TOWARDS AN ABSOLUTE CHRONOLOGY FOR MIDDLE AND LATE BRONZE AGE ANATOLIA

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I dedicate the following article to the persisting memory of Ord. Prof. Dr. Arif M Mansel whom I had the honor to be one of his numerous students in the years 1960-65.

Dating is at the core of most material culture analyses and historical debates. Therefore, changes in the traditional chronologies of the Near East due to the more precise dating of timber-bearing architectural levels of settlements will no doubt challenge conclusions concerning certain cultural and historical episodes of pre-Classical Anatolia. The Aegean Dendrochronology Project directed by P. I. Kuniholm from Cornell University has already made great progress towards creating a long tree-ring Master Chronology for the eastern half of the Mediterranean. It is believed that once completed it will hopefully bring some kind of rational order to Aegean and near Eastern Chronology from the Neolithic to the Present.

Over twenty sites in Turkey, Greece, Syria, Egypt, Cyprus and the Balkans are contributing to the East Mediterranean database (Kuniholm 1995,1996b: 403,1996c: 332). The tree-rings of the living forests of Turkey, Greece, Yugoslavia, Lebanon, Italy and Cyprus provide the starting point of this chronological framework. The absolute tree-ring sequence was traced, not long ago, back from the present to 362 A.D. allowing the precise dating of some Byzantine buildings in Turkey. Dates derived from tree-rings are self-standing, in other words they are independent say of king-lists, glyptic styles or ceramic sequences. Therefore, they can help in the far more precise dating of occupation

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floors and their related archaeological assemblages (Kuniholm 1990). In Anatolia the Bronze Age and Iron Age dendrochronology supported by high precision calibrated radiocarbon dates is still in the process of being firmly pegged-down. Once this ca. 2300 years continuous chronology extending from ca. 2944 B.C. (Troy I) (Kuniholm 2001:79) to 651 B.C. stops floating the historical chronologies of Egypt and Mesopotamia could well assume a secondary role (Kuniholm 1996c: 333, 1996d: 780; Renfrew 1996: 733-734)[1]. As it stands now this floating Master Chronology is already allowing synchronizations between the wiggle-matched tree-ring sequences and the chronology of well-known pottery classes including those of the Assyrian Colony Period, Minoan, Mycenaean, Hittite, Phrygian, Greek and Urartian. The same kind of synchronization is also being attempted with written records of historical importance, namely the Hittite documentary records from Ortaköy, Boğazköy and Kuşakli, and the Old Assyrian period documents from Acemhöyük, Konya-Karahöyük and Kültepe.

Gates referring to the second millennium absolute chronological framework for the Near East remarks that one can establish synchronisms between material culture remains of different geo-cultural sources at peripheral rather than core sites of major cultural regions (1989:60). She suggests that synchronisms indicated by the peripheral sites, such as Alalah (Tell Atchana), at the cross-roads between Mesopotamia and the Levant, and Hittite Anatolia and Egypt, should be given priority whenever they appear to conflict with absolute chronologies reconstructed from the 'heartland' cultures. She convincingly explains that the heartland cultural sequence, for instance the Old Babylonian period in Mesopotamia, will always appear internally consistent because it exists on a sliding chronological scale rather than one fixed by many points of intersection with other cultural zones, as occurs in the peripheries (1989:60).

Hittite sources although having some gaps for the period prior to ca. 1400 B.C., are important in refining the absolute chronological framework for the Ancient Near East. The historical continuity from the Late Old Babylonian period to the end of the Late Bronze Age in Anatolia is an important asset for periods when in most other parts of the Ancient Near East political changes led

1 The higher end of this time-scale is lower than the one claimed in 1993 by some 39 years for two reasons. The first has to do with the effect of applying the 1993 radiocarbon curve to the data from the Bronze and Iron Ages. It moved the chronology down by over three decades from where it had been pinned by the 1986 calibration curve. The second reason has to do with evidence of the eruption of Thera/Santorini in 1627/1628 B.C. and its finger-print on the tree-ring record.

to temporary gaps in historical documentation (Astrom, ed.1989, Part 3:63-64). Synchronisms which link the Old Hittite king Mursili I with the end of Hammurabi dynasty, the founder of the younger Hittite Empire, Suppiluliuma I and the Amarna Age of Egypt or the Hittite kings Muwatalli (II) and a few of his successors with Ramses II do still not provide accurate life-span for these Hittite kings and those who reigned in between. For instance it was remarked by Gurney that a proposed shortening of the reign of Haremheb, the last king of the 19th Egyptian dynasty would conveniently reduce the age of Hattusili III (Astrom, ed. 1989, Part 3:64). Explaining the problems created by a conflicting chronologies, Wilhelm once pointed out (Astrom, ed.1989, Part 3:65-66), that the distance between the sack of Babylon by Mursili I and the low accession date for Suppiluliuma I in the framework of the Long Chronology would be at least 308 if not more. This would be enough for 13 generations (of 23 years each) of Hittite kings. On the other hand the historically attested generations of Hittite kings hardly exceed 12 and probably was much less. Kings such as Hantili II, Zidanta II and Huzziya II who reigned prior to Tuthaliya I, could well constituted a single generation of kings. If this was the case then the number of generations between these kings and Suppiluliuma might have to be reduced to only two. This would leave as much as 9 or as little as 7 generations of Hittite kings. In other words the absolute chronology of second millennium Anatolia based on historical sources is still in need of some revision.

In the historical chronology of Mesopotamia the accuracy of the so-called Venus Tablet, long considered as a pivot stone in the attempts to establish an absolute time framework for the early second millennium B.C. by astronomical means, have often been challenged since the late twenties for some inaccuracies in its data of chronological significance (Gates 1989:77). Huber for instance has claimed that the data provided by the Venus Tablet is of poor quality and from the number of discrepancies between the duplicate texts and internal inconsistencies between the dates of disappearance and appearance of the planet, and the stated durations of visibility, between 20% to 40% of the dates recorded in the text could well be inaccurate (1989:6). As for the Egyptian chronology, Kitchen has rightly pointed out to the complexity of this system with its weak points (1989). In his opinion for this chronology to have any value it has to be constructed in a number of stages. First, it must have a closely-fixed starting point in the Iron Age upon which the second millennium B.C. chronology has to stand, building back from the agreed datum-point of 664 B.C. up to the date of ca. 1070 B.C. (at the highest ca. 1075 B.C.) for the end of the Egypt's New

Kingdom (1989:37). Second, the basic limits for the Ramesside kings, with Ramsess II as the principal figure, should be fixed to also tie it up to Near Eastern chronology. Third, the 18th Dynasty should be studied in two parts: from Tuthmosis III to the end of his reign, and form the beginning of this dynasty to the accession of Tuthmosis III. Fourth, the present state of the 12th Dynasty (MBA) when reviewed, leads to two rival sets of dates, and hence to two rival dates and time spans for the Second Intermediate Period (13th-17th Dynasties). Fifth, that period itself should be examined to determine the amount of time that is required to cover the whole series of successive reigns over Thebes. Sixth, the results of these inquests can then be applied for dating the 12th and later Dynasties, and so providing possible scales of dates for others to utilize in relation to a wider chronology in the Aegean, Levant and Near East. Having followed these steps, one is faced with two options concerning the Egyptian chronology for the Middle Kingdom and down to the predecessors of Tuthmosis III (Kitchen 1989:47). One option is based on the assumption of a northern observation (at Thebes the capital) of Sothis under Amenophis I, 18th Dynasty. This high chronology option allows for any increase in reign-lengths in the Second Intermediate Period that future discoveries might bring. The second option is based exclusively that all the early Sothic observations were made at Elephantine. Its direct result is the lowering of the 12th Dynasts's Sothic date by 42 years, and that of Amenophis I by 11 years (Kitchen 1989: 47). It must be said that such attempts to iron-out problems in Egyptian as well as Mesopotamian and Anatolian chronologies, no matter how convincing, remain controversial and therefore cast shadows on the accuracy of absolute dates based on historical sources.

Going back to dendrochronological framework, Kuniholm claims that the 18 high precision C 14 determinations that he relies upon when wiggle-matched to the radiocarbon calibration curve provide rather reliable fixed points. It is further suggested that inside this range the probable absolute dating of the dendrochronology can be achieved. For instance an outstanding growth anomaly in the seventeenth century B.C., correlated with major growth anomalies at 1628/1627 B.C. in the absolutely dated dendrochronologies of Europe and the United States is seen as the outcome of a dramatic cooler, wetter climatic event in the northern hemisphere (Kuniholm et al. 1996d: 781). As the Anatolian tree-ring chronology confirms, this unusual event was the only one during the 18th-15th centuries B.C. It correlates with evidence from

Greenland ice cores of a major volcanic eruption and other data reflecting a major climatic/atmospheric anomaly. Since the year 1628 B.C. is regarded as a special marker event in Northern Hemisphere tree-ring chronologies, it is proposed that the Anatolian ring 854 event should be correlated with the events of 1627/1628 B.C. in Europe and north America because it is compatible with the date range established by the radiocarbon wiggle-match (Kuniholm et al. 1996d: 781). Support comes from a second coincidence when 470 years after the ring 854 event another growth anomaly begins at ring 1324 in the Anatolian dendrochronology. This provides a very good match (+0-1 year) with the major anomaly commencing in 1159 B.C. known from Europe. This is the only such important event for several centuries in either chronology. It is linked to the eruption of Hekla 3 in Iceland, as attested in the ice-core data from Greenland. The combination of high-precision radiocarbon wiggle matching and the correlation of dendro-marker events offer a likely absolute date for the tree-ring chronology from Anatolia (Kuniholm et al. 1996d: 782). There are already enough data to convince us that the tree-ring master chronology will soon make the dating process entirely independent of historical considerations and therefore unbiased in the preference for a high, middle or low chronology.

Anatolian Principalities during the Assyrian Colony Period (ca.1920-1750 B.C.)

Kültepe-Kanis: The Old Palace of Karum Level II period may have been constructed towards the end of the 21st century B.C. This according to the floor planks of juniper recovered from a room adjoining the entranceway to the palace which were cut sometime after 2033 B.C. (Kuniholm 1999b). Such an early date for the construction of the palace should not be refuted before the chronological implications of the new limu-names from Karum-Kanes II are studied (see Karahöyük below). The 520-ring juniper dendrochronology from the Old Palace fits (with a 395-year overlap) with a 503-year juniper sequence in the Northwest trench at Acemhöyük (see below). The two sequences combined produces a 627-year continuous chronology (Kuniholm 1999b) mainly for the Early Bronze Age II-III, extending from 2660 to 2033 B.C.

Concerning the date of the Warsama Palace(Karum Ib period), more than thirty timbers, all of them with bark, recovered from its main constructional phase indicate that the palace was built in 1810 B.C., 58 years before the Sarikaya and Hatipler buildings at Acemhöyük (Kuniholm and Newton

1989:279, Kuniholm et al.1996d: 782). Two pieces of timber that were cut some time later, 17 and 61 years respectively, probably for the purpose of repairs, gives the life-span of the Warsama Palace. It seems that the building was inhabited at least 61 years before it was destroyed in a conflagration in 1749 B.C. (Kuniholm 1993:372; 1999). It may be assumed that this palace was built by Warsama during his reign and may have served the domicile of his successors Harpatiwa, Labarsa (?). If we add the reigns of Pithana, his son Anitta and a certain Zuzu, a date after 1750 B.C. for the end of Kanis as an independent Anatolian kingdom becomes very convincing.

Acemhöyük-Aksaray: The main palace complex at Sarikaya and its attached compound at Hatipler Tepesi constructed 58 years after the Warsama Palace in Kanis, in other words in ca. 1752 B.C., have a large number of timbers that were cut in the "Relative Year (Kültepe Dating System) 1231"(Kuniholm and Newton 1989:287, fig.2)[2]. The 24 juniper timbers excavated in the Northwest Trench were mainly longitudinal stretchers found inside the lower walls of a series of service buildings. These timbers provide 502 years-long time sequence stretching from 2659 to 2157 B.C(Kuniholm 2001:80). Since this tree-ring sequence in the third millennium B.C. do not fit the MBA chronology based on material culture remains found in-situ, the only logical explanation would be that wood used in the construction of service buildings belonged to an earlier EBA III construction that was destroyed by fire[3]. This may be construed as proof the principalities period in Anatolia started before the second millennium B.C. most probably during the EBA III.

In contrast to the main Palace complex at Sarikaya or the Hatipler Tepesi building where no reused wood at all was employed, recycled timbers were used in some of the auxiliary palace structures, perhaps kitchens.

The bullae from the 10th year of Šamsi-Adad as well as bullae from other Near Eastern notables found in the Sarikaya Palace now could be dated with more precision with the help of the tree-ring sequence which could be linked not

2 Of the numerous pieces recovered, more than thirty timbers from both the Sarikaya Palace and the Hatipler Tepesi Building, ten pieces have a last preserved ring ranging from 1229-1231. Apparently these timbers were peeled to remove the bark but not shape them radically.

3 Two of the longer wood specimens sent by Kuniholm to Heidelberg for radiocarbon wiggle matching produced the much needed confirmation that they fit right into a five centuries gap in the long third millennium tree-ring sequence from ca 2671 to 2169 B.C. Apparently the timber of this building was recovered and stored for future use (Kuniholm 1996a: 184-185.

only to the Old Assyrian historical chronology but also tied with the distinctive artistic style of the MBA (Kuniholm 1993:372). On the basis of the construction date of the Sarıkaya palace and the bullae of the 10th year of Šamsi-Adad, one may suggest that this king reigned in the second and/or third quarters of the 18th century B.C. Indeed, the epigraphic data derived from the tree-ring dated MBA palaces of Kültepe and Acemhöyük and linked to the Assyrian and Syrian king lists can now provide more precise dates for some of the latter. The new fixed dates provide important evidence towards the resolution over a century of debate over Assyrian or Mesopotamian chronology. According to Kuniholm (1993) it renders the so-called High chronology very unlikely. In the meantime it supports a new independent time-scale, tilting more towards a Middle and not a low chronology. Additional evidence from both Kültepe and Acemhöyük may in the future further push towards a Middle/High chronology for the MBA in Anatolia.

Karahöyük-Konya: This large site with an impressive MBA settlement provides a 301-year-long tree-ring chronology based on 16 juniper timbers which provide cross-dates with Gordion, Acemhöyük and Porsuk (Kuniholm 1993:371). In other words the timbers recovered from the MBA stratum cross-dates with the over 15 centuries long master chronology for Anatolia[4]. It has been calculated that the timbers used in the MBA constructions at Karahöyük were apparently cut at least six years after the Acemhöyük palace complex was built and 64 years after the Warsama palace at Kültepe-Kanis was constructed (Kuniholm 1996a: 183-184). Unfortunately without the bark that preserves the terminal ring the exact construction dates of the buildings in question cannot be established. In the total count, Ring 736=1785 ±37 B.C. is established as the last preserved ring at Karahöyük. However, since no bark was preserved, it is logically concluded that the construction of the building may have taken place a few years later. Kuniholm's tentative calculation (1993:372) of the construction date of the MBA Karahöyük(=Acemhöyük+6 years+?; or Karahöyük=Kültepe-Warsama Palace+64+?) is rather convincing. Therefore, the end of the MBA settlement with its palace compound would have been after 1764 B.C. How long after is still a question mark? However, as things stand now it may be possible to postulate that the Assyrian Colony period in Anatolia lasted longer than assumed. This could be corroborated by the relatively recent

4 One long juniper beam with198 rings probably coming from MBA Level 6 or 7 cross-dates with the Acemhöyük tree-ring sequence. Its last ring as wiggle-matched is ca 2181 B.C.

discovery at Karum-Kanes II of some 130-135 additional limu-names and some names of kings(to be soon published by Prof. K. Veenhof in Leiden) could add over 100 years or so to the Karum period. If this is the case then it is possible to postulate that the gap between the end of this period and the beginning of the Old Hittite Kingdom period was much shorter than it is usually assumed.

The Hittite Old Kingdom and New Kingdom Periods

Porsuk/Ulukişla: The recovery of over 100 more pieces of juniper, pine and cedar wood from Porsuk, made the combined Porsuk chronology 321 years long by 1989. This chronology overlaps the MBA chronology from Kültepe and Acemhöyük, thereby making a 677-years long chronology. This sequence runs from ca 24th century B.C. to the ca 17th centruy B.C. (Kuniholm 1990:90). There is a good chance, according to Kuniholm, that future discoveries in the LBA levels will close the existing very small gap with the Gordion series.

The wood recovered from the Old Hittite Period remains at Porsuk, have rings that are pegged by wiggle matching to the 17th century B.C. It is important to emphasize that according to Kuniholm there is an exceptional growth event at and immediately following relative ring 854 dated to ca. 1641 ±76/±22 B.C. by wiggle matching (Kuniholm et al. 1996d: 781-782, Fig.3; Kuniholm 1993:372). With the help of this dendrochronological data, especially from timbers with bark, it is possible to date the construction year of the Old Hittite Period postern in the west city wall at Porsuk. This postern has two phases: the inner or eastern portion was built 169 years after the construction of the palaces at Acemhöyük in other words in (1752-169=) 1583 B.C., and the outer or western portion was built 200 years after Acemhöyük, at 1552 B.C. (or 31 years after the inner postern at Porsuk) (Kuniholm 1991:131-132). This outer postern seems to have been a modification and strengthening of the original Hittite fortification built 31 years earlier (Kuniholm 1993:372). If such construction activities in this settlement were carried-out during the reign of one of the Old Hittite kings, say Hattusili I, and/or his successor, then the early date can give us a rough estimate on the foundation date of the Old Hittite kingdom dynasty by the predecessor/s of Hattusili I, probably in the 17th century B.C.

Tille Höyük: A 100-year oak sequence from this site either from the end of the LBA or the beginnings of the Early Iron Age can be cross dated tentatively with the 1503-year master Bronze/Iron Age chronology, even though the latter

is mostly juniper, at 1154 B.C± 37 years. The measurement of the Tille charcoal is not complete, and a slightly later date may be possible if more rings can be added to the later end of the chronology (Kuniholm 1992:126).

Boğazköy: The excavations in the Early and Middle Iron Age levels at Büyükkaya yielded a series of radiocarbon dates(Seeher 2000:373-374) which should be considered rather reliable. It would appear that soon after the abandonment of the Hittite capital at the end of the 12th or early in the 11th century B.C. the site of Büyükkaya was re-occupied by a rural community. Although the precise date of this Early Iron Age occupation cannot be ascertained yet, the time-gap between the two events according to the C 14 dates was certainly not a long one, perhaps a few decades if not much less. In this particular instance had data for dendrochronology existed it would have helped immensely in further refining the Büyükkaya dates, and therefore a more precise approximate time of the abandonment of the Hittite capital.

Dr. Jürgen Seeher in his communication during the recent Symposium in Ankara (May 2001) reported that new high-precision calibrated radiocarbon dates of carbonized remains recovered from the large silo-complex in the northwestern slope overlooking the Great Temple provide an unexpectedly early date in the 16th century B.C. Such an early date suggests that the construction of the postern-wall in this sector was carried out much earlier than it was thought, perhaps in the 15th century B.C. Such new and reliable dating of Hittite remains at Hattusa will certainly necessitate the re-examination of the ceramic-based time-scale in LBA sites in Anatolia

Ortaköy: A few timber fragments recovered from the palace-like compound (Building A) in Ortaköy (Sapinuwa), where more than 3500 Hittite period documents were found provide a last ring dated to 1304 B.C.±37. However, since no terminal ring exist because no bark was found, it may be said without reservation that these trees used in the construction of this building were cut later may be at the end of the 14th or beginning of the 13th century B.C. Another date comes from a second building. Burned pine timber recovered from Building B, have a last ring, but not a terminal one dated 1365 B.C. (Kuniholm 1994, 1996a:183,1998). Again this storage facility was built later than this date. Such a low date from Building A necessitates an explanation concerning the date of the historical documents from the reign of Tudhaliya III found in Building A.

Maşat Höyük: From the final Hittite level at Maşat Höyük (Level 1) showing traces of serious destruction there is a last preserved ring which is not the terminal ring dated to 1392 B.C.

Mainly on the basis of imported Late Helladic IIIB stirrup-jars Özgüç dated the beginning of this occupation level to 1275 B.C. (1978; 1982), in other words approximately to the reign of Hattusili III. Linking the tree ring date with the conventional dating of the LH IIIB ceramics provide interesting results. The dating formula proposed by Kuniholm is: 1392+B.C. +an unknown number of lost rings +the lifespan of the building=time of LHIIIB pottery (1993:372). Taking into consideration the similarity between the LH III pottery from Maşat and the similar material from the Kaş/Uluburun shipwreck this dating formula is convincing[5].

The last preserved ring, not terminal ring, from one of the timber fragments recuperated is dated to 1305 B.C. In other words the tree was cut after this date. This fact should convince us that the construction or at least the final repair date of the ship should be dated according to dendrochronology and not by the material culture remains. In other words in cases of a discrepancy say between tree-ring dating and a particular art or pottery style the uncontested dendrochronological date should prevail, demanding a chronological revision of the former.

Going back to the tree-ring date for Level 1, even assuming that the terminal ring together with a number of rings disappeared when the bark was removed we could still get a date earlier than the beginning of the reign of Hattusili III. If future data can substantiate this to be correct then it would be reasonable to suggest that the buildings of Level 1 were erected by the predecessor/s of Hattusili III. In other words extra years for the level will not mean that extra years should be added to the reign of this king but to the occupation level. This will naturally increase the chronological range of certain material culture assemblages, and in particular certain of the Hittite ceramic forms. The previous level, Level II, produced two seal impressions, one of Tudhaliya, according to Özgüç Tuthaliya II, and the other of Suppiluliuma I.

Kuşaklı-Sarissa: The northwest terrace of the main temple at Kuşakli produced a timber with a last-preserved ring at 1560 B.C. Another temple, Building

5 The cargo of this ship produced among chronologically significant finds such as early LH IIIB pottery and a gold scarab of Nefertiti, wife of Akhenaten. These finds obviously provide important links to the chronologies and histories of the Aegean and Egypt. See also Kuniholm et al. 1996d: 782.

C also produced a timber with a last preserved ring 1573. Since these samples had no bark it is obvious that the exact date of the felling of the trees cannot be estimated with exactitude (Kuniholm 2001;82). Nevertheless, since Sarissa is mentioned in the Old Hittite texts and material culture remains of this period exist on the site, one may safely assume that the construction of the temples pre-date the 14th century B.C. In line with this argument it is necessary to review the date of the ceramic assemblages found in these temples. In other words, the 14th/13th century ceramic assemblages found in Hittite settlements may have had a much longer time span than assumed before the excavations at this site started.

Kilisetepe: Excavations at this LBA site produced a number of charcoal samples. One of them, probably belonging to a stretcher (with no preserved bark) placed between the stone foundations and the mudbrick wall of a building in phase IIc, has a last preserved ring dated to 1350 B.C. (Kuniholm 2001:82). Since the felling date of this particular tree should be after 1350 B.C., the relative dendro date for this and the following occupation phase (IId) whose debris produced Mycenaean IIIC pottery can be estimated as lasting approximately a century.

Gordion: Data for the dendrochronological framework were obtained from more than twenty architectural units on the City Mound, from the adjacent tumuli, the Great Tumulus at Ankara, and archaic wood recovered from the Athenian Agora (Kuniholm 1988). The best estimates for absolute dates were derived from the innermost rings of the Great Tumulus burial chamber. The innermost rings were dated to the late 16th century B.C. and the outermost rings of the 8th century B.C. The latter date do not contradict the traditional dating of the Middle Iron Age material culture remains found in the tomb chamber. Already in 1977 the tree-ring (juniper) chronology for the Midas Mound Tumulus at Gordion and dates for other buildings on the City Mound was 806-years long. The 24 juniper log samples from this site have an average span of 500-600 years each. In addition, one of the logs suggests that the tree was 918 years old when it was cut down in the 8th century B.C. As things stand now the estimated gap between the Gordion Iron Age chronology and the 677-year Middle Bronze chronology has apparently been reduced to ca 20-30 years. In 1990 the Master chronology for this site was further expanded by the collection of juniper timbers from one of the Kızlarkaya Tumuli a few km north of

Gordion, some of which must have been around a thousand years old at the time they were cut down some time in the 8th century B.C. In one of the three tumuli at Kızlarkaya, Tumulus A, a simple rectangle of juniper slabs forming the grave chamber produced additional Middle Iron Age dates. Since up to a century of sapwood is missing, the guess was that the tomb should be dated to the mid-8th century B.C. (Kuniholm 1992:123). Since 911 annual rings are preserved in these timbers, the resulting graph cross-dates not only with the Gordion master chronology but also with the 677 year long MBA chronology.

In 1991 Kuniholm estimated that a continuous chronology ca 1625 years long, running from the 24th century B.C. to the 8th century B.C. is not beyond reach (1991). With new additions of tree-rings the Gordion time-scale has recently been estimated to cover a 1028 years long period. The extension of the Iron Age chronology allows us to cross-date the Iron and Bronze Age chronologies with each other.

The over 15 centuries long dendrochronological sequence for Anatolia, which could further expand at both extremities, is pinned in place by wiggle-matched 18 radiocarbon dates for specifically selected rings. Therefore, when a particular ring is moved up or down to fit the high or low chronology then all the rings on the graph must move up an equal number of years (Kuniholm 1992:123, 128-129).

In the meantime, Kültepe's Warsama palace and the Northwest trench at Acemhöyük provide the tree-rings for the Early Bronze Age end of the scale while the last ring in the Midas Mound Tumulus at Gordion, where bark was found present on several different logs, provide the date for the Iron Age end of the scale (Kuniholm 1993:373).

Once an unfloating dendrochronological time-scale is achieved for Bronze and Iron Age Anatolia it will be possible to evaluate the precision of absolute and relative chronologies based on historical and archaeological sources. Once this stage is attained then the evaluation of cultural and historical developments can be studied, as already pointed out by Kuniholm (1993:373), independent different of schools of thought, ideologies and preconceptions. It is clear that the contribution of second millennium Anatolian sites towards this goal is tremendous and the results are already crossing geographical boundaries. The 330 year Cedar of Lebanon chronology obtained from the MBA Sarikaya palace complex at Acemhöyük can now be matched with cedars imported by Egyptians from Lebanon and found in historically dated contexts (Kuniholm and Newton 1989:287). Once the master tree-ring time-scale for

the East Mediterranenan region is completed, it will have wide-ranging chronological implications for traditional pottery chronologies and other conventional means of dating.

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