

The Uluburun Shipwreck – a Dendrochronological Scandal

During the Late Bronze Age a trading ship was wrecked off the promontory of Kaş, near Uluburun, in southwestern Turkey. Work on its excavation began in 1984 and the wreck has proved to be a gift to archaeologists. Its cargo included Mycenaean and Cypriot pottery, Canaanite storage jars filled with resin, copper and tin ingots, tools, fishing equipment, weapons, stone artefacts, gold and silver jewellery and a unique gold scarab bearing the name of the Egyptian queen Nefertiti. For more details, photographs and bibliography see online articles by the Institute of Nautical Archaeology on the “[Bronze Age Shipwreck Excavation at Uluburun](#)” and “[Continuing Study of the Uluburun Shipwreck Artifacts](#)”.

As all their contents sank together, shipwrecks like this are veritable “time-capsules”. Excepting occasional problems involving antiques or possible antiques, rich multi-cultural cargoes like that of Uluburun provide invaluable evidence for refining the relative archaeological chronologies of neighbouring regions. Shipwrecks also hold the promise of offering absolute dates for their cargoes, if timbers from the ship can be reliably cross-dated with a well established dendrochronology.

In 1996 Peter Kuniholm, Director of the Aegean Dendrochronology Project at Cornell University announced (in preliminary form) a result for Uluburun, in a article published in the prestigious journal *Nature* (Kuniholm *et al.* 1996, 782):

Wood found as part of the cargo on Kaş/Uluburun shipwreck has a last preserved ring at 1316 BC; other finds include Mycenaean pottery from Greece (the most recent material present is early Late Helladic IIIB; J. B. Rutter, personal communication), and a unique gold scarab of Nefertiti, wife of Akhenaten, pharaoh of Egypt. These provide links to the chronologies and histories of the Aegean and Egypt, and confirm conventional 14th-12th century BC chronology against recent radical critiques. [Reference to James *et al.*, *Centuries of Darkness*, 1991]. Tree-ring dating now offers the route to a new, absolute, chronology of the Old World that is independent of existing assumptions, gaps in evidence and debates.

Since then several other publications (including Manning 1999, 417-18; Dodson 2000, 14-15; Gilboa, Sharon & Zorn 2004, 54, n. 39) have cited the Uluburun date as providing scientific confirmation of the conventional chronology and a refutation of the case made in *Centuries of Darkness* case for a major lowering of the Late Bronze Age in the Eastern Mediterranean.

The following notes, presented in diary form, document why the Uluburun date is dubious in the extreme and how its status as a “scientific” date has gradually unravelled.

Uluburun Critique 1999

When the Uluburun shipwreck date was raised on the Ancient Near Eastern (ANE) discussion group, Peter James submitted the following informal critique regarding the dendrochronology on 8th November 1999 (original presently archived at:

<http://www-oi.uchicago.edu/OI/ANE/ANE-DIGEST/1999/v1999.n314>). The letter is reproduced here (with some corrections to punctuation and spelling):

ane ULU BURUN DENDRO DATE

<snip>

Strictly speaking there is no “dendrochronological date” for the Ulu Burun shipwreck – at least not in the sense that most people might imagine. If your house is burnt down and someone later tries to date either its destruction or when you built it, using radiocarbon or dendrochronology, then some very strange results could arise. Dendrochronology certainly cannot give a date for the first event – the burning of the house – only a *terminus post quem* with an unknown period of time to be subtracted from it. Both methods date the years when particular tree rings grew. And a house (or boat for that matter) may be burnt or sunk many years after it was built (or even used). The dates given by radiocarbon (for wood) and dendrochronology will of course be nearer the date of construction, but even with timbers deliberately cut for incorporation in a structure, time needs to be allowed for seasoning, and if bark wood is not present, then an unknown number of years for the continuing growth of the tree after those particular annual rings grew. These are relatively minor problems with dating wood constructions in the ANE, where timber was reused on a massive scale and used possibly even a number of times in different buildings. Peter Kuniholm’s work on Anatolian dendrochronology has shown this repeatedly.

Of course ships will be somewhat different, but there are analogies to the above caveats about timber buildings. One assumes that boats would have been built with freshly cut timbers – purpose cut, as it were. Still, there is always the possibility that good, ready cut timbers might have been salvaged from an old boat simply to save time and resources. These are unknowns, but to date the construction of a boat, or rather find a *terminus post quem* for its building, then obviously the best wood to use from an ancient shipwreck would be the timbers from which the boat itself is made.

Given that, what do we actually have from Ulu Burun in terms of a dendro date? There is no date for the ship as such, but for a piece of wood found on the boat. In his article in *Nature* (381, p. 782), Peter Kuniholm stated that “wood found as part of the cargo... has a last preserved tree-ring of 1316 BC.” No further detail was given, and the sample has yet to be formally published (as far as I know). Further information can be gleaned from informal, interim reports by Kuniholm and others. In his 1996 newsletter he stated that the “last ring at Ulu Burun is 1315 B.C. I do not think that we are missing any rings on the exterior. Since the shipwreck is a time-capsule, a date for the wood dunnage on board helps date all the rather more glamorous cargo items from half a dozen civilizations or more.”

Despite Kuniholm’s confidence that there were no missing rings on the exterior, after three years of the piece of wood drying out, further rings were detected – actually, an additional nine, bringing the date down to 1305 BC within his Anatolian dendro sequence. This is, near enough, the date reported on the Ulu Burun website (1306 BC), and it is unlikely that it will come down any further.

Still, one cannot take seriously the belief (hope) that there are no further rings missing from the exterior, especially after this proved to be wrong from the initial assessment. No bark has been reported present, so the truth is that an utterly unknown number of rings may have been trimmed from the exterior of the sample.

Turning to the sample itself, as anyone can ascertain from the Ulu Burun website, the wood in question is “a small piece of presumably fresh-cut firewood or dunnage”. Again, the choice of words here is rather hopeful. I burn wood on an open fire, which I collect from skips – the best stuff available is roof timbers from the houses in this area which were built around 1901. I daresay the rings in those timbers go well back into the 19th century. Admittedly this is a comment from a modern urban environment, but then many archaeologists seem to be out of touch with the real world, be it ancient or modern. In the ancient world, even though supplies of timber might have been more accessible (in certain countries), wood was still a precious resource – albeit for fuel, building, sculpture or whatever. The best wood for construction might be well-seasoned timbers (over a few years), but the best wood for burning, as anyone who has lit a fire knows is “rubbish” wood that has been lying around in a dry place for as long as possible. Most green, or freshly cut, wood produces masses of acrid, steamy smoke. If I were collecting fire-wood for a ship voyage (presumably to be lit inside some kind of container) I would not select “freshly-cut firewood”. Apart from the difficulty of lighting it on deck, one would end up with a very smoky barbecue. I would collect my wood from the equivalent of ancient skips. If there are any ethnographers, foresters, old seadogs or carpenters on the group I would appreciate feedback to tell me whether I am talking nonsense or not. As to the second possibility, that the wood was “dunnage”, the OED definition is “mats, brushwood, gratings, etc., stowed under or among cargo to prevent moisture and chafing.” Again, the idea that “freshly-cut” wood would be used to soak up moisture seems silly. Any old bits of wood would do, and the older and drier the better.

In short, whether it was used for firewood or dunnage, the Ulu Burun wood sample was a piece of scrap wood or “rubbish”. For either purpose one does not use good wood that could be used for something else. So there we have it. There is not a dendrochronological date for the Ulu Burun shipwreck, but there is a date for a piece of scrap (possibly very old) wood which was found on board. Why Kuniholm did not date an actual timber from the ship itself I have yet to fathom.

Now let's turn to the dating itself. The most detailed report on the sample comes from a paper by Malcolm H. Weiner, “The Absolute Chronology of Late Helladic IIIA2”, in M. S. Balmuth & R. H. Tykot (eds): *Sardinian and Aegean Chronology: Proceedings of the International Colloquium 'Sardinian Stratigraphy and Mediterranean Chronology', Tufts University, March 17-19, 1995* (Studies in Sardinian Archaeology V – Oxbow Books), pp. 309-319. Weiner funds Kuniholm's laboratory so has access to information from the horse's mouth, as it were. While Weiner himself seems to be delighted with the date, and was using it to moderate LHIIIA2 chronology, the following facts emerge from his paper. The sample in question is of a “badly-twisted piece of cedar, about six inches in diameter and over four feet long.” As a cautionary

note Weiner cites Kuniholm (1997): “any dates from a sampling of only two timbers must be treated with caution, especially when the wood is cedar which can often have eccentric growth characteristics.” There is then a mysterious aside in (Weiner’s) brackets: “(The other timber is not of direct chronological relevance.)” What other timber?

Returning to the timber that has been broadcast, Weiner continues: “The timber in question is particularly twisted and gnarled, and thus is unable to provide a conclusive computer-generated statistical match with the Anatolian master Bronze-Iron Age chronology, although the match (by Student’s t-score, Trend coefficient and D-score) which results in 1305 BC as the year of the last observable ring is superior to that for any other relevant year. The microscopic visual fit is convincing, however (Kuniholm & Steele, pers comm.). Thus there is a high likelihood that the last observable ring represents the year 1305 BC.”

Well, blind me with science! For the uninitiated, the above means that the Ulu Burun “shipwreck” date is not a proper dendrochronological date at all, as far as I understand it. Dendrochronology is a statistical method, which depends on having good enough samples to match patterns of annual growth (thick and thin) against an already established sequence. In this case we have a *particularly* poor sample. The sample was not good enough to run it through the computer using the usual statistical tests (such as those mentioned by Weiner). Instead it seems that it was matched to the overall Anatolian sequence by eye (“the microscopic visual fit”). But matched, or compared, to what? It doesn’t take a leap of imagination to imagine that since the cargo of the ship contained objects from the late 14th century (such as the famous Nefertiti object) that that is where Kuniholm’s team looked for a comparison in the sequence – to use Weiner’s words, in the “relevant years”. On what criteria were other years (or centuries) deemed irrelevant? Several years after word went out that the Ulu Burun shipwreck had been dated by dendrochronology there is still no formal publication to judge from.

I hasten to add that as far as I know Kuniholm’s dendro matching is only reliable for Anatolian trees (pine and a few other species) and that he does not have a sequence for this period for cedars from Anatolia. In the case of the Ulu Burun piece of scrap wood we have no idea where it was picked up. As an analogy that field archaeologists may appreciate, think about the problem of dealing with a piece of undiagnostic pottery (no handle, no rim, no decoration) which is unprovenanced. Under the microscope a thin section might show that the fabric is very similar to that of the Roman period, for example. But that does not mean that you have dated that sherd scientifically to the Roman period, even though you might have reasons to want that as an answer.

To conclude, there is no dendrochronological date for the Ulu Burun shipwreck. Rather, an unprovenanced piece of scrap wood, so twisted and gnarled that it cannot be subjected to the normal computer tests, has been matched by eye (and backed up by unpublished statistical calculations) to fit a possibly preconceived date within the sequence of completely different species of tree. There I rest my case until a formal publication of the result is available – when I will stand corrected and apologise if I have misunderstood something.

<snip>

On the other hand, all is not well with the conventional chronology. I hope my comments above have not seemed too critical of the work of Peter Kuniholm and his team. I sincerely believe that they, ultimately, have the key to ANE chronology. I am also pleased that the only LBA samples from Anatolia which they have fully published certainly support a lowering of chronology. I refer here to the result of 1101 ± 1 BC as a *terminus post quem* for the construction of the last phase of the Hittite Empire Gateway at Tille Höyük. On the conventional dating the Hittite Empire ended c. 1200/1175, so I take Kuniholm's result as strong support for the case argued in *Centuries of Darkness* by myself and my colleagues. (There we argued for a date around 950 BC.)

With apologies for the length of this post,

Peter James

Copies of this letter were also sent to the Aegeanet internet discussion group, Peter Kuniholm and a number of other interested parties.

Uluburun Update 2001

The points made in the above small e-mail 'campaign' appear not to have fallen on entirely stony ground. Two years later the date was virtually withdrawn by the Aegean Dendrochronology Project, as noted in a further letter to the Aegeanet and ANE groups on 23rd December 2001 (the ANE letter is presently archived at: <https://listhost.uchicago.edu/pipermail/ane/2002-January/000014.html>):

ULUBURUN REVISITED

Some time ago I posted a message questioning the value of a dendro date of 1305 BC which was being widely cited for the Uluburun shipwreck. As the cargo included a scarab of Nefertiti and Mycenaean pottery, the date was believed to provide vital support for the accepted dating of the Egyptian New Kingdom and the Aegean LBA. I mentioned many problems with this result, mainly concerning the sample, and too many to rehearse here, but I will gladly repost my original note if there is interest. A copy was sent to Peter Kuniholm at Cornell, whose team produced the date.

Perhaps my message had some effect, as I am now glad to note the following, commendably frank, statement in Kuniholm's latest article, published yesterday (21st Dec.):

“Caution should be exercised concerning a previously stated date derived from just two poorly preserved pieces of cargo/dunnage wood from the famous Uluburun shipwreck (refs). The quality and security of the dendrochronological placement of these samples versus the Bronze-Iron master chronology are not especially strong.”

Reference: n. 38 on last page of S. W. Manning, Kromer, B., Kuniholm, P., I., Newton, M. W., 2001. “Anatolian Tree Rings and a New Chronology for the East Mediterranean Bronze-Iron Ages”, *Science* 294, 2532-2535.

NB the dates still await formal publication, but given the virtual retraction of the date one imagines this may no longer be a priority.

Assuming we now discount the Uluburun result, there now seem to be no published example of an LBA dendro date from Anatolia which clearly supports the accepted Egyptian-based chronology. The only fully published dates for LBA Anatolia are those from Tille Höyük, where the cutting dates for timbers in an apparently imperial Hittite gateway are 1101 +/-1. Kuniholm's latest adjustment (explained in the above article) raises the dates for the master dendro sequence involved by 22 years. Even so, a *post quem* for the construction of the Tille Höyük Gateway of 1123 +4/-7 BC, is surely still too low for the conventional chronology, but in line with that we argued in *Centuries of Darkness*. (See Dendrochronology section in <http://www.centuries.co.uk/faq.htm> on our website.) The situation may be even more acute than that. While 1101 (now 1123) has been the result cited in secondary articles, the formal publication of the dates (Tille Höyük site report) reveal that the best fit for this sample (using the normal T-score statistical test) is actually in 942 +/-1 BC (now 964 +4/-7 BC).

Best,

Peter James

The full text of the *Science* article in question, with the important caveat in footnote 38, is available to read online at:

<http://www.arts.cornell.edu/dendro/science/2532-2535.pdf>

Further comment. Footnote 38 (Manning *et al.* 2001), as quoted in the above letter, continues in more optimistic vein:

If the fit is confirmed, the last preserved ring would now lie ca. 1327 +4/-7 B.C. This would confirm the conventional chronology of ancient Egypt, because the presence of a gold scarab of Nefertiti on the ship requires her standard mid-14th century B.C. data range.

The “if” aside, the statement is a logical *non sequitur*. A piece of scrap wood (with no bark present and of unknown purpose and felling date) can only provide a broad *terminus post quem* for the wreck. It cannot be used to “confirm” the conventional chronology.

Uluburun Update 2003

A new paper by Malcolm Wiener confirms that that ADP are getting cold feet about the Uluburun date:

Director Peter Kuniholm has recently informed me that... he and his colleagues are no longer confident as to the visual fit of the Uluburun branch within the Anatolian floating sequence, and would prefer to suspend judgement until additional dendrochronological material from the Uluburun shipwreck is received and examined, and current work comparing climate patterns reflected

in wood from Anatolia with wood from Syria and the Levant can be completed. In addition, while dunnage or firewood would not have been deliberately aged, as may sometimes be the case with logs used in construction, nevertheless the possibility exists that dunnage (which may have been collected to cushion oxhide ingots in transit, for example) could have been reused over a period of time. (Wiener 2003, 245)

All of which nicely confirms the doubts expressed in James 1999 (above).

Most important is a further snippet of information given by Wiener (p. 244) – based on a pers. comm. from Kuniholm – explaining more clearly how the date was originally arrived at:

The placement of the Uluburun branch within the Gordion floating sequence was based on close visual examination, after comparison by computer proved inconclusive; the visual examination was reported to indicate a better match here [1305 BC] than at an point fifty years in either direction.

First this flatly contradicts Sturt Manning’s (diametrically opposite) claim that the “Correlation [was] determined by computer calculation and checked by eye.” (Manning 1999, 345, caption to Fig. 63.) Second, and most importantly, is the revealing remark about the parameters (“fifty points in either direction” from 1305 BC) of the investigation for the visual matching. On the *Centuries of Darkness* chronology the ship would have sunk sometime in the first half of the 11th century BC. Was a better match with the Gordion Master Sequence made for this century and rejected on archaeological (i.e. conventional chronology) grounds? Or, more likely, was the search restricted to fifty years either side of c. 1300 BC because this is the “known” date? Either way, the claim of Kuniholm and Manning that the published match refutes the *CoD* model (see above) turns out to be utterly false. (Cf. Q12 in [Fifteen Frequently Asked Questions](#).)

Uluburun Update 2004a

Doug Keenan (a mathematical scientist) has examined the alleged “visual match” between the Uluburun cedarwood and the Gordion Master Sequence, as shown on the published diagram (see Pulak 1996, 13, Fig. 1; Manning 1999, 345, Fig. 63). He concludes:

It is clear that there is not a visual match. In other words, there was no match at all. The claim that the shipwreck wood had been dated was spurious.

Keenan’s further remarks on the case can be read on his website, in the working draft of his paper “[Anatolian Tree-ring Studies are Untrustworthy](#)”, section 3 in the updated mss (22/02/06).

Uluburun Update 2004b

Awareness about the dubious nature of the Uluburun “date” seems to be spreading. In a detailed review of Sturt Manning’s *A Test of Time* (1999) in *Bibliotheca Orientalis*, senior Egyptologist Manfred Bietak made these blunt remarks about the alleged date:

It is also by no means certain, nor even likely, that the cedar wood from the Ulun [*sic*] Burun shipwreck comes from inner Anatolia. It could be Lebanese, Cypriot or Amanus cedar. Secondly there is no possibility to verify the claim made for fitting the Ulun Burun ship with the Gordion tree-rings, either by the data nor in the graphs published. *If S. Manning and P.I. Kuniholm want us to believe in those results, they will have to come up with far more detailed data that would stand up to the evidential test. Until such time, there is no evidence for an independent date of this shipwreck.* We are still forced to use the artefacts from the ship as a way of dating. [Bietak 2004, 221-222, emphasis added]

The full text of Bietak's (highly recommended) review can now be read online on at: <http://www.informath.org/BiOr04i.pdf>.

Uluburun Update 2005

Kuniholm *et al.* (2005, 46) reported that “the Kaş/Uluburun shipwreck is having its cedar sequence wiggle-matched at Heidelberg to confirm or refute our original placement in the 14th century.” (This is short-hand for saying that a number of radiocarbon tests will be performed on samples taken from the cedar finds at regular intervals – the curve from the plotted results can then be matched to the wiggles on the radiocarbon calibration curve.) It should be noted, however, that ¹⁴C results on the cedar dunnage will only be able to “confirm or refute” the date for the dunnage – *not* the shipwreck, the construction of the boat or the date of Nefertiti. Unless, of course, the results show that the wood was younger than the 14th century BC.

Some preliminary results were discussed in a talk by Marianne Newton and Peter Kuniholm at the Annual meeting of the American Institute of Archaeology in January 2005. The brief information in the available [Abstract](#) is not at all clear and further comment cannot be made until the ¹⁴C determinations are completed and published – hopefully fully, objectively and with reasonable speed. In the meantime, it is to be hoped that spokespersons for the Aegean Dendrochronology Project will up the methodological ante in the way the results are broadcast – something that has been extraordinarily lax so far.

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