A DENDROCHRONOLOGICAL FRAMEWORK FOR THE ASSYRIAN COLONY PERIOD IN ASIA MINOR

ASUR KOLONİ ÇAĞI'NDA KÜÇÜK ASYA'NIN DENDROKRONOLOJİK (AĞAÇ HALKA TARİHLEMESİ) BAKIMDAN GENEL HATLARI

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Keywords: Dendrochronology, radiocarbon, Middle Bronze Age, Assyrian Colony Period, wiggle-matching
Anahtar sözcükler: Ağaç halka tarihlemesi, radyokarbon, Orta Tunç Çağı, Asur Koloni Çağı, fark eğrilerinin örtüşmesi

Anadolu için M.Ö. 2657-649 ±8/10[1] yılları boyunca uzanan iki parça halinde 2009 yıllık bir Eski Tunç-Demir Çağı ağaç-halka kronolojisi sunuyoruz. Bu kronoloji hem Kültepe'nin Karum II ve Karum Ib tabakalarını içermekte, hem de bu tabakaları Acemhöyük ve Karahöyük-Konya'daki çağdaş tabakalara bağlamaktadır. İlk defa her üç kazı alanının Karum II tabakasına ait yapılarına kesin tarih verebiliyoruz. Örneğin, Karum Ib'de, Kültepe'nin Waršama Sarayı (M.Ö. 1832) ve Acemhöyüğ'ün Sarıkaya Sarayı ve Hatipler Tepesi (ikisi de M.Ö 1774'te yapılmıştır) gibi meşhur yapılarını tarihlendirebiliyoruz. Ayrıca, ağaç halkaları Waršama Sarayı'nın M.Ö. 1771'deki yıkımından önce en az 61 sene, ve Sarıkaya Sarayı'nın M.Ö. 1766'daki yıkımından önce en az 8 sene var olduklarını gösteriyor.

The Assyrian Colony Period

Toward the end of the third millennium BC Assyrian merchants began a remarkable, multi-generation-long commercial relationship, principally a trade in metals, with the kings of central Anatolia. Their 'typical' archaeological imprint, seen best at Kültepe, ancient Kaneš, is a settlement or karum of merchants' houses (T. Özgüç 1986) clustered around a large mound where the indigenous Anatolian ruler lived, usually in a substantial palace (T. Özgüç 1999; 2003), and documented by the archives of thousands of cuneiform tablets that recorded the merchants' daily business and personal transactions. In addition, seals and sealings record the names of a number of rulers or magistrates both from Anatolia and the Near East.

This so-called Assyrian Colony Period in Anatolia is conventionally divided into four phases, named after the karum levels at Kültepe. Thus from bottom (early) to top (late) the phasing is: Karum IV, Karum III, Karum II, and Karum Ib and Ia. Not much is known about the lower two levels because of the minimal exca-

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vation carried out to these depths, and the latter half of level I (Ia) encompasses everything from the Middle Bronze Age to the present. Therefore, this paper deals only with the chronology of Karum levels II (=Mound level 8) and Ib (=Mound level 7) (T. Özgüç 1999, 77).

Assigning a length to the period of Karum Level II has been aided in the past several years by the identification of four cuneiform texts excavated from the karum at Kültepe, the so-called *limu*, or eponym, lists. These are lists of the administrative officials who served annually as the *limu* or magistrate at the Assyrian capital Aššur, and after each one of whom the year of his administration was named. The most recent Kültepe eponym list, as modified by the publication of a long list of these names on a single tablet (Veenhof 2003), now includes 129 names of officials who held the post of *limu* during the period of Karum Level II, more than half a century longer than had been posited on the basis of the number of previously-known *limu* names (Balkan 1955). Professor Veenhof has proposed an additional 9 eponyms to fill out the Karum Level II phase, for a total of 138 years.

One of the difficulties of assigning absolute dates to these years has lain in the absence of any correlation between the names of the officials and the material remains of the karum. Instead, archaeologists and Assyriologists have been struggling to date the years of the *limus'* reigns by correlating them with the dates of the reigns of Assyrian kings, Babylonian kings, and local kings of the sites in Anatolia in which the principal Assyrian merchant colonies were located, including Kültepe, Alişar, and Boğazköy. One presumes that karums were also located at Acemhöyük and possibly Karahöyük-Konya, though none have been found in 30 years of excavation. The vast majority of the effort expended at the latter two sites has been on the mounds themselves. Professor Veenhof now dates the Karum II period between ca. 1974 and 1836 BC (absolute dates based on the Mesopotamian Middle Chronology). The end of Karum Level II has been attributed to Assyrian king Naram-Sin based on the latest attested bullae found in the karum at Kültepe (Özkan 1993). What is clear is a distinct shift in the archaeological imprint on the karum after a realignment from the Level II plan. After a maximum interval of perhaps a generation, Karum Level Ib is established ca. 1800 and runs to 1730 BC (T. Özgüç 2003, 28). However, not enough *limu*-names from Level Ib are known to give any chronological dimension to the period from this type of evidence alone.

An alternative set of dates continues to emerge from another, independent, source. This is the dendrochronological dating of a variety of monumental buildings from the Assyrian Colony Period in central Anatolia. Although these dates are not yet absolute (these are floating chronologies, and they will remain floating until the Aegean Dendrochronology Project [henceforth ADP] can connect them with the long tree-ring sequences from later periods), they are securely connected with one another. Lacking a dendrochronological bridge to the present, our dating the tree-ring sequences in absolute time has required the use of a proxy method, namely radiocarbon wiggle-matching. In the late 1980s the ADP began a collaboration with Dr. B. Kromer at the Institut für Umweltphysik at the University of Heidelberg to wiggle-match our long dendrochronological sequences in an effort to come up with precise radiocarbon "dates-within the limits of the method- "for all wood that could be connected to two of our longest tree-ring sequences.

The Karum II Period at Kültepe, Acemhöyük, and Karahöyük-Konya

Kültepe Karum Level II is represented by a 521-year tree-ring chronology, spanning the years 2544-2024 BC[2], built from the juniper door-threshold timbers of rooms in the Eski Saray (T. Özgüç 1999, 106-110 and Plates 45-49; T. Özgüç 2003, 133-137) next to a corduroy road of oak logs from which we have built a 251-year

chronology (not yet dated). Acemhöyük Early is represented by a 508-year chronology built from burned, re-used timbers (Figure 1 and Figure 2) in the foundations of unburned walls of kitchen structures in the Northwest Trench.

Although the kitchen area's period of use was the 18th century BC on the basis of seals, sealings, small finds, and pottery (A. Öztan, pers. comm.; 1992 and her figures 1-3; 1993 and her figures 1-2), the 508-year ring-sequence dates from 2657 to 2150 BC. Finally, Karahöyük is represented by a 198-year timber taken from the scarp of a deep sondage in Trench C, Levels 6/7 made a generation ago by Professor Sedat Alp. There was no indication from the excavator whether or not this sample was part of a wall of a larger building that can be attributed to the Early Bronze Age. But the crossdating against both the Acemhöyük Early junipers and Kültepe Eski Saray junipers is excellent. The rings span the years 2359-2162 BC.

The whole 634-year tree-ring sequence for the Early Bronze Age thus spans the years 2657 to 2024 BC. (see Figure 7 below). Note that 2657 BC has nothing to do with the Karum Level II period but is rather the birthdate of the oldest tree at Acemhöyük. The wiggle-match (illustrated in Figures 4-6) testing the proposed dendrochronological date with the EBA tree-ring chronology starting in year 2657 is based on 13 sets of decadal tree-ring samples from Acemhöyük and Karahöyük, each dated at Heidelberg by Dr. B. Kromer with subsequent analysis by Dr. S. W. Manning.

The end-dates, all *termini post quos*, of the last-preserved rings are therefore as follows: Karahöyük-Konya Early: 2162 BC (no bark, unknown number of rings missing at end, no burning visible in the scarp today); Acemhöyük Early: 2150 BC (no bark, unknown number of rings missing, all partially burned); Kültepe Early: 2024 BC (no bark, trimmed, unknown number of rings missing at end, all badly burned).

Since these sites are widely separated, there is nothing to suggest a common cause of the burning. The end-dates of the rings span almost a century and a half, and an accidental conflagration once every 50 years somewhere in Anatolia is easily conceivable. If a military campaign by some aggressor is a serious possibility, we need to look at the Assyriological record for candidates. Since only the Kültepe samples are in a primary construction context, the latter site deserves the most comment. The threshold timbers of the Eski Saray were cut around 2024 BC, probably some while later, and then after an unknown lifespan the Eski Saray was destroyed in a conflagration. Professor Tahsin Özğüç, the excavator of Kültepe, thinks that the Eski Saray is contemporary with Karum Level II. Whether the burning up on the mound and down in the karum is the same burning is anybody's guess. Recently Professor Özgüç commented that the incineration of palace and karum was due to the same fire, possibly the attack of Uhna, king of Zalpa (T. Özgüç 2003, 131). At any rate, to think of the lifetime of the Eski Saray and the existence of the buildings of Level II in the karum as approximately contemporary seems reasonable. Unfortunately for us, the buildings in the karum were slight enough so that their destruction (which preserved the tablets beautifully) was almost total, and the combustion left us little but ash. After years of trying we have yet to derive a single tree-ring date for any building in the karum at Kaneš.

The Karum Ib Period at Kültepe, Acemhöyük, and Karahöyük-Konya

This period is much better represented dendrochronologically than Karum Level II. All three sites have one or more major burned monuments with long tree-ring sequences, all pinned to our Bronze Age/Iron Age tree-ring chronology which is accurate to within a few years (±4/7 years in Manning et al. 2001 at 2σ; and less than ±16/7 years at 3σ range in Manning et al. 2003). Moreover, repair timbers exist in two monuments that allow us to make an

estimate on dendrochronological grounds alone about the life-span of each building before it was destroyed.

At Kültepe a large number of timbers in the Waršama Sarayı (T. Özgüç 2003, 120-125), all preserving the bark, were cut in 1832 BC. A second building program took place in the northwest corner of the building in 1810/1808 (bark preserved). Additional timbers which we interpret as late repairs were cut as late as 1779 or possibly later (no bark preserved), indicating a minimum of 61 years for the lifetime of the building before its violent destruction some time after 1779. At Acemhöyük, two major buildings, the Sarıkaya Palace and the Hatipler Tepesi building, both violently burned (T. Özgüç 2003, 126-128, and our Figure 3), were constructed in the same year: 1774 BC (bark preserved in both buildings).

Two repair timbers in the Sarıkaya Palace were cut in 1767 and 1766 or later (no bark preserved), indicating that it had a lifespan of at least 8 years. The bulk of the reported 1600 bullae in the Sarıkaya Palace should have been deposited there after 1774 and before its destruction some time after 1766. Foreign royalty whose bullae are found in the Sarıkaya Palace include King Šamši-Adad of Aššur, the Princess Dugedu, daughter of King Iakhdun-Lim of Mari, and King Aplakhanda of Carchemish (T. Özgüç 2003). When the sealings from this building are fully published (Nimet Özgüç, in preparation) we should know more about their distribution, and possibly how many should be assigned to which years of the building's lifetime, and the Anatolian tree-ring work will have a new set of foreign connotations. At Karahöyük - Konya, the last-preserved rings (no bark) of yet another burned building (majority of timbers from Room 4) in Trench X (Alp 1992; 1993) date from after 1768 BC.

Again we need to look at the Assyriological record. Was there a military campaign in the 1760s to blame for all this, or are we dealing with three unrelated destructions of these major mounds? Professor Tahsin Özgüç has recently suggested attacks by competing regional kings (T. Özgüç 2003, 132). As a cautionary point, we note that the wooden city of Novgorod in Russia was destroyed by fire on average once every 24 years over a six-century period (Kolchin 1963, 85), yet there is no evidence whatever in the Russian chronicles for any foreign attack, civil unrest, or the like as a causal factor. Nonetheless, given the historical information concerning military activities in the period, there is more of a case to be made here in the Karum Ib period than there was for the Karum II period for an event such as a single military campaign that might have caused all these destructions at nearly the same time.

Comment on our published dendrochronological dates for the MBA

New articles and commentary by other scholars on the Assyrian Colony Period are appearing practically bi-monthly, most recently Professor Klaas Veenhof's *The Old Assyrian List of Year Eponyms from Karum Kanish and its Chronological Implications* (Ankara, 2003), and Professor Tahsin Özgüç's *Kültepe Kaniš/Neša* (Tokyo, 2003), and still others are in advanced stages of preparation, such as Professor Cahit Günbatti's *limu* text referred to above and Professor Nimet Özgüç's final reports on both the seals and sealings from Acemhöyük as well as the architecture volume. We therefore feel it necessary to set the dendrochronological record straight so that our colleagues will not inadvertently cite one of our earlier reports with the possibly confusing dating systems noted below. We now think that our tree-ring dates, especially for the Middle Bronze Age, are accurate to within a very few years. Confirmation of all these dates, of course, will come when the absolute dendrochronological sequence for the Aegean and eastern Mediterranean is extended from the present to the second millennium BC. But if it turns out that we have to move a date up one year, then everything moves up one

year; if we have to move a date down one or two years, then everything moves down one or two years, and so forth. We cannot change one date without changing all the others. The intervals between the dates listed below remain constant. Thus, as of December 2003, from the tree-rings alone, we have the following sequence, and it is the column on the right in **bold** characters that should be cited from now on. Columns 1-5 are provided for readers who have seen some but not all of our earlier publications. Superscripts after the publication names refer to the six sets of paragraphs which follow the table.

Publication	*TÖF*[1]	*Syria*[2]	*NÖF*[3]	*Nature*[4]	*Science*[5]	*Antiquity*[6,7]
Publication Date	(1989)	(1992)	(1993)	(1996)	(2001)	(2003)
Warsama Sarayı, the first building from our Middle Bronze Age sequence:						
Construction	1173 (MBARD)	1173 (MBARD)	1849±37BC	1810 BC	1832+4/-7BC	**1832-1835BC**
Early repair/column installation in NW corner	1194 (MBARD)	1194 (MBARD)	1810±37BC	n/a	1810+4/-7BC	**1810-1813BC & 1808-1811BC**
Late repair	1234 (MBARD)	1234 (MBARD)	1788±37BC	1749 BC	1771+4/-7BC	**1771-1774BC**
Sarıkaya Palace (58 years later than the Warsama Sarayı):						
Construction	1231 (MBARD)	1231 (MBARD)	1791±37BC	1752 BC	1774+4/-7BC	**1774-1777BC**
Repair	1239 (MBARD)	1239 (MBARD)	1783±37BC	1744 BC	1766+4/-7BC	**1766-1769BC**
Hatipler Tepesi Building (same year as the Sarıkaya Palace):						
Construction	1231 (MBARD)	1231 (MBARD)	1791±37BC	1752 BC	1774+4/-7BC	**1774-1777BC**
Karahöyük, Trench X (6 +? years later than the Acemhöyük buildings):						
Last preserved ring	n/a	n/a	1785±37BC	1746 BC	1768+4/-7BC	**1768-1771BC**
Porsuk/Ulukışla, Hittite City Wall (170 &201 years after the Acemhöyük buildings):						
Hittite city wall, inner postern construction	1439 (MBARD)	1439 (MBARD)	1621±37BC	1582 BC	1604+4/-7BC	**1604-1607BC**
Hittite city wall, outer postern construction	n/a	1470 (MBARD)	1590±37BC	2551 BC	1573+4/-7BC	**1573-1576BC**

Table 1

1. Our first announcement was in 1989 in "A 677 Year Tree-Ring Chronology for the Middle Bronze Age," in *Anatolia and the Ancient Near East: Studies in Honor of Tahsin Özgüç* (Ankara: Türk Tarih Kurumu). Here all dates were expressed in terms of a Middle Bronze Age Relative Dating system, which we built upon a date assigned for the first measured sample from Kültepe. The ADP relative dating procedures were adopted from the Laboratory for Tree-Ring Research, University of Arizona. The system arbitrarily assigns the first measured ring of the first sample to a year 1001. This allows flexibility for crossdating any tree-ring sample against the first one either to any year up to 1000 years before, or 1000 years after, the year 1001. These years have always been relative, and are in part the legacy of the days of punch-cards and an

old computer system when the machines could not handle negative (BC) numbers. This no longer applies, but we still maintain a relative dating system for all BC dates that is linked to the first measured sample from Gordion (Kuniholm 1977).

Since the Middle Bronze Age chronologies had not (in 1989) been linked with the Gordion chronologies, the tree-ring chronologies from the Waršama Sarayı at Kültepe, the Sarıkaya Palace and Hatipler Tepesi Building at Acemhöyük, and the postern gate at Porsuk were linked to the same MBA relative dating system. Though an absolute date could not then be assigned, the relative dates reported in 1989 remain the same as those reported today, with the Waršama Sarayı at Kültepe's being built 58 years[3] before the two palatial buildings at Acemhöyük. In addition we reported, in preliminary fashion, a 321-year tree-ring chronology under development for the postern gate at Porsuk (Kuniholm, et.al. 1992). This sequence extended the Middle Bronze Age tree-ring chronology from Kültepe and Acemhöyük by 113 years on the recent/lower end, providing a total of 677 years for what we called the Middle Bronze Age chronology, spanning MBA-RD 763-1439.

2. A major tree-ring anomaly at Porsuk -an upward spike- the most singular anomaly in the last 9000 years and an apparent reaction to a series of cool, wet summers (of which more below), was noted in a "Preliminary Report on Dendrochronological Investigations at Porsuk / Ulukışla, Turkey 1987-1989," in *Syria* LXIX (1992), 379-389, but at the time of that publication the event was described only in terms of significance based on the number of trees recording it. Thirty-one trees (then; the total is now 61) recorded the growth as deviating from normal as a positive anomaly of between 167% and 207% of normal in the years, according to the Middle Bronze Age Relative Chronology, occurring in MBA-RD 1356-1357.

When this chronology was connected to the one from Gordion via the discovery of exceptionally long-lived juniper boards used in the construction of the Phrygian tumulus at Kızlarkaya in 1991, the relative years for the spike became Gordion MMT-RD 854-855 (see #3 below). This is the positive growth anomaly we would later publish in *Nature* in 1996 (see #4 below) as occurring in these years, and in that publication we correlated these years with the then growing consensus for a major tree-ring growth anomaly in the northern hemisphere in 1628-1627 BC (also suggested in work published 1984-1995 to be perhaps correlated with the Thera eruption). This was **not** the best match for the AD 1996 wiggle-match (which was c.1641 BC +/-), but was chosen for the simple reason that it seemed likely that the Porsuk extraordinary growth anomaly correlated with the other recorded tree-ring growth anomalies around the northern hemisphere and because we thought that what we had come to refer to as "the Porsuk Anomaly" was exactly the kind of response expected from trees growing in the eastern Mediterranean after the eruption of Thera. The fact that Porsuk is situated within the arc of the recorded ash fallout only increased our confidence in this connection. In AD 1996 this hypothesis was possible within the then established dating error on the radiocarbon wiggle-match. But this situation has subsequently changed: see #5 below.

3. In 1993 we reported, in a third paper, "A Date-List for Bronze Age and Iron Age Monuments Based on Combined Dendrochronological and Radiocarbon Evidence".

Aspects of Art and Iconography: *Anatolia and Its Neighbors-Studies in Honor of Nimet Özgüç* (Ankara, Türk Tarih Kurumu, 1993), the connection of the Middle Bronze Age dendrochronology (Middle Bronze Age Relative Dating Years 763-1439) with the Late Bronze Age-Iron Age dendrochronology developed from wood from Gordion, including the Kızlarkaya Tumulus (spanning Gordion Relative Dating Years 739-

1647). We converted all of our dendrochronological dates for MBA wood to the Gordion Relative Dating system based on the so-called Midas Mound Tumulus dendrochronology (MMTRD).

The 677-year Middle Bronze Age tree-ring series (mostly juniper) now spanned the years MMTRD 257-933. It had an overlap with wood of the same species from the Kızlarkaya Tumulus of 216 years based on the then-current 1986 radiocarbon calibration curve which gave us cutting dates of 1849 BC +/-37 years for the Waršama Sarayı and 1785 BC +/-37 years for the Acemhöyük buildings. The Porsuk growth anomaly was now back in the 1660s (+/-37), a fact immediately noted by Professor F. H. Schweingruber who commented that it was a pity that the center of the anomaly did not line up with one of the proposed eruption dates (1628/1627) for Thera/Santorini.

4. By 1996 not only was the 1993 radiocarbon calibration curve available, but we had enough radiocarbon dates in hand to report in "Anatolian tree rings and the absolute chronology of the eastern Mediterranean 2220-718 BC," *Nature* 381 that we thought the Porsuk anomaly should be placed at 1641 BC ±76/22. Since this window included 1628, we opted for the latter, even though it was 13-odd years lower than the center of the chi-squared fit function (in retrospect an ill-advised move, although it seemed thoroughly reasonable at the time). The effect on the dating of the big MBA buildings was a construction date for the Waršama Palace of 1810 BC, construction dates for Acemhöyük of 1752 BC, and a date for the Porsuk outer postern at 1551.

5. By 2001 we had not only the 1998 radiocarbon calibration curve but also nearly three times the number of radiocarbon determinations that had been available for the *Nature* article. The morphology of the fit with the radiocarbon curve showed that the earlier downward placement of the Gordion tree-ring chronology was incorrect. In two articles in *Science* (Kromer et al., and Manning et al., December 2001, and a supplementary comment by Reimer in the same volume), we reported a modification of our previous position, thereby moving the construction dates of the Waršama Sarayı up 22 years to circa 1832 BC and the Acemhöyük buildings to circa 1774 BC. This time the error margins were relatively negligible, plus 4 or minus 7 years at 2σ (95.4%) confidence, and the Porsuk anomaly moved up to around 1650, no longer having any connection to any 1628 BC northern hemisphere tree-ring growth anomaly.

6. Most recently in a paper in the March, 2003 *Antiquity*, "Confirmation of near-absolute dating of east Mediterranean Bronze-Iron Dendrochronology", (available online at http://antiquity.ac.uk/ProjGall/manning/Manning.html) we reported that the likely best-fit margins varied by perhaps 0-3 years within a 3σ (99.7%) confidence range of less than ±16/7 calendar years, probably even narrower (see Manning et al. 2001, 2535 n.17). While noting that an error range applies (given above and below at 3σ confidence - see also n.1 above), we cite in Table 1 the specific best-fit (0-3 years variation therein) as the approximate dates that should be used at present for the ADP Bronze Age-Iron Age chronology (as of AD 2003). These dates are the column of figures in bold type on the right. As noted, these dates are shown without the error margins (see next paragraph) that should be used and remembered in any discussion. These current best-fit dates are robust, but could move very slightly if new samples have the rings we currently lack, or if minor modifications are made to the radiocarbon calibration curve itself.

7. On the basis of the published exercises in wiggle-matching in *Science* (2001) and *Antiquity* (2003) we believe a fit for the last preserved rings, across various scenarios and options, lies within the four year span shown in the last column and that an overall 3σ error range of less than ±16/7 calendar years, and likely ±9/5 calendar years, exists around this 4 year fit 'zone'.

This seems to agree well with new, as yet unpublished data and analysis for the late end which has been reported to us by our collaborators Drs. Kromer and Manning in recent months from the work on the East Mediterranean Radiocarbon Intercomparison Project.

Connecting the Two Chronologies

The ADP now reports a significant addition on the early end to the long Bronze Age-Iron Age tree-ring chronology that began with the collection of timbers in the Midas Mound Tumulus at Gordion. The 1599-year Bronze-Iron tree-ring chronology as published in *Science* 2001 spanned the years 2247-649 ±4/7 BC. We have been aware of the long overlap (now 223 years) with the Early Bronze Age master tree-ring chronology for some time, but had been unable to connect the two convincingly because almost all of the overlap depended largely on a 440-year-old, highly erratic juniper timber (KUL-23) from the Waršama Sarayı. We think we have finally worked out the problems, and the ADP Bronze Age-Iron Age tree-ring chronology now spans the years 2657-649 BC (with the caveat that there could be surprises in the form of missing rings in the area of the overlap). The dendrochronological linkages are shown in Figure 7, with the associated t-scores as a measure of the quality of fit. Clearly, the retrieval of additional timbers from the 21st century BC (available in the Eski Saray at Kültepe) would help confirm this placement. Indeed, the discovery of additional missing rings in the earliest 150 years of KUL-23 or the latest 100 years of KUL-85 and KUL-88 (Eski Saray juniper door thresholds) would improve the quality of both the visual and statistical match by helping align a number of the tree-ring signatures.

However, we do not want to 'invent' rings we cannot actually see in the material currently available. We note that the radiocarbon wiggle-match in Figure 4, while supporting the proposed dendrochronological date, would fit better if we could find missing rings, thereby pushing the Eski Saray earlier by a few years. Figures 5 and 6 illustrate the quality of the fit for the wiggle-matches according to two scenarios. The first is with all existing 13 radiocarbon data (Figure 5), and clearly shows two competing dates for the whole. The second is with the most significant outlier removed (Figure 6), and clearly shows a preference for an earlier date for the EBA chronologies. The effect on the dates reported here for the EBA sequences would then require our shifting them up by perhaps as much as a decade, increasing the span of time for the Kültepe Karum Level II dendrochronological sequence to 202 years. Work on resolving this discrepancy (both by radiocarbon dating of more samples that are linked dendrochronologically in the Early Bronze Age master, and by a sampling strategy to retrieve additional dendrochronological samples from the Eski Saray door thresholds and additional fragments of KUL-23) is ongoing. However, the dendrochronological fit between the EBA sequence and the MBA sequence reported here, supported by the two sets of wiggle-matches, is the best we can achieve as of December 2003. It should be thought of as tentative, subject to verification or modification as samples become available in the future.

Conclusions

These observations still do not tell us whether the karum buildings or the palaces came first. Was the prosperity obvious in the palatial structures on the mound above a by-product of the commercial activities in the karum below? Or did the merchants come to an already prosperous center? Clearly, if we had datable buildings in the karum, that would be a big help. A building date of 1832 BC for the Waršama Sarayı is later than the last-preserved ring (2024 BC) of the Eski Saray by 192 years. If, say, a half-century of rings is missing from the latter, does the resulting difference of 142 years have anything to do with the long *limu* lists of circa 138 years being published for the Karum II period? We

have the impression, simply from the dendrochronological results, that the Assyrian Colony Period, at least the last two phases of it, was a longer, more stretched-out affair than some scholars have been prepared to admit.

Acknowledgments:

The Malcolm and Carolyn Wiener Laboratory for Aegean and Near Eastern Dendrochronology at Cornell University is supported by the National Science Foundation, the Malcolm H. Wiener Foundation, and individual Patrons of the Aegean Dendrochronology Project. For fundamental research permissions we thank the appropriate governmental and religious authorities in all the countries in which we work, as well as the many excavators, especially those cited in this report, who not only take time out to explain the intricacies of their sites but who make us welcome at their excavation houses year after year. We owe special thanks to Dr. Bernd Kromer and Dr. Sahra Talamo for radiocarbon dating and Dr. Sturt Manning for statistical commentary and graphical help.

NOTES

1 For convenience and clarity we cite absolute dates according to the exercise published by Manning et.al. in Science in 2001. For a more conservative calculation of the error see Manning et.al. (2003). The error margins stated in the main text apply to all the absolute dates reported in this paper, especially those in Column 6 in the table below, that are linked dendrochronologically

2 See figure 3 and following text for an explanation for these and the following dates)

3 [Sic] We reported the difference as both 58 (p.279) and 68 (page 293) years. We thank Professor Klaas Veenhof for noting the discrepancy and communicating it to us.

REFERENCES

ALP, S., 1992
"Konya-Karahöyük 1991 Kazısı", XIV. *Kazı Sonuçları Toplantısı*, Ankara, T. C. Kültür Bakanlığı, 301-306.

ALP, S., 1993
"Konya-Karahöyük 1992 Kazısı", XV. *Kazı Sonuçları Toplantısı*, Ankara, T. C. Kültür Bakanlığı, 267-270.

BALKAN, K. 1955
Observations on the Chronological Problems of the Karum Kaniš, Ankara, Türk Tarih Kurumu,.

BRONK RAMSEY, C. 1995
"Radiocarbon calibration and analysis of stratigraphy: the OxCal program", *Radiocarbon* 37, 425-430.

GÜNBATTI, C.
in preparation. *Second long limu̇ text from Karum Level* II

KOLCHIN, B. A., 1963
Novi Metodi v Archeologii III: *Trudi Novgorodskoi Archeologicheskoi Ekspeditsii*. Moscow, Akademii Nauk.

KROMER, B., S. W. MANNING, P. I. KUNIHOLM, M. W. NEWTON, M. SPURK, I. LEVIN, 2001
"Regional 14CO2 Offsets in the Troposphere: Magnitude, Mechanisms, and Consequences", *Science* 294, 2529-2532.

KUNIHOLM, P. I., 1977
Dendrochronology at Gordion and on the Anatolian Plateau, Philadelphia unpublished Ph.D. dissertation).

KUNIHOLM, P. I., M. W. NEWTON, 1989
"A 677 Year Tree-Ring Chronology for the Middle Bronze Age," *Anatolia and the Near East: Studies in Honor of Tahsin Özgüç*, Ankara, Türk Tarih Kurumu, 371-373.

KUNIHOLM, P. I., S. L. TARTER, M. W. NEWTON, C. B. GRIGGS, 1992
"Preliminary Report on Dendrochronological Investigations at Porsuk/Ulukışla, Turkey 1987-1989", *Syria* LXIX, 379-389.

KUNIHOLM, P. I., 1993
"A Date-List for Bronze Age and Iron Age Monuments Based on Combined Dendrochronological and Radiocarbon Evidence", *Aspects of Art and Iconography: Studies in Honor of Nimet Özgüç*, Ankara, Türk Tarih Kurumu, 279-293.

KUNIHOLM, P. I., B. KROMER, S. W. MANNING, M. W. NEWTON, C. E. LATINI, M. J. BRUCE, 1996
"Anatolian tree rings and the absolute chronology of the eastern Mediterranean, 2220-718 BC", *Nature* 381, 780-783.

MANNING, S. W., B. KROMER, P. I. KUNIHOLM, M. W. NEWTON, 2001
"Anatolian Tree Rings and a New Chronology for the East Mediterranean Bronze-Iron Ages", *Science* 294, 2532-2535.

MANNING, S. W., B. KROMER, P. I. KUNIHOLM, M.W. NEWTON, 2003
"Confirmation of near-absolute dating of east Mediterranean Bronze-Iron Dendrochronology", *Antiquity* 77, No 295 /March. http://antiquity.ac.uk/ProjGall/Manning/manning.html

ÖZKAN, S., 1993
"The Seal Impressions of Two Old Assyrian Kings", *Aspects of Art and Iconography: Studies in Honor of Nimet Özgüç*, Ankara, Türk Tarih Kurumu, 501-502.

ÖZTAN, A.
1992 "1991 Yılı Acemhöyük Kazıları", XIV. *Kazı Sonuçları Toplantısı*, Ankara, T. C. Kültür Bakanlığı, 281-300.
1993 "1992 Yılı Acemhöyük Kazıları", XV. *Kazı Sonuçları Toplantısı*, Ankara, T. C. Kültür Bakanlığı, 245-254.

ÖZGÜÇ, N.
in preparation. *Final reports on the bullae and architecture of Acemhöyük.*

ÖZGÜÇ, T., 1986
Kültepe-Kaniš II: New Researches at the Trading Center of the Ancient Near East, Ankara, Türk Tarih Kurumu.

ÖZGÜÇ, T., 1999
The Palaces and Temples of Kültepe-Kaniš/Neša, Ankara, Türk Tarih Kurumu,

ÖZGÜÇ, T., 2003
Kültepe Kaniš/Neša: The earliest international trade center and the oldest capital city of the Hittites, Tokyo, MECCJ.

REIMER, P. J., 2001
"A New Twist in the Radiocarbon Tale", *Science* 294, 2494-2495.

STUIVER, M., P.J. REIMER, E. BARD, J.W. BECK, G.S. BURR, K.A. HUGHEN, B. KROMER, G. MCCORMAC, J. van der PLICHT, M. SPURK, 1998
"INTCAL98 radiocarbon age calibration, 24,000-0 cal BP.", *Radiocarbon*, 40, 1041-1083.

VEENHOF, K., 2003
The Old Assyrian List of Year Eponyms from Karum Kanish and its Chronological Implications, Ankara, Türk Tarih Kurumu.

Fig. 1: Partially burned EBA juniper timber at Acemhöyük. Photograph courtesy A. Öztan.

Fig. 2: Partially burned EBA juniper timbers at Acemhöyük. Photograph courtesy A. Öztan.

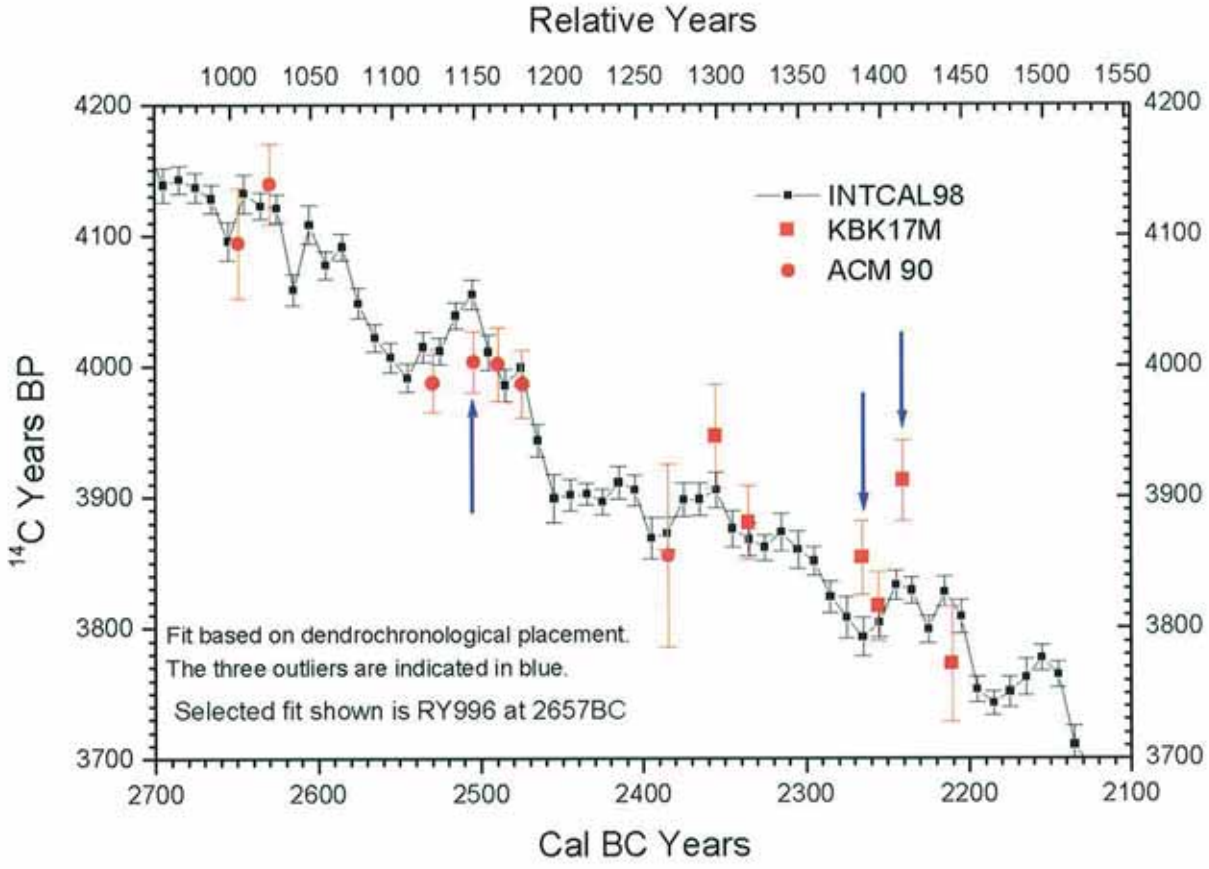

Fig. 3: Wiggle-match for Acemhöyük Early and Karahöyük Early.

Fig. 4: Burned juniper foundation timbers in one room of the Hatipler Tepesi building at Acemhöyük. All were cut in the same year, 1774 BC.

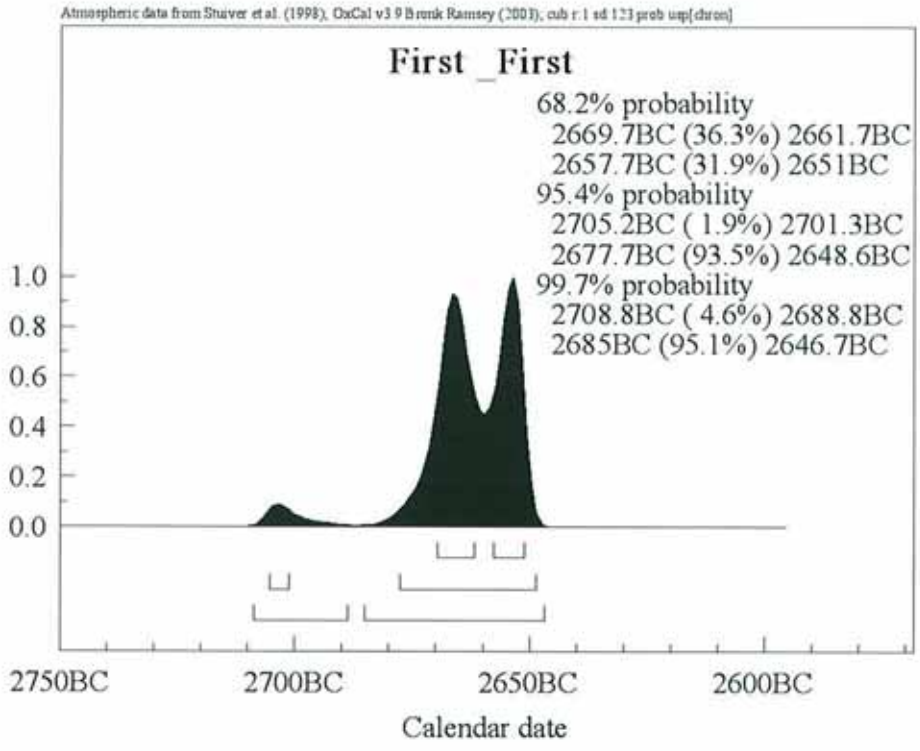

Fig. 5: The statistical fit for the EBA Wiggle-Match using all 13 data.

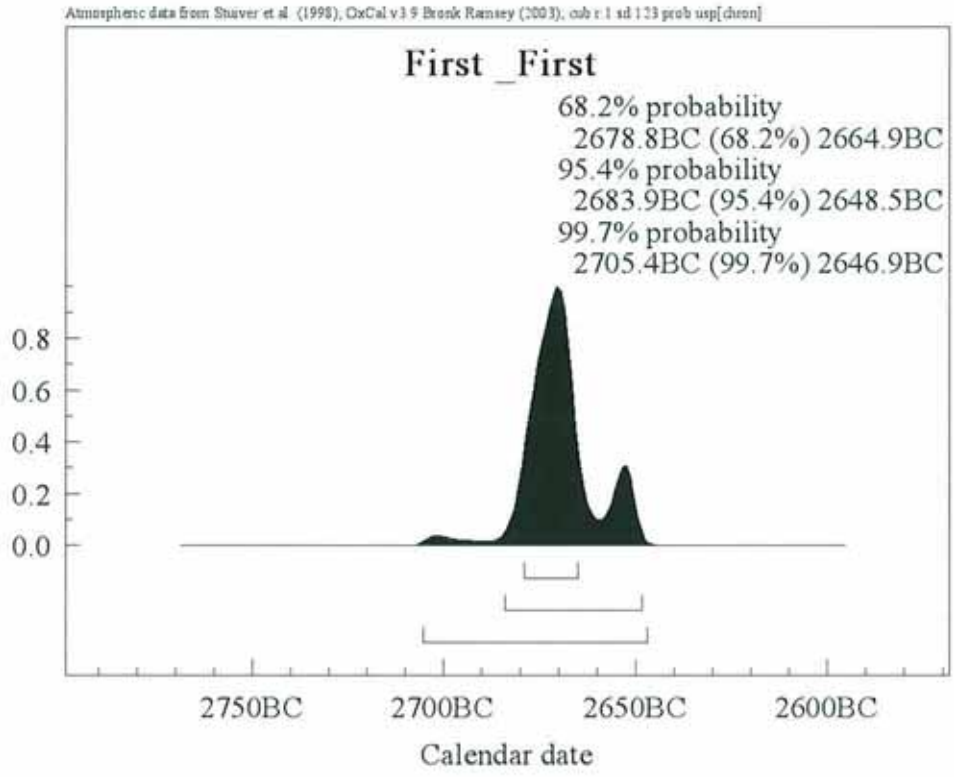

Fig. 6: The statistical fit for the EBA Wiggle Match using only 12 data, with the biggest outlier removed.

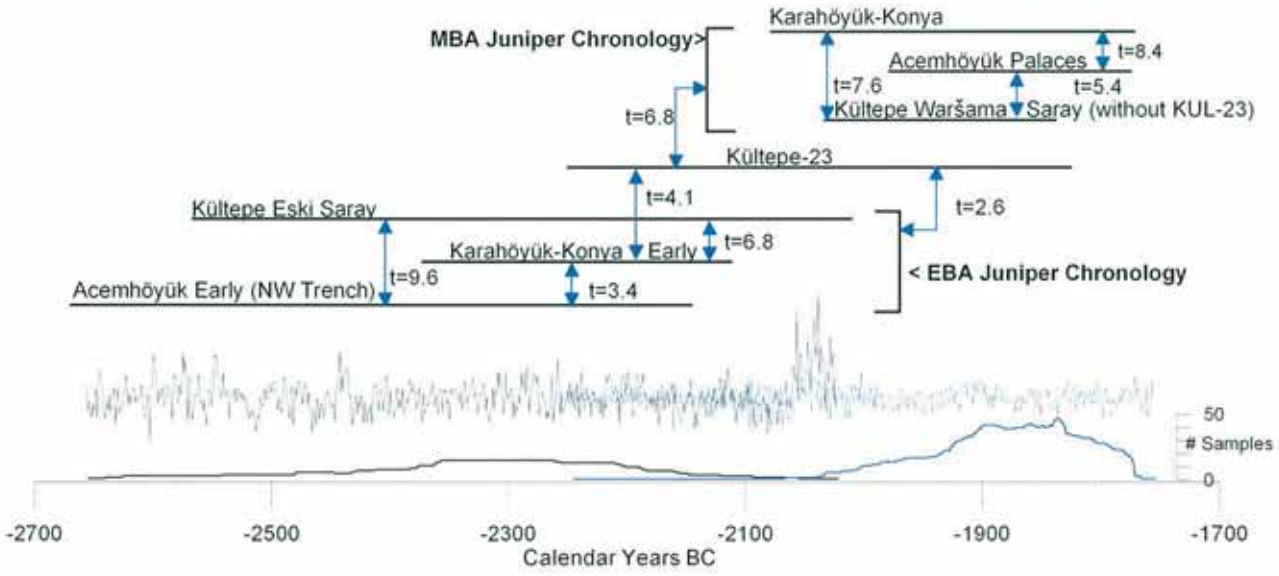

Fig. 7: Aegean Dendrochronology Project EBA and MBA sample spread and depth, for Anatolian juniper only, 27th-17th centuries BC.