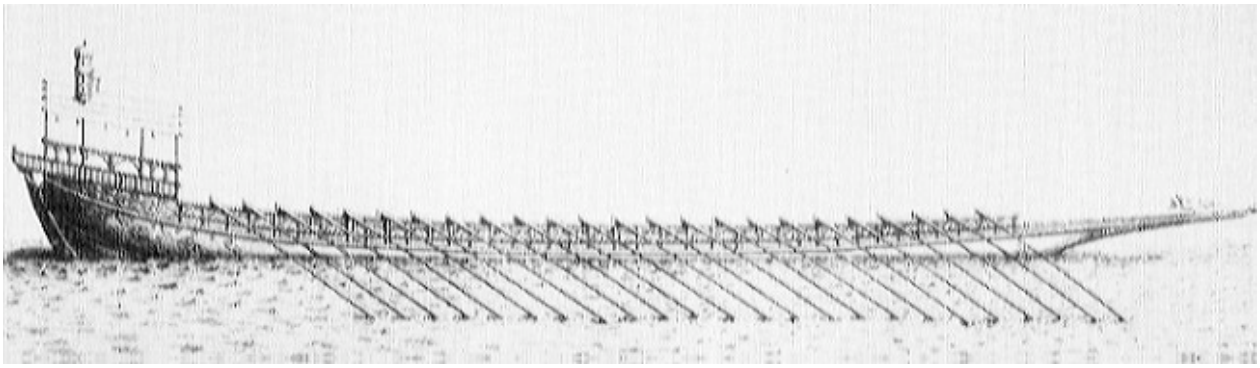
Aegean Dendrochronology Project December 2000 Progress Report

Instead of starting out in the usual fashion with an account of what-we-did-last-summer, let us look back at A.D. 2000 from the point of view of what went on in the lab, by far and away the most important part of any year's work, but usually saved for the next-to-last paragraph because of the generally gee-whiz nature of the summer's collecting. Moreover, it also used to be that our activities were sufficiently circumscribed that I could enumerate them in a couple of pages. This is no longer so. Here, then, are a number of highlights from the year as a whole.

MARITIME MATTERS--THE KADIRGA or GALLEY:

From an extraordinary ship, the Ottoman Sultan's galley, possibly built as far back as 500 years ago and restored in the last century, now in the Naval Museum in Besiktas, Istanbul, came pieces of wood from the keel, floor, and frames. The last preserved ring on the oak keel is 1827 with no sapwood. The oak floor has a last preserved ring of 1860, again with no sapwood. The wood is almost certainly from the Black Sea coast. What we have been measuring are pieces possibly to be associated with repairs ordered in 1885, presumably by Sultan Abdülhamid II. See the most recent *INA Quarterly* 27:2/3, page 17, for a discussion of this galley.



The Sultan's Galley, possibly our Kadirga, in 1671 (Nederlandsch Scheepvaart Museum, Amsterdam).

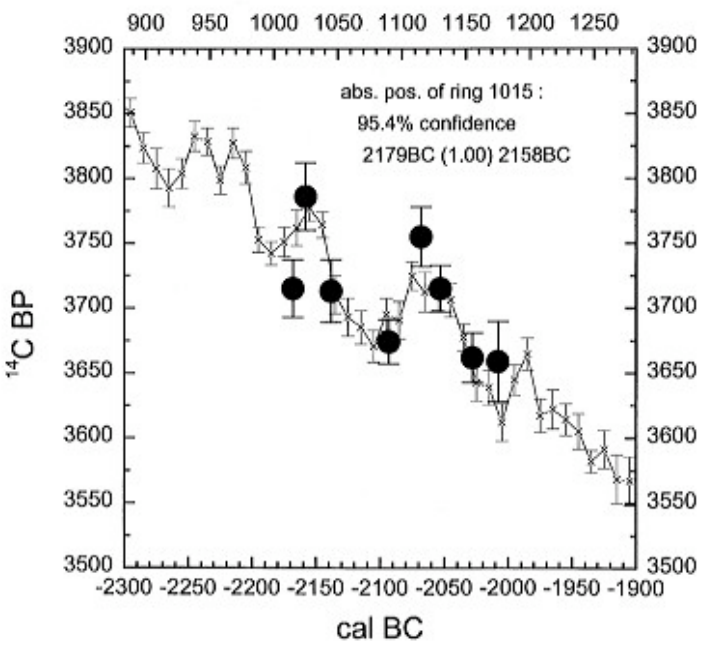
THE HARBOR AT PISA:

Workers digging the foundations for a new central railway station at Pisa had to stop when they realized, in considerable dismay, that they had just cut a Roman ship in half. The area was designated an archaeological zone and is currently being excavated by Prof. Stefano Bruni. The total number of ships as of the time of our visit last summer was 16 Roman vessels ranging in date from 1st to 6th centuries, and one Hellenistic ship. Have a look at the official web-site for the Soprintendenza: http://www.navipisa.it/ with pages in both Italian and English and elegant color photographs of the ships, also a report in English from Archaeology: http://www.archaeology.org/9907/etc/pisa.html, the latter report now somewhat out of date but at least in English.

Of course, just because the ships sank in Pisa does not mean they were built anywhere near Pisa. Indeed, one ship has a tooth of a lioness which means that the vessel could have stopped at Carthage to bring an animal north for the games. Wood species identified so far include *Pinus pinea, Pinus pinaster, Abies alba,* and *Ulmus*. Anywhere in the Roman world will do for the origin of a given ship. We have reached an agreement with Professor Bruni to try to date the entire fleet. This might represent just the material we have been needing to bridge our chronological gap across the Roman period, and it certainly represents a richer maritime possibility than the lonely galley (but what a galley!) in Istanbul.

LAVAGNONE DI BRESCIA:

Carol Griggs is just about done with the Early Bronze Age site only a few kms. south of Lake Garda (1997 ADP Newsletter). The Lavagnone chronology covers 297 years, and Carol has worked up a dating scheme that appears to be divisible into at least 4 building phases: Phase I ending at about 2048 B.C., Phase II at about 2010-2008 B.C., Phase III at about 1994-1991 B.C., and Phase IV at about 1984 B.C. There are miscellaneous trees that can be assigned to single years other than these "phases," or whose cutting can not be pinpointed due to lack of sapwood. For at least 65 years after 1984 B.C., there was building and repair work going on, but there are no perceptible building phases within that later period. A bar-graph showing these "phases" or groupings is available (although somewhat large). The dates B.C. are based on Bernd Kromer's wiggle-matching.



The phases are also made up of two groups of trees from apparently geographically-separate places. Since there is enough difference in the individual tree-ring patterns, without the large number of pieces from each place there would have been considerable difficulty in putting the chronology together.

	ALL		Group 1		Group 2	
	Samples	Trees	Samples	Trees	Samples	Trees
Phase I	16	13	16	13	0	0
Phase II	25	12	8	4	17	8
Phase III	18	10	11	6	7	4
Phase IV	18	5	8	3	10	2
No phase	3	2	3	2	0	0
Later	7	5	2	2	5	3
TOTALS	87	47	49	31	38	16

What this tells us (we think) is that wherever the people of Lavagnone obtained their wood (almost all oak) they got it in the ca. 2048 B.C. Phase I from a forest or forests represented by the 13 trees from Group 1. By the time of Phase II ca. 2010-2008 B.C. and thereafter, although they continue to exploit the forest(s) of Group 1, they are also cutting wood in quantity from another slightly different locality, Group 2. Our colleagues A. Billamboz and H. Schlichtherle have noticed the same phenomenon on Lake Constance (the Bodensee), where the earliest Neolithic timbers (all cut in the round) can be distinguished from a later phase of the Neolithic (halved and quartered timbers) and an even later phase in which squared timbers are cut out of much larger oak trees.

Similarly, by the time of Phase IV at Lavagnone (ca. 1984 B.C.), technology at this site was so well advanced that a large number of radial pie-shaped sections could be cut out of a single tree. We are still working away on details in advance of the date (February 2001) in which our colleague Professor Raffaele DeMarinis's Lavagnone report is to be sent to the publisher, but we feel we have made a good start in helping him and his staff toward their final interpretation of the site.

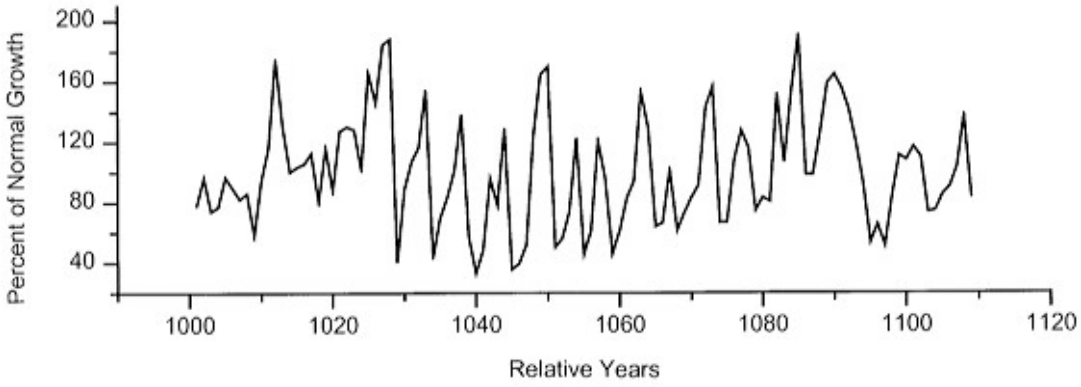
RAVENNA, SAN MARCO, SAN FRANCESCO DEL DESERTO, and TORCELLO:

Other Roman or Late Antique sites are still being worked on. The long tree-ring sequences from Ravenna that Annie Koehne built last year are still being wiggle-matched in Heidelberg. One thing we note is that some of them which were originally thought by excavator Maria Grazia Maioli to be either Augustan or 2nd century may be rather older by a couple of centuries. The same is true for planks and posts excavated by our colleague Albert Ammerman from near the island of San Francesco del Deserto in the Lagoon of Venice. The significance of dates for these efforts at channel control is that we will have a way of measuring the siltation rate and the infill of the lagoon.

From a set of 50 drill-holes underneath the Basilica of San Marco in Venice we have a number of pieces of wood, thanks to Soprintendente Roberto Cecchi, which will give us a notion of the ancestry of this monument. At first glance, San Marco is going to have a much more venerable history than the handbooks tell us [i.e., it has forerunners]. We are also at work on oak sections from the Basilica at Torcello. Patience until all the results are in.

VERUCCHIO:

Most of the readers of this letter know about bugs, especially in their computers. We have evidence of bugs from the first half of the seventh century B.C. A couple of years ago at Verucchio, a hilltop settlement west of Ravenna excavated by Soprintendente Patrizia von Eles, a tomb loaded with furniture, huge leech fibulae decorated with large pieces of amber, and other elegant objects, also produced a fine set of planks from the tomb covering. We reasoned that this was definitely going to be datable against something. Well, it does not. Moreover, something seems to have been eating its leaves on a 5-to-6-year cycle. The graph below shows the problem. The extraordinary zig-zag pattern of the rings has nothing to do with local climate conditions but much more likely with the life cycle of something like a cockchafer beetle. We have a two-page list of creatures which like to eat elm leaves or burrow around in elm roots thereby causing strange patterns to appear in the ring- growth, but we have not yet identified the source of the problem. Nice well-excavated site, apparently nice wood, but so far no date. Aggravation!



Verucchio elm sequence with severe damage at 5-6 year intervals, possibly from cockchafer beetles.

NEUTRON ACTIVATION ANALYSIS AT THE WARD CENTER:

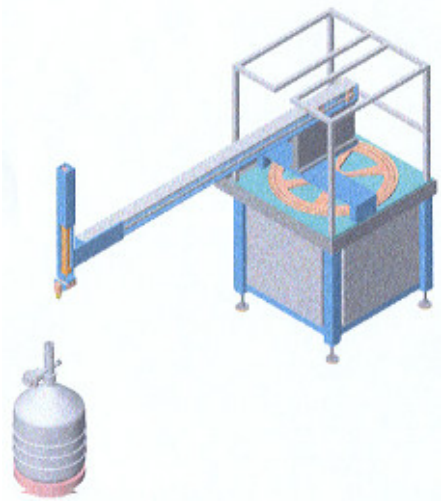
In the December 1998 version of this newsletter I mentioned that John Chiment had found traces of gold uptake in certain tree-rings, specifically 1816, the so-called "year without a summer" one year after the eruption of Tambora in 1815. Continued work with 19th century tree-rings also shows a spike of gold in 1884, one year after the eruption of Krakatoa in 1883. The phenomenon is to be found in both Turkish pines and Greek

oaks in the same two years. Lesser volcanic eruptions produce lesser, but nonetheless recognizable, spikes.

Accordingly, we have set out to take apart the last several thousand years' worth of tree-rings, one at a time. Here you see Amanda Erwin chopping off single absolutely-dated tree-rings from a sample taken from Kalkim Forest not far from the peak of Mt. Ida in the Troad. This has been the single most difficult part of this exercise. Amanda was ably assisted by Michael West and Karola Kirsanow. All three are now graduates of the NRC's Radiation Safety Course. As of this writing several hundred single rings have been cut out and put into labelled plastic vials.

After the rings are dissected, they are subjected to neutron activation analysis (NAA). The flux at the core of the Ward Center's reactor is 2 x 10(superscript 12) neutrons per square centimeter per second. Since Dr. Kenan Ünlü, the director of the Ward Center, activates each batch for 6 hours, that means a total fluence of 4.3x10(superscript 16) neutrons per square centimeter. If you are uncomfortable with exponential notation, try 43 quadrillion neutrons. (It adds a new dimension to the concept of "well-done.")

In our pilot project for the past two years, we found that the biggest nuisance was finding appropriate times when the reactor could be turned on, then the samples removed, then put into the counters. That meant having qualified students with plenty of free time standing by at just the right times, not easy when the activated gold for which we were looking has a half-life of only 2.7 days after which there is nothing left to detect. So we built a robot. In this contraption, the big box holds a large carousel tray with two rows of holes, in the outer one of which is a set of vials, each with the wood from a single tree-ring in it. Upon command the robot arm comes down and picks up a vial and carries it to the germanium detector, which is shielded by several tons of lead bricks (not pictured in this illustration). Then at the desired time the robot arm comes back, picks up the vial, and returns it to the carousel, but to the inner row of holes. Then the arm picks up the next vial and repeats the process, 24 hours a day, 7 days a week. That means the students who load the tray merely have to put the vials into the holes in the correct order, punch the start button, and go away, knowing that the all the data will be detected and recorded on four kinds of media.



We have assembled a working group of plant physiologists, a number of whom work with heavy metal uptake by plants, a climatologist interested in global atmospheric circulation models, a physicist and his staff who actually run the reactor, and a palaeontologist to help us interpret the results. We are also looking for other trace elements in years of stress. Our new multi-channel analyzer can search for up to 25 elements at a time. Duplicate samples are being sent to the Cornell High Energy Synchrotron Source (CHESS) for X-Ray fluorescence analysis. The two methods of investigation should complement each other.

SUMMER 2000:

A somewhat abbreviated collection season nevertheless allowed us to acquire highly-stressed tree-ring samples from previously neglected areas: the Peloponnese and the west coast of Asia Minor. Two of the more notable forest stands were Kalkim in the Troad and Mt. Taygetos in the Peloponnese where the Spartans used to expose their unwanted baby daughters (for non-classicists that means to leave them for the vultures) and where we collected splendidly sensitive *Pinus nigra* with the help of Dr. Kate Paraskevopoulou, Greek Forestry Research Institute, and Robert Brandes, &Uml;niversität Erlangen. Robert is in the middle of an ecological study of the Peloponnese, and we have agreed to join forces and resources. We also collected similarly good sets from the forests at Mugla and Köycegiz in Turkey. A visit to the 'Palace of Nestor' at Pylos yielded pieces of charcoal collected car efully half a century ago by Carl Blegen and Marion Rawson. It is doubtful that these can be dated by dendrochronology, but the shorter-lived pieces will be splendid for radiocarbon. Ditto for Kommos on Crete, Triandha on Rhodes, and Akrotiri on Thera/Santorini.

Dispilio, on Lake Kastoria

The Neolithic lake-side settlement of Dispilio at Kastoria yielded, thanks to Professor George Chourmouziades, 17 pilings, all with significant numbers of rings. This one day's collection yielded more wood than has ever been collected from all Greek Neolithic sites combined. Professor Chourmouziades and his staff have built a wonderful reconstruction of the settlement right on the shore of Lake Kastoria, so that one gets a vivid impression of what village life may have been like some 7000 years ago. He has partially burned one of the houses so that the visitor may realize whaat kinds of difficulties the archaeologist may face in trying to interpret an ancient site.

On left, the Neolithic lakeside settlement of Dispilio, Kastoria, as reconstructed by Professor Chourmouziades and his crew. On the right, Christine Groneman is the proud owner of a 7000-year-old piling.

OUTSTANDING OLD BUSINESS:

A couple of years ago I reported collecting charcoal from Mycenae from the British excavations in the late 1950s. Maryanne Newton has now finished measuring some 51 sets of nasty little pieces, mostly Juniperus, but with one lot of Quercus (oak). She is still experimenting with some of the more problematic pieces. Prof. Andreas Müller-Karpe's Hittite site, Kusakli, also continues to be enigmatic, and we have sent another batch of small outer rings off for wiggle-matching. Maryanne has reworked the oak samples from Kaman-Kalehöyük excavated by Prof. Sachihiro Omura and has identified a microscopically-small ring right in the middle of the sequence, the apparent absence of which had been giving us fits. Wood sent to us from the French excavations in Alexandria Harbor crossdates with wood from Caesarea Maritima, but we need more than just the four samples currently in hand before we can say anything more intelligible. Christine Groneman continues with Bronze Age wood from Lecce/Roca. Kenneth Harris is rewriting our measuring and analysis system (CORINA) so that it will be compatible with WINDOWS.

INTERNATIONAL TREE-RING DATA BANK (ITRDB):

The total number of chronologies provided by us to NOAA's Palaeoclimatology data bank in Boulder, Colorado, is currently 12, thanks in large part to hard work last year by Isabel Tovar. Christine Groneman has finished re-checking a 455-year chronology of *Taxus baccata* (yew) from the Republic of Georgia, and that will be submitted later this month. If you want to visit this web-site, see http://www.ngdc.noaa.gov/paleo/treering.html.

PUBLICATIONS:

Current Patrons of the Aegean Dendrochronology Project should recently have received two offprints on Panel Paintings and on Ottoman Architecture. Forthcoming are papers in D. Brothwell and M. Pollard's *Handbook of Archaeological Science*, and W. F. Jashemski's *The Natural History of Pompeii and Other Vesuvian Sites*. A paper with M. K. Hughes and others on the climatic reasons for why we get crossdating across such long distances is in press at the *Tree-Ring Bulletin*. If you can read Japanese, ask me for lab-member Yuki Furuya's translation of two of my dendrochronological papers to appear in T. Mitsutani, ed., *Proceedings of a Dendrochronological Symposium in Nara, Japan.*

Laboratory Offspring:

Maryanne Newton passed her Ph.D. "A" exams with flying colors. Carol Griggs, energized by her work on the Chemung mastodon site, has formally embarked on a Ph.D. dissertation on geological timbers in New York. Isabel Tovar is in the anthropology department at the Field Museum. Chris Roosevelt won the A.I.A.'s Olivia James Award. Alex Rau, a rookie last year, won a Marshall scholarship to Oxford where he is studying physics. Annie Koehne is teaching in a preparatory school in or near Washington. Joan Ramage, a member of this lab on and off since she was in high school, defended her Ph.D. dissertation most satisfactorily and is teaching geology at Union College in Schenectady where she is known as Professor Ramage. Bravo, Joanie!

The year 2000 also saw the establishment of our first "daughter" laboratories, the first in Trento, Italy, overseen by Dottoressa Maria Ivana Pezzo, the second in Istanbul, Turkey, overseen by Dr. Aliye Aras. We wish them well.

Jane Terrell puts Doryphoros' head on straight.

As all visitors to the lab know, and as all former project members recollect, we are surrounded by plaster casts of Greek and Roman statues. One of the saddest has always been Doryphoros who had had his head stolen before I came to Cornell in 1976. Mary Jaye Bruce recently organized the making and sending of a copy of the missing head from the Royal Cast Collection in Copenhagen, and Jane Terrell did the necessary installation. He is almost ready for viewing, and the improvement over the headless version is remarkable.

Peter Ian Kuniholm

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