined, even from a "bad" section of the calibration curve, provided the sequence is long enough to span several wiggles.

25 Christopher Bronk Ramsey et al., "Dating the Volcanic Eruption at Thera," *Radiocarbon* 46:1 (2004): 325–344.

26 Caitlin E Buck et al., "Calibration of Radiocarbon Results Pertaining to Related Archaeological Events," *Journal of Archaeological Science* 19:5 (1992): 497–512.

Of course, the process is carried out by a computer program, of which the Oxcal package is one of the most used.[27] The only disadvantage is a tendency for Bayesian analysis to be a "black box" process that yields little intuitive evidence for the robustness of the resulting ages. For this reason, the age calibrations discussed below will be analysed using the calibration curve alone, in order to give a better visual impression of the reliability of different age results.

Dating the Thera Eruption

As noted above, Bruins and Van Der Plicht proposed an earlier date for the Exodus, in the late seventeenth century BC, based on the possibility that it was connected with the eruption of the Thera (Santorini) volcano. However, radiocarbon ages for the Thera eruption are in conflict with pottery-dating evidence, causing this to become something of a test case for the accuracy of radiocarbon dating.

In fact, "pottery stratigraphy" was the original means of dating the eruption, so when radiocarbon dating gave ages about one hundred years older, they were greeted with suspicion.[28] However, additional radiocarbon measurements generally supported the older dates. For example, Bronk Ramsey and coworkers presented sixteen radiocarbon dates for charred seeds from the volcanic destruction layer at Akrotiri.[29] These data gave a conventional radiocarbon age of 3350 +/– 20 years before present, yielding the calibrated age probabilities (black shading) shown in Figure 2. Because the charred seeds could only be a few months or years old when they were carbonised by the eruption, this avoids a common problem with dating charcoal, which can be from timber many decades older than the destruction layer. Therefore, Bronk Ramsey and coworkers assessed a high probability that the

27 Christopher Bronk Ramsey, "Radiocarbon Calibration and Analysis of Stratigraphy: The OxCal Program," *Radiocarbon* 37:2 (1995): 425–430.

28 Philip P. Betancourt and Gail A. Weinstein, "Carbon–14 and the Beginning of the Late Bronze Age in the Aegean," *American Journal of Archaeology* 80:4 (1976): 329–348.

29 Bronk Ramsey et al., "Dating the Volcanic Eruption at Thera," 326.

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eruption occurred in the late seventeenth century. However, several other researchers have suggested reasons why the radiocarbon age might have been overestimated.

These objections principally concern the reliability of the calibration process, based on several different factors. Firstly, there were suggestions that the calibration curve in the Mid/Late Bronze Age might be inaccurate due to reliance on older (pre accelerator-based) radiocarbon analyses.[30] Therefore, attempts were made to improve the quality of the calibration curve in this period, based on the analysis of single annual growth bands from dendrochronologically dated Bristlecone Pine and European Oak sample sequences.[31] These new samples were used in the 2020 international calibration exercise (IntCal 2020), and were found to cause substantial increases in the apparent age of the calibration curve in the interval of interest (Figure 3). The most dramatic change is the removal of the low wiggly part of the curve between 1650 and 1690 BC. The resulting probability distribution (pale pink shading) greatly reduces the likelihood of calibrated Thera ages over 1650 BC, relative to IntCal 1998. The new calibration also creates a steeper section of the curve between 1640 and 1610 BC, which will have important implications for new dating approaches to be described below.

Although the new international calibration is clearly important, we also need to examine whether various more localised effects could have perturbed the radiocarbon signature of the Mediterranean atmosphere relative to the international curve. The IntCal curve is based on worldwide (Northern Hemisphere) averaging of tree-ring data, assuming global atmospheric radiocarbon homogenisation. The evidence for this homogenisation comes from analyses of atmospheric C–14 in the months and years after the atmospheric nuclear tests of the early 1960s, which indicated worldwide atmospheric homogenisation within three

30 Johannes Van Der Plicht et al., "Recent Developments in Calibration for Archaeological and Environmental Samples," *Radiocarbon* 62:4 (2020): 1095–1117.

31 Charlotte L. Pearson et al. "Annual Radiocarbon Record Indicates 16th Century BCE Date for the Thera Eruption," *Science Advances* 4:8 (2018): eaar8241.

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years.[32] However, it has been suggested that local atmospheric contamination effects could have perturbed the global record.

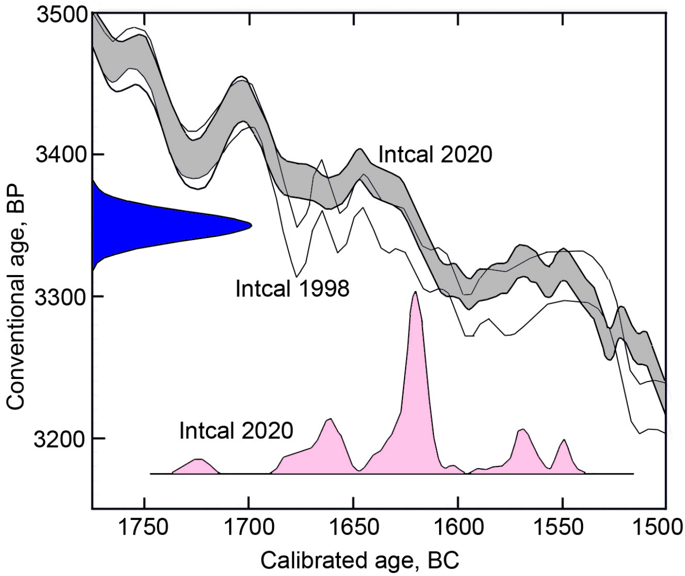

Figure 3. Comparison of the IntCal 1998 and 2020 calibration curves, showing the probability distribution of calibrated ages (pale pink shading) for a 3350 BP conventional age using the more recent curve. Modified after Van Der Plicht et al. (2020).

Firstly, it was argued that the volcanic eruption, which was doubtlessly preceded by fumarole activity, might have polluted the local atmosphere with volcanic carbon dioxide carrying "dead" radiocarbon, thus increasing apparent C–14 ages by an unknown amount.[33] Such a criticism might have applied to the early radiocarbon data, which were quite noisy, possibly reflecting local perturbation effects. However, it is

32 Willard F. Libby, "Ruminations on Radiocarbon Dating," in *Radiocarbon Variations and Absolute Chronology: Proc. 12th Nobel Symp.*, ed. I. U. Olsson (Wiley, 1970): 629–640.

33 Malcolm H. Wiener, "Problems in the Measurement, Calibration, Analysis, and Communication of Radiocarbon Dates (with Special Reference to the Prehistory of the Aegean World)," *Radiocarbon* 54:3–4 (2012): 423–434.

very hard to see how volcanic CO_2 could have perturbed the much more consistent data of the past twenty years.[34] A more serious objection is that the global calibration curve might not be representative of local interactions between vegetation and radiocarbon in the Mediterranean atmosphere. For example, global homogenisation of radiocarbon within a few years does not preclude seasonal changes in atmospheric radiocarbon, which might lead to offsets in radiocarbon activity in different kinds of plants, if they have different growing seasons. To test this possibility, Michael Dee and coworkers analysed short-lived plant specimens of known age collected over the past three hundred years in Egypt.[35] They found an offset of about 20 years between the radiocarbon ages and collection dates, implying that such an offset might also have affected ancient samples.

To test this effect for the period of interest concerning the Thera eruption, some labs, most notably the Arizona radiocarbon lab, established local Mediterranean calibration curves for the Mid/Late Bronze Age. These curves imply that indeed there might be local offsets within the period of interest, even from the IntCal 2020 curve. In line with the data for the recent Egyptian samples, the new Mid/Late Bronze Age calibration for the eastern Mediterranean suggests a fourteen-year increase in the apparent age of the calibration curve, relative to IntCal 2020.[36] The result is that the best fit curve for the regional calibration now runs almost exactly along the upper envelope of the IntCal 2020 uncertainty band (Figure 3). We do not need to reprocess the data completely in order to see the expected result of this change on the Thera data discussed above: the effect is to reduce further the likelihood of calibrated age-peaks above 1650 BC, and correspondingly to increase the likelihood of calibrated ages below 1600 BC. This

34 Sturt W. Manning et al., "Chronology for the Aegean Late Bronze Age 1700–1400 BC," *Science* 312:5773 (2006): 565–569.

35 Michael W. Dee et al., "Investigating the Likelihood of a Reservoir Offset in the Radiocarbon Record for Ancient Egypt," *Journal of Archaeological Science* 37:4 (2010): 687–693.

36 Charlotte Pearson et al., "Olive Shrub Buried on Therasia Supports a Mid–16th Century BCE Date for the Thera Eruption," *Scientific Reports* 13:1 (2023): 6994.

means that, based on a single conventional age such as the one shown in Figure 3, it is impossible to achieve a precise calibrated age for the Thera eruption, due to the long plateau in the calibration curve between 1610 and 1550 BC.

Dating Thera Olive Branches

This is clearly an unsatisfactory situation, but it can be overcome by dating samples with internal age structure spanning a known period, such as pieces of wood with many annual growth rings. For such a sample, the outer (bark) layer dates the destruction event when the tree died, but the inner tree rings are several decades older, and can therefore "anchor" the radiocarbon age of the bark to a steep part of the calibration curve that gives precise calibrated ages. In the case of Thera, this means analysing wood from a tree that was actually alive when the eruption occurred.

Such a sample was obtained by Walter Friedrich and coworkers from the branch of an olive tree, found in situ within the ash deposit of the volcano near the top of the caldera wall on the island of Thera.[37] Since the branch is "suspended" within the tephra layer, it cannot represent dead wood lying on the pre-eruption land surface. It must have been standing, and the fact that dead leaves were found below the ash layer under the tree suggests that the tree (and another one nearby) were still alive when the eruption began (unfortunately the leaves were too small for radiocarbon analysis).[38] Friedrich et al. cut a section of the branch into four contiguous blocks, spanning an estimated seventy-two years of annual rings, identified by X–ray tomography. The resulting "floating sequence" of conventional radiocarbon ages was a good fit to the IntCal 1998 curve, but a bad fit to the IntCal 2020 curve and the new Mediterranean calibration curve in Figure 4a (open symbols).

37 Walter L. Friedrich et al., "Santorini Eruption Radiocarbon Dated to 1627–1600 BC," *Science* 312:5773 (2006): 548–548.

38 Jan Heinemeier et al., "The Minoan Eruption of Santorini Radiocarbon Dated by An Olive Tree Buried by the Eruption," *Antiquity* 88:339 (2014): 285–293.

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Other researchers disputed the ability of Friedrich et al. to count annual growth bands in olive wood, due to the weak seasonality of Mediterranean growing conditions.[39] In response, Friedrich suggested that since the four analysed sample blocks were contiguous, their conventional ages could be directly fitted to the new calibration curve, ignoring the counted "annual" rings.[40] The result of this procedure is shown by the solid symbols in Figure 4a. The four radiocarbon analyses define a good fit to one of the few straight sections of the calibration curve, firmly anchoring the youngest of the wood samples, so that its bark surface (arrow) defines a calendar age of 1608 (+/– 10 years) BC. However, the age span of the blocks calculated in this way (twenty-three years on the x-axis) is less than a third of the seventy-two rings estimated by X–ray analysis of the wood.[41]

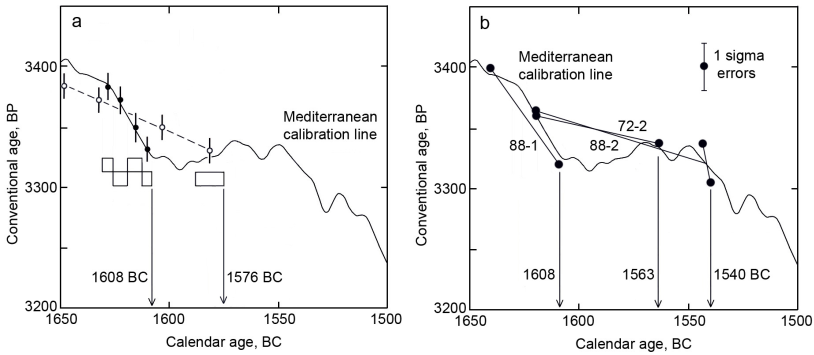

Figure 4. Attempted fitting of floating radiocarbon data sets for olive branches from (a) Thera and (b) Santorini, relative to the latest eastern Mediterranean calibration curve of Pearson et al. (2023).

To test these results, Pearson et al. analysed branches from an "olive shrub" on the island of Santorini that was buried under the same ash

39 Paolo Cherubini et al., "The Olive-Branch Dating of the Santorini Eruption," *Antiquity* 88:339 (2014): 267–273.

40 Walter L. Friedrich et al., "The Olive Branch Chronology Stands Irrespective of Tree-Ring Counting," *Antiquity* 88:339 (2014): 274–277.

41 Friedrich et al., "The Olive Branch Chronology," 548.

deposit.[42] Samples were collected from the central and outer tree-rings of four branches, but only three of the pairs gave a usable spread of conventional ages for fitting to the calibration curve. Results for the three usable branches are plotted in Figure 4b. In all three cases, conventional ages for the core of the branch can be anchored in the steep section of the calibration curve (> 1610 BC). Then, based on counted "annual" rings, calibrated ages can be determined for the outermost/bark layer for the three branches, yielding ages of ca 1540, 1563, and 1608 BC (Figure 4b). Clearly, these ages are in substantial disagreement, but before discussing them further it is helpful to examine ice-core evidence from polar regions.

Ice Core Records of Volcanic Eruptions

Since large explosive eruptions such as Thera launch dust and aerosols into the stratosphere, these materials can be distributed globally and then accumulated in ice cores from Greenland and Antarctica. In both locations, drill cores through the ice can be dated to individual calendar years based on ice stratigraphy, a method analogous to dendrochronology. A few dozen "event horizons" have been identified for the past few thousand years, based on concentrations of sulphate aerosols (Figure 5).[43] The largest of these sulphate deposits in the period of interest, at 1628 BC, had previously been speculatively linked with the Thera eruption, and also with a poor growth year in Irish dendrochronology records.[44] However, analysis of dust from the 1628 BC horizon showed that this signal was actually caused by the eruption of an Aleutian volcano, Aniakchak. A link between Thera and the second-largest signal (at 1654 BC, Figure 5) can also be excluded, because radiocarbon dating of Thera-related tsunami debris from SW Turkey gives a maxi-

42 Pearson et al., "Olive Shrub Buried on Therasia," 6994.

43 Charlotte Pearson et al., "Geochemical Ice-Core Constraints on the Timing and Climatic Impact of Aniakchak II (1628 BCE) and Thera (Minoan) Volcanic Eruptions," *PNAS nexus* 1:2 (2022): pgac048.

44 Michael G. L. Baillie and Mackenzie A. R. Munro, "Irish Tree Rings, Santorini, and Volcanic Dust Veils," *Nature* 332:6162 (1988): 344–346.

mum age of 1612 BC for the eruption.[45] However, one of several smaller sulphate horizons in Figure 5 might be correlated with the Thera eruption.

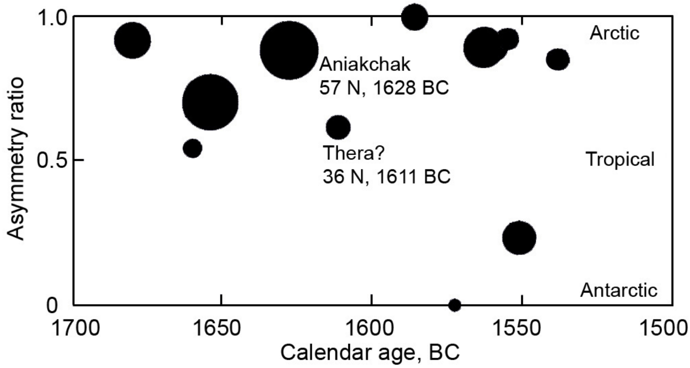

Figure 5. Black spheres representing the relative sizes of sulphate aerosol deposits in polar ice cores are plotted against ice core stratigraphic ages for the late Middle Bronze Age. The "asymmetry ratio" plotted on the y-axis is discussed in the text. Modified after Pearson et al. (2022).

To provide further constraints on the possible sources of sulphate signals in Greenland and Antarctic ice cores, Pearson et al. developed an index they termed the "asymmetry ratio" (AR), plotted on the y-axis in Figure 5. This AR index expresses the relative magnitude of sulphate horizons observed in three Greenland ice cores relative to two Antarctic cores. The AR index is a rough guide to the latitude of the eruption, such that values near unity indicate Arctic events, values near zero indicate the Antarctic, while intermediate values indicate tropical eruptions. However, the direction of volcanic ejecta lofting may have affected these values. For example, Aniakchak has a larger AR value than we might expect from its latitude of 57 N, but the distribution of

45 Vasif Şahoğlu et al., "Volcanic Ash, Victims, and Tsunami Debris from the Late Bronze Age Thera Eruption Discovered at Çeşme-Bağlararası (Turkey)," *Proceedings of the National Academy of Sciences* 119:1 (2022): e2114213118.

its ash deposits indicates a strong northward trajectory of the eruption products.[46] This would have fed material directly into the Canadian Arctic jet stream, to be directly deposited in Greenland. In turn, Thera ash deposits indicate an easterly ejecta plume,[47] which would most likely have fed into the Middle Eastern jet stream.[48] This would have distributed aerosols more globally, generating a relatively low AR value, consistent with the 1611 eruption in Figure 5. In fact, the 1611 event is the only one after 1650 BC that has a signature consistent with a Mediterranean (subtropical) eruption, whereas the other eruptions all have Arctic or Southern Hemisphere signatures.

For the data of Friedrich et al. (Figure 4a), the 1611 BC ice-core date provides by far the best fit to the radiocarbon data. A model based on the counted rings (open symbols) is excluded by the very bad fit of the third sample block to the calibration curve, thus favouring a direct fit to the calibration curve (solid symbols). This approach was advocated in the 2014 paper by Friedrich et al., suggesting that they were aware of having misjudged the growth banding in their 2006 paper. But the study of Pearson et al. (Figure 4b) suffers from inadequate sampling. Ages from the three different branches support each of the possible ice-core dates for the eruption (ignoring the latitude evidence). However, these cannot be resolved because two-point sampling of each olive branch is not sufficient to provide adequate "wiggle matching" with the calibration curve (compared with other similar investigations).[49] A conclusive test of the data would require the analysis of intermediate samples for branches 72–2 and 88–2 to allow better wiggle matching. In the meantime, the present author considers that the balance of the evidence

46 James Begét et al., "Age, Extent and Climatic Significance of the c. 3400 BP Aniakchak Tephra, Western Alaska, USA," *The Holocene* 2:1 (1992): 51–56.

47 Emma N. Johnston et al., "Reconstructing the Tephra Dispersal Pattern from the Bronze Age Eruption of Santorini Using an Advection–Diffusion Model," *Bulletin of Volcanology* 74 (2012): 1485–1507.

48 Qiaoling Ren et al., "Dynamical Analysis of the Winter Middle East Jet Stream and Comparison with the East Asian and North American Jet Streams," Journal of Climate 35:14 (2022): 4455–4468.

49 Carla S. Hadden et al., "'Approximate' Wiggle-Match Dating Applied to Early American Museum Objects," *Radiocarbon* (2023): 1–14.

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supports the 1611 eruption age. According to the theory of Bruins and Van Der Plicht, this means that the Israelite exodus from Egypt was in 1611, and therefore the sack of Jericho was forty years later, around 1570. However, we need to compare this hypothetical date with evidence from Jericho itself.

The Sack of Jericho

Jericho was excavated in the early twentieth century by Sellin and Watzinger, and the overall structure of the city was confirmed in two subsequent excavation programs, by John Garstang and Kathleen Kenyon. These expeditions showed that Middle Bronze Age Jericho was surrounded by a large stone revetment, on top of which a mud brick wall had been erected. This mud brick wall had evidently suffered a catastrophic collapse, presumably due to a major earthquake event. The city was subsequently consumed by fire, as demonstrated in an excavation trench on the east side of the city, which contained collapsed building material, broken pottery, charcoal, and ash.[50]

In a review of his early twentieth century excavation work, Watzinger dated the destruction event to the Middle Bronze Age (before 1600 BC), whereas Garstang placed it in the Late Bronze Age, around 1400 BC, both based on different interpretations of pottery stratigraphy.[51] Kenyon reversed this assignment back to 1550 BC, also based on pottery evidence, because she considered the newly available radiocarbon method too inaccurate to yield a reliable result.

The pottery evidence is equivocal because it is based on gradual changes in style, which cannot necessarily be dated with a precision of less than a hundred years. For example, Byers et al. acknowledged that

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50 Titus Kennedy, "The Bronze Age Destruction of Jericho, Archaeology, and the Book of Joshua," *Religions* 14:6 (2023): 796.

51 Carl Watzinger, "Zur Chronologie der Schichten von Jericho," *Zeitschrift der Deutschen Morgenländischen Gesellschaft* 80:2/3 (1926): 131–136; John Garstang, "The Date of the Destruction of Jericho," *Palestine Exploration Quarterly* 59:2 (1927): 96–100.

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Middle Bronze III pottery styles continued into Late Bronze I.[52] Nevertheless, there is one type of artefact that can be linked to the reign of individual Egyptian pharaohs, and may therefore give precise historical ages. This is the evidence from Egyptian scarabs. The Egyptian scarab amulet was an artistic representation of a dung beetle, whose flat underside was used as a form of "stamp seal."[53] So-called "royal scarabs" bearing the symbol or name of a specific pharaoh began to appear in the Second Intermediate Period of Egyptian history (ca 1850–1550 BC).[54] However, these scarabs quickly evolved from a personal seal of the pharaoh into a symbol of royal patronage. This trend continued into the New Kingdom (eighteenth to twentieth dynasties) with increasingly widespread royal scarab distribution up until the time of Amenhotep IV (Akhenaten), when the system temporarily collapsed.

With their distribution spreading beyond Egypt, royal scarabs became popular as burial goods in Canaan. Furthermore, because each pharaoh used a consistent design, scarabs found in tomb contexts can be identified with a particular pharaoh, and can therefore provide dating evidence. Specifically, since pharaonic reigns of the New Kingdom can be dated to within about ten years, they provide a maximum age for a burial, corresponding to the beginning of that pharaoh's reign. However, as prized personal items, it is highly unlikely that scarabs deposited as grave goods would date much before the end of a pharaoh's reign, and there is evidence that the scarabs of some long-reigning pharaohs (such as Thutmose III) were produced posthumously.[55] Hence, their incorporation into a tomb context could be many decades after the start-date of the reign in question.

At Jericho, most of the tombs are located outside the city walls. Garstang excavated many such tombs in what he called a necropo-

52 Gary A. Byers et al., "Excavations at Khirbet el-Maqatir: The 2009–2011 Seasons," *Judea and Samaria Research Studies* 25:2 (2016): 69.
53 Regine Schulz, "Seals and Scarabs," in *The Oxford Handbook of Egyptology*, ed. Ian Shaw and Elizabeth Bloxam (Oxford University Press, 2015), 367–408.
54 Kathlyn M. Cooney, "Scarab," *UCLA Encyclopedia of Egyptology* 1:1 (2008).
55 Cooney, "Scarab."

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lis, about 250m west of the city.[56] The more elaborate of these tombs consisted of a shaft about 3m deep, cut through superficial gravel deposits into bedrock, from which a chamber was excavated on one side of the shaft. When the tomb went out of use, the opening of the chamber was blocked with large rocks. However, the contents of the tombs show that they were used over long periods of time, with older disarticulated skeletons being cleared to the sides of the chamber in rough heaps so that space could be created at the front for new interments.[57] The result is that the deposits in each tomb generally lack stratigraphy, and can only provide approximate age ranges for human occupation at Jericho.

Garstang's Tomb 4 is particularly important, as it contained two scarabs of Amenhotep III (Figure 6), whose reign was dated at the time from 1411 to 1385 BC. This led Garstang to argue that the Jericho IV city that ended with a conflagration was occupied up to near the end of the reign of Amenhotep III, probably between 1400 and 1385 BC.[58] Backdating 40 years from these ages led to an estimated date for the exodus between 1440 and 1425 BC. Garstang considered this to be adequately close to the date of 1446 BC that can be derived from 1 Kings 6:1 by adding 480 years to the date of Solomon's temple. This therefore became part of the basis for the early exodus noted above.

An important factor in Garstang's argument was that no seals of Amenhotep IV (Akhenaten) were found in any of the Jericho tombs, making 1385 BC his lower age-limit for the period of occupation. However, it has since been found that production and distribution of royal scarabs declined markedly during the reign of Akhenaten, so the absence of such scarabs from Jericho does not mean that occupation of the site must have ended before his reign.[59]

56 John Garstang, "Jericho, City and Necropolis," *Palestine Exploration Quar*terly 64:3 (1932): 149–153.
57 Kathleen M. Kenyon, "Some Notes on the History of Jericho in the Second Millennium BC," *Palestine Exploration Quarterly* 83:2 (1951): 101–138.
58 John Garstang and J. B. E. Garstang, *The Story of Jericho,* revised edition (London: Marshal & Morgan, 1948), 125.
59 Schulz, "Seals and Scarabs," 396.

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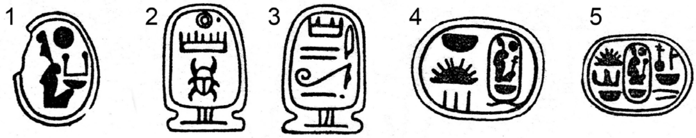

Figure 6. Royal scarabs and seals excavated from Jericho. Modified from Garstang.[60] 1: Hatshepsut; 2: Thutmose III (with throne name); 3: Thutmose III; 4, 5: Amenhotep III (in cartouche).

With subsequent revisions to Egyptian dynastic chronology, the best estimate for the reign of Amenhotep III has been lowered considerably, to 1390–1352 BC.[61] In addition, we must remember that these scarabs are in a mortuary context. They were placed in the tombs of their deceased owners, probably after a lifetime of usage. It is therefore inconceivable that they date from near the beginning of Amenhotep's reign. Hence, far from providing support for the destruction of Jericho by the Israelites in 1406 BC, the Amenhotep III scarabs actually refute this date, by showing that Jericho was occupied fifty years later, around the mid-fourteenth century BC.

If these scarabs do not date the occupation of Jericho before the destruction and conflagration caused by the Israelites, what do they represent? The best clue is given by the Middle Building, which was constructed on top of a talus slope of debris from the earlier destruction of the city. Garstang dated this building to the fourteenth century BC, and attributed it to an Egyptian vassal king, probably Eglon, King of Moab. He is recorded in Judges 3:12–14 as having defeated the Israelites and taken possession of Jericho (the City of Palms).[62] On this basis, Kenyon attributed the post-destruction material found in the tombs to

60 Garstang and Garstang, *The Story of Jericho*, 117.
61 Mark D. Janzen, "The Exodus: Sources, Methodology and Scholarship," in *Five Views on the Exodus: Historicity, Chronology, and Theological Implications*, ed. Mark D. Janzen et al. (Grand Rapids, MI: Zondervan Academic, 2021), 13–24.
62 John Garstang, "The Story of Jericho: Further Light on the Biblical Narrative," *The American Journal of Semitic Languages and Literatures* 58:4 (1941): 368–372.

the reuse of these tombs during the occupation of the Middle Building.[63] However, after a brief occupation (perhaps eighteen years, as described in Judges), Jericho again fell into ruin and was abandoned until the Iron Age.

It has been argued by early exodus advocates that the presence of a Hatshepsut seal in one of the (reused) tombs indicates an earlier (mid-fifteenth century) occupation of the site. The argument is that since most of Hatshepsut's hieroglyphic carvings in Egypt were defaced after her death, her scarabs would no longer have had protective power as amulets after her death, and would therefore have been useless as grave goods. However, this argument is based on a misunderstanding of the nature of the iconoclasm to which Hatshepsut was subjected. Betsy Bryan suggested that Hatshepsut's monuments were not defaced until twenty-five years after her death, implying that this was motivated by the politics of succession (by Amenhotep II, son of Thutmose), and not due to an attempt to erase her role as an Egyptian deity.[64] This suggests that the scarabs of Hatshepsut would still have been valuable as amulets in faraway Jericho well after her death. Therefore, these artefacts do not provide a minimum age for the occupation of the site, but a maximum age (given that time must pass between the veneration of the scarab and the death and interment of its owner). Therefore, since pottery and scarab evidence cannot reliably date the destruction of Jericho, we turn to radiocarbon evidence.

Radiocarbon Evidence from Jericho

Detailed radiocarbon dating of the Mid/Late Bronze Age destruction layer at Jericho was not undertaken until the work of Bruins and Van Der Plicht in 1995. These authors analysed both charcoal and carbonised remains of short-lived plant material, with the resulting conventional radiocarbon ages presented in histogram form in Figure 7.

63 Kenyon, "Some Notes," 261.
64 Betsy M. Bryan, "The 18th Dynasty before the Amarna Period (c.1550–1352 BC)," in *The Oxford History of Ancient Egypt*, ed. Ian Shaw (Oxford University Press, 2000), 241.

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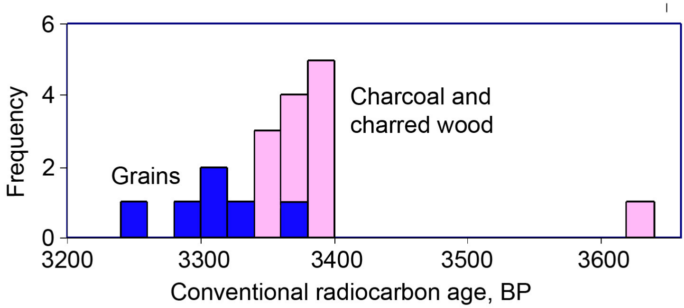

Figure 7. Histogram of conventional radiocarbon ages for carbonised grains and charcoal from Jericho. Data from Bruins and Van Der Plicht.

As discussed above, woody samples can only give accurate ages for a destruction layer if they show evidence of being felled near the time of destruction. However, they are important for testing the results of short-lived material. As such (and omitting the early outlier) the charcoal samples from Jericho are important in yielding a consensus of conventional ages around 3370 BP. Based on its intersection with a steep section of the new Mediterranean calibration curve (Figure 4), this gives the age of the Jericho conflagration a secure upper limit in the late seventeenth century BC.

In comparison, six samples of carbonised grain yielded a consensus of conventional ages around 3300 BP, with an outlier on either side. However, the outliers are within two sigma confidence limits of the mean, suggesting a normal error distribution, so they should be included in the average. A weighted average yielded a conventional age of 3306 +/– 14 years BP at the 95% confidence level (2 sigma).[65] The significance of this result is evaluated in Figure 8, relative to the same Eastern Mediterranean calibration line used for the Thera data (Figure 4).

The conventional age of 3306 years BP is slightly below the long plateau in the calibration curve, yielding a maximum likelihood of cali-

65 Bruins and Van Der Plicht, "Tell es-Sultan (Jericho)," 216.

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brated ages between 1530 and 1540 BC (i.e., 1535 +/– 5 years). However, based on two intersections with low but non-zero likelihood, the possible age range is much wider, and could extend from 1520 to 1600 BC (Figure 8).

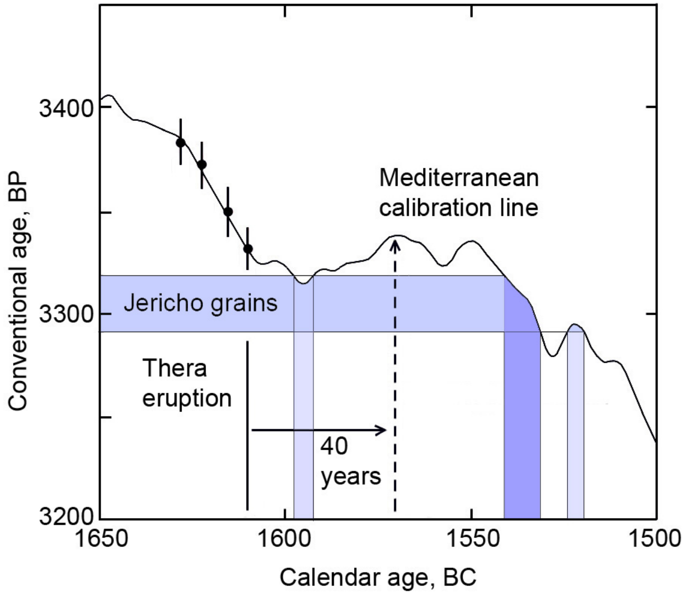

Figure 8. Comparison of the 95% confidence limits for six carbonised grains from the destruction layer at Jericho, relative to the new Mediterranean calibration curve,[66] showing possible calibrated age solutions relative to an age derived from an Israelite exodus at the time of the Thera eruption.

Based on the biblically stated interval of forty years between the exodus and the sack of Jericho, this wider age range would be consistent with an exodus in 1611 BC. However, if we date the sack of Jericho from a hypothetical exodus in 1611 BC, we find that the hypothetical date of 1571 BC coincides with a local age maximum in the calibration curve that is well outside the confidence limits of the Jericho grains

66 Pearson et al., "Olive Shrub Buried on Therasia," 6.

determined by Bruins and Van Der Plicht. This means that the 1611 date for the exodus is relatively unlikely, and the exodus was therefore probably *not* associated with the Thera eruption. On the other hand, based on an age of 1535 for the Jericho destruction layer, we determine a most likely date of 1575 BC for the exodus.

At this point it is necessary to comment on claims that the radiocarbon date of the Jericho destruction layer is unreliable, since other researchers have apparently obtained much less consistent age results.[67] This argument is invalid, because it treats the precise data of Bruins and Van Der Plicht equally with the aberrant data obtained by other researchers. The whole point of the very carefully controlled investigation of Bruins and Van Der Plicht was to exclude such uncertainty. Firstly, a significant number of grain samples (six) were analysed, and the consistency of their data provided internal evidence of their reliability. For example, this consistency excludes the type of occasional low ages measured by other researchers, which are most likely due to contamination of the context and/or the samples themselves.

Secondly, external control was provided by the analysis of wood samples from the destruction layer. Although such samples cannot give accurate ages for the destruction layer itself, they do provide strong circumstantial evidence for the validity of the grain ages. The average conventional age of 3370 BP for this material falls well on the upper steep section of the calibration line (Figure 8), providing a reliable calibrated age of ca 1620 BC. This is 85 years older than the age of the destruction layer obtained from the grains, a difference within the range of excess ages normally obtained from construction timbers.[68] In contrast, the next oldest of the "conventional" scholarly dates for the exodus (1446 BC) leads to a proposed date for the sack of Jericho (1406 BC) that is ca 130 years younger than the calibrated radiocarbon age for the Jericho destruction layer, which is vanishingly unlikely from a scientific point of view.

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67 Kennedy, "The Bronze Age Destruction of Jericho," 14.

68 Michael W. Dee and C. Bronk Ramsey, "High-Precision Bayesian Modeling of Samples Susceptible to Inbuilt Age," *Radiocarbon* 56:1 (2014): 83–94.

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Compared with the high degree of certainty with which a 1446 BC date for the exodus is rejected, the exclusion of the 1611 BC (Thera) date is less certain. However, the effect of Thera in causing the plagues that preceded the exodus can more definitely be excluded. Suggestions of such an association were based on the belief that volcanic ash from Thera would have acidified the waters of the Nile, creating toxic effects for various life-forms.[69] However, studies of the distribution of the Thera ejecta blanket over the eastern Mediterranean show that the main direction of ash dispersal was eastwards (as discussed above) rather than southwards to Egypt. Therefore, the suggestion that the plagues of blood, boils, and animal death were due to the Thera eruption is unlikely, in view of the mismatch in both the age determinations and the ejecta distribution.

The Israelite Sojourn at Avaris

It is important to see how the new proposed date of 1575 BC for the exodus fits into what is known of Egyptian history in the early sixteenth century. To do this, it is first necessary to identify the probable location of the Israelite sojourn in the Egyptian delta region. In the Bible, it is claimed that the Israelite slaves built the Egyptian store cities of Pithom and Rameses (Exodus 1:11). The link with Rameses is one of the major reasons for the popular mid-thirteenth century date for the Exodus (placing the exodus during or after the reign of Rameses II). However, we have seen that this date is completely incompatible with the archaeological evidence from Jericho.

If the exodus occurred around 1575 BC but the Israelites were building a city named after a pharaoh who reigned over 300 years later, this would clearly be an anachronism. However, it is common in the Pentateuch for editorial updates to have substituted a more recent name for an original place name that had gone out of use. For example,

69 Siro I. Trevisanato, "Treatments for Burns in the London Medical Papyrus Show the First Seven Biblical Plagues of Egypt are Coherent with Santorini's Volcanic Fallout," *Medical Hypotheses* 66:1 (2006): 193–196.

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Bryant Wood has shown that when biblical place names were updated, it was more common to replace the older name altogether rather than add the new name to the text in addition to the old one.[70] A case in point is Genesis 47:11, which refers to the "land of Rameses" anachronistically in the time of Joseph.

The original name of the city of Rameses was Avaris, which lies immediately adjacent to the later city.[71] Ancient Avaris (modern Tell el-Daba) has been excavated over many years by an Austrian expedition led by Manfred Bietak.[72] It was a large city on the eastern tributary of the Nile delta, and the capital of Egypt during the Semitic "Hyksos" dynasty in the Second Intermediate Period (SIP) of Egyptian history. However, there is good evidence that Semitic immigration to Avaris began in the twelfth dynasty (late Middle Kingdom), since Semitic burial practices and house architecture are already seen in the oldest (twelfth dynasty) parts of the city. Widespread excavation of the ancient city also shows the establishment of new neighbourhoods during the early SIP, and especially during the Hyksos (fifteenth) dynasty in the second half of the SIP (Figure 9).

Avaris has been divided into excavation horizons based on the usual principle, namely, that the notation begins at the surface and progresses downwards, and therefore moves backwards through time. These excavation levels (C to H in Figure 9) were dated by pottery stratigraphy, leading to the age calibration shown on the left side of Figure 9. However, when a comprehensive radiocarbon dating program was applied to Tell el-Daba, it yielded ages for the same excavation horizons averaging 120 years older than the pottery stratigraphy (right hand side of Figure 9).

70 Bryant G. Wood, "The Biblical Date for the Exodus Is 1446 BC: A Response to James Hoffmeier," *Journal of the Evangelical Theological Society* 50:2 (2007): 249.

71 Manfred Bietak, *Tell el-Dab'a II* (Vienna: Verlag der Österreichischen Akademie der Wissenschaften, 1975).

72 Manfred Bietak, *Houses, palaces and development of social structure in Avaris,* Part I, vol. 60 (Vienna: Verlag der Österreichischen Akademie der Wissenschaften, 2010), 11–68.

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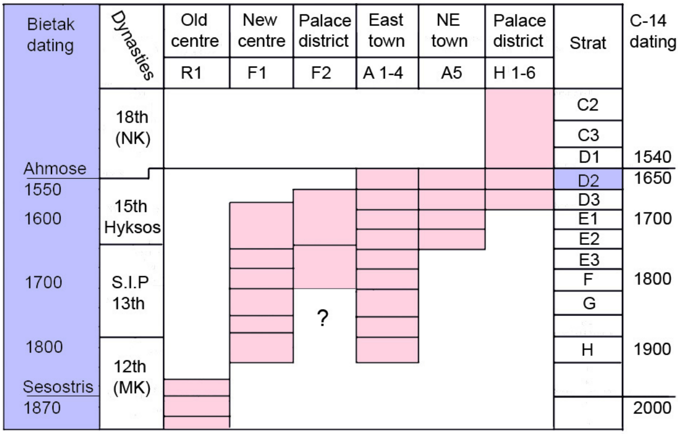

Figure 9. Chronology of Tell el-Daba (Avaris) neighbourhood occupation history based on pottery and radiocarbon dating. MK = Middle Kingdom; NK = New Kingdom. Modified from Bietak.

Bietak has engaged in a "dialogue" with the radiocarbon evidence for several years. However, this "dialogue" is very one-sided, in that it consists of proposing every possible reason why the radiocarbon dates might be wrong, while never questioning the pottery dating stratigraphy. For example, since Bietak was a coauthor of the principal radiocarbon dating paper on Tell el-Daba, the presentation of the radiocarbon evidence seems designed to skew the reader's perception that it is the radiocarbon dates that are anomalous (Figure 7 in their paper).[73] Bietak's real position is revealed by his celebratory tone when it appeared (erroneously) that the radiocarbon evidence was refuted.[74] This impression was principally based on the long saga of dating the Thera eruption, which was argued above to be a test-case for the application

73 Kutschera et al., "The Chronology of Tell el-Daba," 418.

74 Manfred Bietak, "Recent Discussions about the Chronology of the Middle and the Late Bronze Ages in the Eastern Mediterranean: Part II: The End of High Chronology in the Aegean and the Levant?" *Bibliotheca Orientalis* 78:3–4 (2021): 282–318.

of radiocarbon dating to the Mid/Late Bronze Age, including Tell el-Daba. In turn, Bietak's pottery dating stratigraphy makes the unproven assumption that most of the Tell el-Daba excavation levels in Figure 9 had the same thirty-year duration.[75]

The robustness of the radiocarbon dating chronology for Tell el-Daba rests on the application of Bayesian modelling to a sequence of dates on stratigraphically secure samples of short-lived plant material.[76] The use of short-lived material such as carbonised seeds avoids the problem of excess ages derived from samples of old wood. In turn, the use of Bayesian modelling turns a series of short-lived samples into a kind of long floating sequence that can essentially be "wiggle matched" with the calibration curve. This works by specifying that the radiocarbon calibration process must produce dates that are in the correct stratigraphic order.[77] This procedure acts to exclude the extreme age outliers that are otherwise generated as possible solutions to the calibration process. In other words, the wiggles of the calibration curve are turned into a strength rather than a weakness, by using a long radiocarbon sample sequence that spans several of the short-term wiggles in the calibration curve that caused so much trouble for dating the Thera eruption.

The result of this process is the radiocarbon age calibration shown on the right side of Figure 9. However, Bayesian modelling is only as good as the "priors" (i.e., dating constraints) used. These constraints are usually much weaker at the ends of the sequence, resulting in larger calibration uncertainties. Furthermore, there is an additional problem at the top of the sequence, due to errors in the calibration curve itself. Thus, Kutschera et al.[78] used the IntCal 2009 curve, which significantly misrepresented Mediterranean atmospheric radiocarbon at the end of the Middle Bronze Age (ca 1600–1500 BC). The Tell el-Daba data have not yet been recalibrated for the IntCal 2020 curve or

75 Bietak, "Recent Discussions about Chronology," 296.
76 Kutschera et al., "The Chronology of Tell el-Daba," 416–417.
77 Christopher Bronk Ramsey et al., "Radiocarbon-Based Chronology for Dynastic Egypt," *Science* 328:5985 (2010): 1554–1557.
78 Kutschera et al., "The Chronology of Tell el-Daba," 411.

the new Mediterranean calibration line. However, conventional radiocarbon ages for the units above and below the critical "abandonment horizon" can be compared with the calibration line shown in Figures 4 and 8.

The average conventional age for the unit below the abandonment (D2) is 3399 +/– 37 years BP, whereas the average for the units above the abandonment (C2/3 and D1) is 3313 +/– 25 years.[79] Based on the shape of the calibration curve, we can see that the calibrated age for the unit below the abandonment horizon is securely within the seventeenth century (ca. 1650 BC), whereas the most probable date for units above the abandonment is 1540 BC, consistent with the radiocarbon corroborated reign of the first king of the eighteenth dynasty (Ahmose), beginning around 1550 BC.[80] In other words, the radiocarbon data for the top of the Avaris sequence are consistent with the established Egyptian dynastic chronology, but the levels immediately below may be compressed date-wise, contrary to Bietak's assumption of equal durations for each excavation level.

Bietak equated the abandonment of Avaris with the conquest of the Hyksos (fifteenth) dynasty by Ahmose, twenty years into his reign (ca 1530 BC). This is shown by the twenty-year step in the horizontal line (Figure 9) that marks the beginning of the New Kingdom and the abandonment of Avaris. However, no direct linkage is necessary between the Hyksos defeat and the abandonment of Avaris.[81] For example, the "palace district" in the west of the city continued to be occupied after the abandonment of the eastern part of the city. Therefore, large areas of the city could have been abandoned in the early sixteenth century, before the final fall of the Hyksos dynasty around 1530 BC. With this in

79 Kutschera et al., "The Chronology of Tell el-Daba," 412.
80 Bronk Ramsey et al., "Radiocarbon-Based Chronology," 1556.
81 Felix I. Höflmayer et al., "An Early Date for Khyan and Its Implications for Eastern Mediterranean Chronologies," in *The Hyksos Ruler Khyan and the Early Second Intermediate Period in Egypt: Proceedings of the Workshop of the Austrian Archaeological Institute and the Oriental Institute of the University of Chicago, Vienna*, ed. Irene Forstner-Müller and Nadine Moeller (Vienna: Österreichisches Archäologisches Institut, 2014), 159.

mind, the major abandonment of Avaris at the end of horizon D2 could be linked to an Israelite exodus around 1575 BC.

The Pharaoh of the Exodus

Important information about the dynastic history of ancient Egypt comes from Flavius Josephus, quoting from the lost account of Manetho, an Egyptian priest who wrote a summary of Egyptian history in Greek.[82] In this work, Josephus identifies a date for the exodus near the beginning of the New Kingdom (in the eighteenth dynasty), but he also suggests that Manetho's account seems to be contradictory and to some extent fictitious.[83]

Josephus quotes Manetho as saying that Egypt was earlier conquered without a battle by eastern peoples, whom we would call Semitic. He names them as the Hyksos, which he translates as Shepherd Kings or Captive Shepherds. These rulers apparently established a dynasty of six kings who ruled from Avaris in the Nile Delta, reputedly for a total of 254 years.[84] However, Manetho is quoted as saying that the Hyksos had possessions in Egypt for 511 years, which implies that they were living in Egypt before they became its rulers. Although these time periods appear inflated, the overall concept that the Hyksos lived in Egypt for a period of time during the SIP before they established their own (fifteenth) dynasty seems reasonable.

Manetho may have used a source similar to the Turin Canon of kings to obtain his information about the SIP.[85] Unfortunately, the Turin Canon is damaged in the section that describes the Hyksos dynasty. Only one king, Khamudi, is clearly named, and another five entries seem to have been lost. Table 1 gives a reconstruction of the

82 Flavius Josephus, *Against Apion* 1.14, trans. William Whiston (Project Gutenberg EBook).

83 Josephus, *Against Apion* 1.26.

84 Josephus, *Against Apion* 1.14.

85 David A. Aston, "How Early (and How Late) Can Khyan Really Be: An Essay Based on ›Conventional Archaeological Methods‹," in *The Hyksos Ruler Khyan* (2014), 159.

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Hyksos dynasty based on various epigraphic fragments, and shows how this could be related to the account of Manetho and a Semitic source, except that the order in Manetho is based on Sextus Africanus (in Eusebius) rather than Josephus.[86]

Regarding the end of the Hyksos rule, Josephus quotes Manetho as saying that the Egyptian dynasty of Thebes under king Alisphragmuthosis rose up against the Hyksos and confined them to Avaris, after which his son Thummosis laid siege to Avaris (Thummosis is evidently Thutmose—probably Thutmose I). He was apparently unable to take the city, but supposedly negotiated a settlement whereby the Hyksos would leave Egypt and go back to Syria. Manetho supposedly said that 240,000 of the Hyksos left Egypt, and went via the wilderness to Judea, but stopped there because of fear of the Assyrians. This account seems to be based on conflating the Hyksos with the Hebrews, and this is borne out when Josephus quotes Manetho as saying "in another book" that the Hyksos were called Captive Shepherds because they tended sheep, and because their ancestor Joseph had been a captive in Egypt.[87]

	Manetho	**Reign**	**Semitic**	**Epigraphy**	**Turin Canon**
1	Salitis	13	Shara-Dagan	?	-------
2	Bnon	44	Bin-Anu	?	?
3	Apachnan	37	(Apaq)-Hajran	Khyan	?
4	Jannas	50	Jinassi-Ad	Yanassi	?
5	Assis	49	Sikru-Haddu	Seker-Her	?
6	Apophis	61	Apapi	Apophis	?
7	-------		Halmudi	Khamudi	Khamudi
	Total years	254			108

Table 1. Kings of the Hyksos dynasty (and possible reigns) in various sources

86 Thomas Schneider, "The Relative Chronology of the Middle Kingdom and the Hyksos Period (Dyns. 12–17)," in *Ancient Egyptian Chronology*, ed. Erik Hornung (Leiden: Brill, 2006): 168–196.

87 Josephus, *Against Apion* 1.14.

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A way in which this chronology could fit with the biblical account was proposed by John Rea.[88] He suggested that the "king who did not know about Joseph" was at the beginning of the Hyksos (fifteenth) dynasty rather than during the New Kingdom (eighteenth and nineteenth dynasties). He argued that the Hebrew expression in Exodus 1:8 that a new king "arose over Egypt" can have the meaning of "rose against" (e.g., Deuteronomy 28:7 and 2 Samuel 18:31). This may suggest a violent rather than a peaceful transfer of power, consistent with the establishment of a new dynasty. Furthermore, the Hyksos could have had good reason to fear the Israelites (Exodus 1:10), because if the Israelites allied themselves with the Egyptians, they could together have driven out the Hyksos (as the Egyptians eventually did).

Manetho, cited by Josephus, actually accuses the Hyksos of being extremely cruel rulers, and enslaving the population.[89] This description of the Hyksos is usually attributed by scholars to an error by Manetho, whereby he conflated the Hyksos with later cruel Egyptian pharaohs.[90] The logic seems to be that the Hyksos cannot have oppressed the Israelites, since they were both "Asiatics." However, this idea is completely refuted by the Bible's universal anathema against the Canaanites. In fact, if the Canaanite Hyksos attempted genocide against the Israelites in Egypt (Exodus 1:16, 22), the subsequent annihilation of Canaanite cities by the Israelites makes much more sense.

The biblical account of pharaoh's army and possibly the pharaoh himself being drowned in the Sea of Reeds also provides evidence relevant to dating the exodus. According to this account, the pharaoh of the Exodus or his immediate successor are required to be weak kings whose power had been decimated. However, the early 1446 BC date for the exodus falls within the reign of Thutmose III (1479 to 1425 BC), one of the most powerful pharaohs of the eighteenth dynasty. Thutmose

88 John Rea, "The Time of the Oppression and the Exodus," *Bulletin of the Evangelical Theological Society* 3:3 (1960): 58–66.

89 Josephus, *Against Apion* 1.14.

90 Peter Feinman, "The Thirteenth-Century Hyksos/Levite-Led Exodus View," in *Five Views on the Exodus: Historicity, Chronology, and Theological Implications*, ed. Mark D. Janzen (Grand Rapids, MI: Zondervan Academic, 2021), 135–160.

is credited in contemporary inscriptions with several successful invasions of Canaan, while his son Amenhotep II was also fairly successful, with two campaigns in Syria mentioned on stelae at Amada, Memphis, and Karnak.[91]

The alternative nineteenth dynasty of the late exodus is even more problematical to look for a pharaoh weakened by the exodus. Archaeological evidence suggests that Rameses II and his son Merneptah gained complete control over the coastal plain of Canaan, establishing it as a virtual "Egyptian highway."[92] In contrast, we know that the Hyksos were weakened in the mid-sixteenth century BC, since they were defeated shortly after by Ahmose, founder of the eighteenth dynasty.

Implications for the Conquest of the Promised Land

How would an exodus in the early sixteenth century BC affect our understanding of the biblical claim of an Israelite conquest of the Promised Land? It should be noted that practically all archaeologists of ancient Israel deny that the "conquest" ever happened.[93] This is because (apart from the failure to explain the radiocarbon dates from Jericho), the thirteenth and fifteenth century dates for the exodus are in conflict with archaeological evidence from several other Canaanite cities. In contrast to limited evidence for an Israelite conquest at these later dates, Canaanite cities record a "collapse" at the end of the Middle Bronze age (ca 1550 BC). However, this collapse has traditionally been attributed to an invasion by the Egyptians, following their defeat of the Hyksos.

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91 Betsy M. Bryan, "The 18th Dynasty before the Amarna Period (c. 1550–I352 BC)," in *The Oxford History of Ancient Egypt*, ed. Ian Shaw (Oxford University Press, 2000), 207–264.

92 Itamar Singer, "Merneptah's Campaign to Canaan and the Egyptian Occupation of the Southern Coastal Plain of Palestine in the Ramesside Period," *Bulletin of the American Schools of Oriental Research* 269:1 (1988): 1–10.

93 William G. Dever, *What Did the Biblical Writers Know and When Did They Know It? What Archeology Can Tell Us about the Reality of Ancient Israel* (Grand Rapids, MI: Eerdmans, 2001), 99.

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The theory that the Middle Bronze Age collapse was caused by the Egyptians was espoused by both William Albright and Kathleen Kenyon.[94] Subsequently, it was also aggressively championed by James Weinstein and William Dever.[95] However, several scholars, beginning with William Shea and more recently followed by James Hoffmeier and Felix Hoflmayer, have argued that the "archaeological model" for the Middle Bronze Age collapse is seriously flawed.[96] There is no evidence that the invasion of the first eighteenth dynasty pharaoh (Ahmose) got further north than Sharuhen, in the Negev. Instead, Egyptian sources attribute the conquest of Canaan to Thutmose III, in the mid-fifteenth century, which is several decades later. For example, the Karnak inscription of Thutmose III, which describes the battle of Megiddo, places it in the twenty-third year of his reign, and therefore sometime around 1460 BC.[97]

Based on these difficulties, Hoflmayer posed the Middle Bronze Age collapse as a serious conundrum.[98] However, an early sixteenth-century exodus solves this problem by attributing the Canaanite "collapse" to the Israelites, as suggested for example by Barbara Sivertsen.[99] The

94 William F. Albright, *The Archaeology of Palestine* (London: Penguin Books, 1960); Kathleen M. Kenyon and Iorwerth ES Edwards, "Palestine in the Middle Bronze Age," in *The Cambridge Ancient History*, 2:1: *History of the Middle East and the Aegean region c. 1800–1380 B.C.*, ed. I. E. S. Edwards et al. (Cambridge University Press, 1973), 77–116.

95 James M. Weinstein, "The Egyptian Empire in Palestine: A Reassessment," *Bulletin of the American Schools of Oriental Research* 241:1 (1981): 1–28; William G. Dever, "Archaeological Sources for the History of Palestine: The Middle Bronze Age: The Zenith of the Urban Canaanite Era," *The Biblical Archaeologist* 50:3 (1987): 149–177.

96 William H. Shea, "The Conquests of Sharuḥen and Megiddo Reconsidered," *Israel Exploration Journal* (1979): 1–5; James K. Hoffmeier, "Reconsidering Egypt's Part in the Termination of the Middle Bronze Age in Palestine," *Levant* 21:1 (1989): 181–193; Felix Höflmayer, "The Expulsion of the Hyksos and the End of the Middle Bronze Age: A Reassessment in Light of Recent Chronological Research," *Journal of Ancient Egyptian Interconnections* 21 (2019): 20–30.

97 *Asiatic Campaign of Thutmose III*, in *Ancient Near Eastern Texts (ANET)*, ed. James B. Pritchard, trans. John A. Wilson (Princeton University Press, 1958).

98 Hoflmayer, "The Expulsion of the Hyksos," 27.

99 Barbara J. Sivertsen, *The Parting of the Sea: How Volcanoes, Earthquakes, and Plagues Shaped the Story of Exodus* (Princeton University Press, 2009), 112.

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book of Joshua does indeed claim the conquest of many Canaanite cities and their kings (Joshua 12). However, there is no claim that the Israelites settled these cities. They defeated the Canaanites, and even annihilated them, in order to forestall future attacks against Israel, but the Israelites themselves withdrew to the hill country on either side of the River Jordan (Joshua 12–17).

The consequence of this was that when the Egyptian invasion began several decades later, there was little or no direct conflict between the Egyptians and the Israelites. The Egyptians were mainly interested in the coastal plain, which could control trade from the north and supply tribute.[100] In contrast, the hill country would have been regarded by the Egyptians as too poor.[101] Here, even the famous claim that Canaan was the "land of milk and honey" has misled scholars. Literally, this description refers to the wild steppe, which is pastureland (not arable), and whose wildness is indicated by the availability of honey, which is mainly harvested from scrubland and open woodland.

One of the most well-dated Canaanite cities that displays a clear Middle/Late Bronze Age transition is Megiddo. Although there is no evidence for a destruction layer at this horizon, there is a clear cultural break between well-dated sequences.[102] A recent intensive campaign of excavation and radiocarbon dating at Megiddo has given a precise date for the Mid/Late Bronze transition of 1536 BC, modified from 1554 BC based on the IntCal 20 calibration curve.[103] This is seventy-five years before the expedition of Thutmose III. Similar evidence is also being obtained at Lachish, another important Canaanite city which shows evidence of a Mid/Late Bronze Age collapse. Here, radiocarbon dating

100 Nadav Na'aman, "Economic Aspects of the Egyptian Occupation of Canaan," *Israel Exploration Journal* 31:3/4 (1981): 172–185.

101 Etan Levine, "The Land of Milk and Honey," *Journal for the Study of the Old Testament* 25:87 (2000): 43–57.

102 Mario A. S. Martin et al., "Radiocarbon-Dating the Late Bronze Age: Cultural and Historical Considerations on Megiddo and Beyond," *Bulletin of the American Schools of Oriental Research* 384:1 (2020): 211–240.

103 Martin et al., "Radiocarbon-Dating the Late Bronze Age," Appendix B.

of the transition horizon is not yet complete, but it seems likely that a mid/late sixteenth century date will be obtained.[104]

Conclusions

The failure of Biblical Archaeology was caused in part by attempts to place the Israelite exodus in the wrong age setting. In contrast, an early sixteenth-century exodus satisfies many lines of evidence, including radiocarbon, archaeological, and historical data, and explains the mystery of the Middle Bronze Age collapse at several Canaanite cities. Unfortunately, space does not permit a comparison with the account of the conquest in the book of Judges. However, I hope that enough evidence has been given to show that a sixteenth-century exodus offers a new hope for understanding the origins and history of ancient Israel.

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104 Katharina Streit and Felix Höflmayer, "Tel Lakhish (Tel Lachish)," *Hadashot Arkheologiyot: Excavations and Surveys in Israel* 134 (2022): 8.

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