22. ARKEOMETRİ SONUÇLARI TOPLANTISI

29 MAYIS - 2 HAZİRAN 2006
ÇANAKKALE

AEGEAN DENDROCHRONOLOGY PROCET: 2004-2006 RESULTS

Peter Ian KUNIHOLM, Jennifer D. WATKINS, Alison G. PETRUCCI
“The Aegean Dendrochronology Project”s (hereafter the ADP) summer field trips in 2004-2005 yielded 501 samples from 45 sites in Turkey, Greece, Italy, Croatia, Serbia, and Georgia. Additional samples arrived via the post. Of interest were the following, listed by period.

MODERN FORESTS

Six oak forests—Zonguldak, Bolu, Belgrade, Devecikonak, Komotini, Arnaia

Five conifer forests—Kyllini, Gazipaşa, Çağlayancerit, Grammos, Katara.

Using tree-ring growth for her data, Carol Griggs finished her dissertation and among other things completed an 800-year dendroclimatic reconstruction for the North Aegean. A poster on the 1169-1984 part of this work was shown in Antalya at the KST in May 2005. A formal paper: Griggs, C. B., DeGaetano,
A. T., Kuniholm, P. I., and Newton, M. W., “A regional reconstruction of May-June precipitation in the north Aegean from oak tree rings, AD 1089-1989,” is expected to appear in the *International Journal of Climatology* in the very near future. Since a number of these trees were collected more than 20 years ago, we spent time revisiting a number of oak and pine forests in 2004 and 2005 so that the last 20 years could be filled in.

**THE MEDIEVAL PERIOD—İstanbul Yenikapı Marmaray Kazısı**

On 16 and 18 June 2005 the ADP, with the help of Metin Gökçay, the staff of the İstanbul Archaeological Museum, and archaeologist Sırrı Çölmekçi, collected thirty-five samples (YMK-1-35) from the old Byzantine harbor of İstanbul. All the samples were cut from oak posts, most of them whole timbers (all in the round) unless otherwise noted. The samples had been excavated under the direction of Museum Director Dr. İsmail Karamut during excavations for the construction of a metro station in İstanbul at Yenikapı.

We were able to build a 198-year sequence from fourteen of these posts. No fits with any Anatolian sites from that period could be found. However, some sixteen medieval monuments in Greece crossdate with the YMK sequence, with the latter ending at 1445. The fit with Thracian and Macedonian sites is better than with sites in Thessaly. It is possible that the Turkish incursions across Anatolia in the 14th century prevented the Byzantines from drawing from Anatolian resources for wood and caused them to look to Greece, part of it firmly under Byzantine control, for their lumber. Cemal Pulak has also pointed out that the Venetians, who at this period were responsible for much of the big city’s maritime trade, may have found ready sources of timber in the northern Aegean, especially in the neighborhood of Thessaloniki.
Subsequently, we put together a 188-year sequence from another seven YMK pieces, ending in 1439. These crossdate with the first twelve YMK sections (t-score 5.51, overlap 188 years, trend coefficient 64%, D-score 78.1) and have therefore been combined with them into a single master YMK chronology from twenty-one pieces spanning the years 1248-1445 (see the list below). The quality of the external crossdating should be apparent from the numbers that appear in the second list. It is our guess that this second group of posts could have come from the Marmara region or the Black Sea coast. Now, we observe significant crossdating results between YMK and Turkish and Black Sea oak chronologies where none were apparent before.

Most of the YMK pieces preserve a significant amount of sapwood—up to 32 rings. Since we usually expect to find 26 +/-9 sapwood rings on Aegean oak, we assume that most of the YMK pieces with more than ten sapwood rings still preserved were cut down within a very few years after the last ring shown below.

### DATES FOR THE İSTANBUL YENİKAPI MARMARAY KAZISI POSTS

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>PROVENIENCE</th>
<th>RINGS</th>
<th>ABSOLUTE DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>YMK-2</td>
<td>H 23, Kazik 1 (Bati), Max. D. = 0.095m., Quercus sp., measured to 1431. 22 sapwood rings begin in 1422. Import from Greece. A = p+ 43 +12v</td>
<td>1389-1443+v</td>
<td></td>
</tr>
<tr>
<td>YMK-4</td>
<td>K 14, Kazik 1 (Güneybatı), Max. D. = 0.09m., halved, Quercus sp., 15 sapwood rings begin in 1309. Probably local or Black Sea. A = p+ 59 +1v</td>
<td>1264-1323+v</td>
<td></td>
</tr>
<tr>
<td>YMK-6</td>
<td>J 23, Kazik 1 (Güney), Max. D. = 0.115m., Quercus sp., 11 sapwood rings begin in 1426. Probable import from Greece. A = p+ 45 +1v</td>
<td>1391-1436+v</td>
<td></td>
</tr>
</tbody>
</table>
YMK-10  H 23, Kazık 1, Max. D. = 0.103 m., partially squared, *Quercus* sp., 24 sapwood rings begin in 1387. Import from Greece. 
\[ A = p + 136 + 1v \quad 1274-1410 + v \]

YMK-11  H 23, Kazık 2, Max. D. = 0.078 m., *Quercus* sp., 10 sapwood rings begin in 1387. Import from Greece. 
\[ A = p + 37 + 1v \quad 1359-1396 + v \]

YMK-13  H 23, Kazık 4, Max. D. = 0.08 m., *Quercus* sp., 13 sapwood rings begin in 1389. Import from Greece. 
\[ A = p + 31 + 1v \quad 1370-1401 + v \]

YMK-16  H 23, Kazık 7, Max. D. = 0.075 m., *Quercus* sp., 15 sapwood rings begin in 1414. Import from Greece. 
\[ A = p + 37 + 1v \quad 1391-1428 + v \]

YMK-17  H 23, Kazık 8, Max. D. = 0.105 m., partially squared, *Quercus* sp., 15 sapwood rings begin in 1418. Import from Greece. 
\[ A = p + 41 + 1v \quad 1391-1432 + v \]

YMK-18  H 23, Kazık 9, Max. D. = 0.10 m., *Quercus* sp., 14 sapwood rings begin in 1427. Probably local or Black Sea. 
\[ A = p + 68 + 1v \quad 1372-1440 + v \]

YMK-19  I 21, Kazık 1, Max. D. = 0.11 m., halved timber, *Quercus* sp., no sapwood rings. Measured to 1423. Probably local or Black Sea. 
\[ A = 1 + 61 + 6vv \quad 1363-1429 + vv \]

YMK-21  I 21, Kazık 3, Max. D. = 0.094 m., partially squared, *Quercus* sp. 
17 sapwood rings begin at 1389. Local or Black Sea. 
\[ \text{YMK21AB} = p + 45 + 1v \quad 1360-1405 + v \]

YMK-22  I 21, Kazık 4, Max. D. = 0.092 m., *Quercus* sp., 17 sapwood rings begin in 1323. Import from Greece. 
\[ A = p + 91 + 1v \quad 1248-1339 + v \]

YMK-23  J 23, Kazık 1, Max. D. = 0.10 m., halved timber, *Quercus* sp., 
15 sapwood rings begin in 1423. Import from Greece. 
\[ A = p + 47 + 1v \quad 1390-1437 + v \]
YMK-25  J 23, Kazik 3, Max. D.= 0.10m., Quercus sp., no sapwood rings. Measured to 1321. Local or Black Sea.  
A=  p+  70  +2v  1252-1323+v

YKM-26  J 23, Kazik 4, Max. D.= 0.11m., Quercus sp., 8 sapwood rings begin in 1426. Import from Greece.  
A=  p+  28  +1v  1405-1433+v

YMK-27  J 23, Kazik 5, Max. D.= 0.103m., Quercus sp., 18 sapwood rings begin in 1380. Probably local or Black Sea.  
A=  p+  41  +1v  1356-1397+v

YMK-28  J 23, Kazik 6, Max. D.= 0.095m., Quercus sp., 9 sapwood rings begin in 1438. Import from Greece.  
A=  p+  59  +1v  1387-1446+v

YMK-29  J 23, Kazik 7, Max. D.= 0.115m., partially squared, Quercus sp., 32 sapwood rings begin in 1374. Probably local or Black Sea.  
A=  p+  82  +1v  1323-1405+v

YMK-31  N 2, Kazik 1, Max. D.= 0.115m., partially squared, teredo worm holes, Quercus sp., 23 sapwood rings begin in 1365. Import from Greece.  
A=  p+  100  +1v  1297-1397+v

YMK-32  N 2, Kazik 2, Max. D.= 0.136m., teredo worm holes, Quercus sp., 17 sapwood rings begin in 1364. Import from Greece.  
A=  p+  63  +1v  1318-1380+v

YMK-33  N 2, Kazik 3, Max. D.= 0.135m., squared, teredo worm holes, Quercus sp., 16 sapwood rings begin in 1406. Import from Greece.  
A= 1+  107  +1v  1314-1421+v

YMK-21-piece SUM  M=  198  1248-1446+v

includes YMK-2, 4, 6, 10, 11, 13, 16, 17, 18, 19, 21, 22, 23, 26, 26, 27, 28, 29, 31, 32, 33
SUPPORTING EXTERNAL CROSSDATING STATISTICS for YMK at 1248-1445 (n=198 years)

<table>
<thead>
<tr>
<th>SITE OR MASTER CHRONOLOGY</th>
<th>DISTANCE</th>
<th>t-SCORE</th>
<th>OVERLAP</th>
<th>TREND</th>
<th>D-SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrace/Thessaloniki Master Chronology</td>
<td>varies</td>
<td>6.20</td>
<td>198</td>
<td>65.0%</td>
<td>92.9</td>
</tr>
<tr>
<td>Central/West Greece Master Chronology</td>
<td>varies</td>
<td>5.35</td>
<td>198</td>
<td>61.0%</td>
<td>58.4</td>
</tr>
<tr>
<td>Thessaloniki, Hg. Apostles</td>
<td>510km</td>
<td>5.23</td>
<td>198</td>
<td>67.0%</td>
<td>87.5</td>
</tr>
<tr>
<td>Thessaloniki, Vlatadon Monastery</td>
<td>510km</td>
<td>5.01</td>
<td>92</td>
<td>67.0%</td>
<td>85.4</td>
</tr>
<tr>
<td>Thessaloniki, Hg. Aikaterini</td>
<td>510km</td>
<td>3.90</td>
<td>68</td>
<td>59.7%</td>
<td>37.8</td>
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<tr>
<td>Thessaloniki, Frourio Vardari 21</td>
<td>510km</td>
<td>3.90</td>
<td>198</td>
<td>58.0%</td>
<td>31.7</td>
</tr>
<tr>
<td>Elassson, Olympiotissa</td>
<td>590km</td>
<td>3.76</td>
<td>88</td>
<td>64.0%</td>
<td>51.9</td>
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<tr>
<td>Didymoteichon, Celebi Sultan Mehmet Mosque</td>
<td>210km</td>
<td>3.65</td>
<td>198</td>
<td>63.0%</td>
<td>47.2</td>
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<tr>
<td>Serres, Zincirli Cami 10A</td>
<td>460km</td>
<td>3.57</td>
<td>151</td>
<td>58.0%</td>
<td>29.7</td>
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<tr>
<td>Arta, Faik Pasha Türbe</td>
<td>710km</td>
<td>3.54</td>
<td>103</td>
<td>56.9%</td>
<td>24.3</td>
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<tr>
<td>Thessaloniki, White Tower early</td>
<td>510km</td>
<td>3.40</td>
<td>198</td>
<td>56.9%</td>
<td>23.3</td>
</tr>
<tr>
<td>Thessaloniki, Hg. Antonios, early</td>
<td>510km</td>
<td>3.39</td>
<td>144</td>
<td>60.0%</td>
<td>34.4</td>
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<tr>
<td>Serres, Prodromos, Early</td>
<td>460km</td>
<td>3.34</td>
<td>98</td>
<td>62.0%</td>
<td>39.6</td>
</tr>
<tr>
<td>Turkey Oak Master Chronology</td>
<td>varies</td>
<td>3.20</td>
<td>198</td>
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<tr>
<td>Black Sea Master Chronology</td>
<td>varies</td>
<td>3.12</td>
<td>198</td>
<td>56.9%</td>
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<tr>
<td>Çanakkale, Kilid-ul Bahir</td>
<td>240km</td>
<td>3.05</td>
<td>152</td>
<td>57.3%</td>
<td>22.2</td>
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<tr>
<td>Meteor, Monastery of the Transfiguration</td>
<td>640km</td>
<td>2.92</td>
<td>69</td>
<td>50.0%</td>
<td>0.0</td>
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<tr>
<td>Aghia, Panteleimon</td>
<td>550km</td>
<td>2.89</td>
<td>88</td>
<td>58.6%</td>
<td>29.3</td>
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<tr>
<td>Thessaloniki, Nikolaos Orphans</td>
<td>510km</td>
<td>2.77</td>
<td>189</td>
<td>57.0%</td>
<td>20.6</td>
</tr>
<tr>
<td>Verroia, Tou Christou</td>
<td>570km</td>
<td>2.67</td>
<td>80</td>
<td>59.5%</td>
<td>25.4</td>
</tr>
<tr>
<td>Aiani, Hg. Demetrios</td>
<td>620km</td>
<td>2.58</td>
<td>128</td>
<td>54.3%</td>
<td>11.2</td>
</tr>
</tbody>
</table>

Contemporary sites with which the YMK chronology ought to crossdate but which have scores that are not significant: Kariye Cami, Kemerli Kilise, Python Castle, Hg. Sophia NW Buttress, Serres Orestes Tower, Hg. Sophia Türbes, Serres Mustafa Bey and Zincirli Mosques, Thessaloniki Hg. Demetrios and Hg. Sophia Ottoman phase.
This report will make more sense after we have sat down and compared notes with the archaeologists and architects who have been studying the YMK site. What is clear to us, even though we are not able to locate the samples any more precisely than the large 10-meter grid-squares from which they were retrieved, is that the maritime business of the city of Constantinople, whether fishing or small-sized shipping, was going on right up to the time of the Turkish attack in 1453. A hungry city population needs active fishermen and their small craft. Small craft need docks, and docks need repairs. Thus, three of the dated YMK timbers were cut in the 1440’s, five more in the 1430’s, four more in the 1420’s, and so on. Two timbers, cut in the late 14th century, show damage from teredo worms. It will be especially instructive to see which posts were on dry land and which were in salt water. For example it is difficult to imagine how YMK-25 with a last-preserved ring in 1323 could have survived for about a century if it was anywhere near salt water. Much interpretation lies ahead for all of us in the summer of 2006.

The potential that the YMK project has for shedding light on the day-to-day development of Constantinople/İstanbul is therefore incalculable, and we are pleased to have been able to play a small part therein, especially as the excavations proceed ever more deeply.

**THE “ROMAN GAP” PROJECT—Çanakkale, Biga, Parion**

In addition to on-going radiocarbon work at Heidelberg, in the summer of 2005 the ADP collected 107 pieces of charcoal from the Çanakkale Museum’s storage facility. They had been excavated the year before from a series of four graves (60, 146, 183, and “J-9”). All pieces were *Quercus* sp. (oak).

One dataset of ten pieces from “Grave J-9” has a significant fit against the early part of our new, provisional, master oak chronology ending in the year AD 208 (t-score 4.23, trend 65.9%, D-score 67.17 with a 64-year overlap, if the master chronology has been correctly put together). It also had a significant fit with the radiocarbon-dated material from one of the only sites we have
that covers this period, Değirmendere, 75 km. away across the Dardanelles near Tekirdağ (t-score 3.09, trend 68.3%, D-score 56.3, but with only a 64-year overlap). Unfortunately, the data-sets for Biga-Parion are generally so short that multiple significant fits may be seen with the master oak chronology. Therefore, we cannot securely date any of these other graves. Director Nurten Sevinç and Assistant Candan Kozanlı of the Çanakkale Museum are the archaeologists in charge, and we hope that this year’s excavations will have produced more material by the time we visit them in Çanakkale in May-June 2006.

IRON AGE—The Tatarlı Tumulus and Four Painted Cedar Logs in Münich

I. The Archaeological Museum in Afyon, Turkey

In 1989 the Aegean Dendrochronology Project was invited by the late Director Ahmet Topbaş to core tree-ring samples from a pile of painted timbers from the Tatarlı Tomb, then stored in the basement of the Afyon Museum. Due to deterioration of the logs over the years and problems of identifying micro-rings, the cores came out in multiple pieces, and crossdating proved extremely difficult.

Accordingly, in 1991 we revisited the Afyon Museum with permission from Director Topbaş to cut thin cross-sections from the ends of the pieces now stored under the museum roof. Almost all had been surfaced flat on one side, presumably on the surfaces which were subsequently to be painted.

Crossdating with the sections was successful. Tatarlı yielded two long ring-sequences: a 259-year sequence of Juniperus sp. from 15 trees, ending in the waney edge, and a 238-year sequence of Cedrus libani from 18 trees, also ending in the waney edge. There were additional pieces of wood stored in the Afyon Museum, but these were not collected, due to the shortness of the ring-counts and our reluctance to do any harm to the painted surfaces.
The two chronologies crossdated with each other with good statistical fits, and immediately we realized that the cedars had been cut three years before the junipers, a detail for which we did not then have a ready explanation. Our first question was: what was the date? The painting style suggested something near the middle of the first millennium BC. We tried matching Tatarlı against the junipers from Gordion, the only available tree-ring chronology reasonably near in time, but the fits were unsatisfactory because, as we now know, the Gordion ring-sequence ends about four years before Tatarlı begins. A detailed report on the Afyon work should appear this month.

II. The Archaeologische Staatssammlung in Munich, Germany

Over the years English and German colleagues reported the existence of painted timbers in the collection in Munich. On June 6 and 7, 2005, with the kind help of the Keeper, Frau Dr. Gisela Zahlhaas, and thanks to arrangements made by Dr. Lâtife Summerer who has prepared a report on these timbers from the point of view of an art-historian, we were permitted access to the four timbers, two with a funeral procession and two with an Achaemenid combat scene. Each timber, stored carefully in a wooden box with cloth padding and acid-free paper, fitted the physical dimensions and descriptions of those in Afyon, i.e., smoothed on one face that was then painted. We sanded a radius from pith to the terminal ring, and then measured each ring to the nearest 1/100 mm. (Fig. 1). The Munich wood not only matched the two Afyon chronologies in general but also several specific ring-sequences, so spectacularly, in fact, that we can state with complete assurance that certain timbers in Munich are from the same original tree as ones in Afyon (Fig. 2, for example). The

piths and bark years are the same for the timbers in both museums. The fits between the relevant pairs of Munich and Afyon timbers are as follows:

Munich-1A and -3A (same tree) are also the same tree as Afyon-37A: t=25.77, r=0.94.
Munich-2A and -4A (same tree) are also the same tree as Afyon-38A: t=20.77, r=0.92.

Moreover, the combined length of each of these sets of pieces from the two museums, end-to-end, is about three meters, or the typical length of the longest Tatarlı timber on the longitudinal axis. What is clear is that somebody must have preceded the visit of the Afyon Museum authorities to the tumulus site, selected the two best-painted sections, sawed each of them into two suitcase-sized lengths (roughly a meter each), and then removed them to Germany (Fig. 3).

III. Questions for the Future

1. We need to find out from the excavator(s) and/or the Afyon Museum whether our recorded excavation numbers correspond to specific timbers in their section drawings. It would be useful to know whether cedar and juniper were intermixed randomly or whether one species was used for the walls and the other used for the ceiling. As noted from our very first study of the wood, the juniper sequence ends three years after the cedar one. If the juniper is mostly from the roof of the tomb chamber and the dromos, it may come from a building program three years later than the cutting-date of the painted cedar walls of the tomb chamber. This would imply that the tomb-builders and painters preferred to paint on dry wood rather than on freshly-cut wood. They therefore seasoned their to-be-painted cedarwood surfaces in much the same manner as did the Netherlandish painters in the Renaissance with their oak panels.²

2. It will then be an informative exercise to try to reconstruct the principal sections of the Tatarlı chamber so that the scenes can be viewed and studied in their entirety and the painting program set out in proper order. For example, are there yet other parts of this painted program in collections elsewhere in the western world? This question cannot be answered until the \textit{disjecta membra} of the tomb are finally reuniited. We owe the Staattssammlung staff a vote of thanks for preserving their four painted timbers so carefully. The Afyon Museum will also need help in conserving the paintings and providing a temperature and humidity-controlled environment for the exhibition and long-term preservation of this important tomb. We are at work trying to find major foundation support for this work.

\textit{BRONZE AGE—\textbf{the Work of Sturt W. Manning and others at Santorini}}

In the April 28, 2006 issue of Science magazine appeared two articles on Santorini-Thera, one by the new director of our laboratory, Prof. Sturt W. Manning, et al., and another by W. L. Friedrich, et al. See also the commentary by Michael Balter\textsuperscript{3}. A link from our web-page to the Science articles will appear shortly\textsuperscript{4}.

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4 Acknowledgments: The Malcolm and Carolyn Wiener Laboratory for Aegean and Near Eastern Dendrochronology is supported by the National Science Foundation, the Malcolm H. Wiener Foundation, and individual Patrons of the Aegean Dendrochronology Project. At the time of our first visit to Afyon we were also supported by the National Endowment for the Humanities, the National Geographic Society, and the Samuel H. Kress Foundation. For fundamental research permissions we thank the appropriate authorities in all the countries in which we work, as well as the many excavators and curators who not only take time out to explain the intricacies of their material but who make us welcome at their excavation houses and museums year after year. We thank Dr. Aleksandar Durman, Hope Kuniholm, Maclaren North, and Maryanne Newton for their assistance in the measurement of the Afyon pieces, Dr. Bernd Kromer for the radiocarbon dates, and Mary Jaye Bruce and Tania Lemos for assistance with the graphics.
Fig. 1: Measurement of the Munich Staatssammlung wood from pith to the terminal ring.

Fig. 2: Tatari-37 (black line) plotted against Munich-1A (light line). The measurements are in 1/100mm. The fit is spectacular (r-correlation = .94), and the fact that the two pieces of wood are from the same tree is unquestionable.

Fig. 3: Reconstruction drawing of the way these timbers looked before being cut up and transported to Munich. (Drawing courtesy of Dr. Latife Summerer.)