A Dendrochronological Analysis of the

West Camp House

Town of Saugerties,
Ulster County, New York

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Introduction

This is the final report on the dendrochronological analysis of the West Camp house, located on Route 9W in West Camp, Town of Saugerties, Ulster County, New York. In an effort to confirm the construction history of this house, architectural historian Walter Wheeler of Hartgen Archeological Associates, Inc., 1744 Washington Ave Ext, Rensselaer, NY 12144 , requested that dendrochronologists William Callahan and Dr. Edward Cook perform a tree-ring analysis of its structural timbers. Together with Mr. Wheeler, Callahan visited the house on 22 April, 2005, and collected wood core samples for dendrochronological analysis of timbers. Of the 11 samples acquired and analyzed, 10 were oak (Quercus sp.) and 1 was an unidentified coniferous wood. Every effort was made on site to locate bark or waney edges on the sampled timbers in order to ascertain an absolute cutting date, or dates, of the trees used in the construction.

Dendrochronological Analysis

Dendrochronology is the science of analyzing and dating annual growth rings in trees. Its first significant application was in the dating of ancient Indian pueblos of the southwestern United States (Douglass 1921, 1929). Andrew E. Douglass is considered the "father" of dendrochronology, and his numerous early publications concentrated on the application of tree-ring data to archaeological dating. Douglass established the connection between annual ring width variability and annual climate variability, which allows for the precise dating of wood material (Douglass 1909, 1920, 1928; Stokes and Smiley 1968; Fritts 1976; Cook and Kariukstis 1990). The dendrochronological methods first developed by Douglass have evolved and been employed throughout North America, Europe, and much of the temperate forest zones of the globe (Edwards 1982; Holmes 1983; Stahle and Wolfman 1985; Cook and Callahan 1992, Krusic and Cook 2001). In Europe, where the dendrochronological dating of buildings and artifacts has long been a routine professional support activity, the success of tree-ring dating in historical contexts is noteworthy (Baillie 1982; Eckstein 1978; Bartholin 1979; Eckstein 1984).

The wood samples collected from the West Camp house were processed in the Tree-Ring Laboratory by Dr. Edward Cook, following well-established dendrochronological methods. The samples were carefully glued onto grooved mounts and sanded to a high polish to reveal the annual tree rings clearly. The rings widths were measured under a microscope to a precision of ±0.001 mm. The cross-dating of the obtained measurements utilized the COFECHA computer program (Holmes 1983), which employs a sliding correlation to identify probable cross-dates between tree-ring series. In all cases, the robust non-parametric Spearman rank correlation coefficient was used for determining cross-dating. Experience has shown that for oaks growing in the northeastern United States, this method of cross-dating is superior to the traditional skeleton plot technique (Stokes and Smiley 1968). It is also very similar to the highly successful CROS program employed by, for instance, Irish dendrochronologists to cross-date European tree-ring series (Baillie 1982).

COFECHA is used to first establish internal, or relative, cross-dating amongst the individual timbers from the site. This step is critically important because it locks in the relative positions of the timbers to each other, and indicates whether or not the dates of those specimens with outer bark rings are consistent. Subsequently, the internally cross-dated series are each compared with independently established tree-ring master chronologies compiled from living trees and dated historical tree-ring material. All of the "master chronologies" are based on completely independent tree-ring samples.

In the West Camp study, a regional composite master dating chronology from living trees and historical structures in the Hudson Valley region was referenced primarily. This historical master covers the period 1449-2002 A.D. All dating results were verified finally by comparison with independent dating masters from surrounding areas in New York, New Jersey, Massachusetts and central Pennsylvania. In each case, the dating as reported here was verified as correct.

Results and Conclusions

The results of the dendrochronological dating of the West Camp house timbers are summarized in **Table 1** and **Figure 1**. A total of 10 oak and 1 conifer samples were analyzed in the laboratory, with all of the 10 oak samples providing firm dendrochronological dates. To achieve this success required attention during analysis to the previously recorded structural context of the samples (see **Table 1**). The contextual association of samples from within the house, the redundancy of the indicated relative cross-datings, and the existence of bark/waney edges demonstrating cutting year, provide the essential constraints necessary for establishing cross-dating both within the site and with absolute chronological masters.

The strength of the cross-dating of the oak samples is indicated by the Spearman rank correlations in column 7 ("CORREL")of **Table 1**. These correlations, produced by the COFECHA program, indicate how well each sample cross-dates with the mean of the others in the group. These individual correlations vary slightly in statistical strength, but all are in the range that is expected for correctly cross-dated timbers from buildings in the eastern United States. Of the 10 samples that cross-dated well between themselves, and also dated well against the local oak historical dating master (see **Table 1**, column 6), all had bark edge at the time of sampling. An additional, single, bark-edged sample was of an unidentified coniferous species, and is undated.

From the ten datings that were achieved, there emerged clear indications of an intrinsic construction period that produced the West Camp house. The samples from the house indicate a construction phase sometime (probably shortly) after the end of the year 1754. The last annual ring (outermost ring) in 5 dated barked timbers cut in 1754 is complete, which means that the trees were cut during seasonal dormancy in the late autumn/early-winter of 1754 or late winter/very early-spring of 1755. One additional sample with complete growth was cut in 1753. Those 4 samples that had wane edge, but where outermost ring growth was incomplete or was disturbed, strongly support the 1754 date. One had an incomplete growth year for 1754 (perhaps the remainder of the outer year "eroded" during the years since construction, or perhaps the trees were cut slightly earlier - late summer or early autumn but slightly before dormancy began - in preparation for construction), and the remaining 3 had breaks or degradation in the outermost rings. None, however, precluded the 1754 dating: 2 had outermost rings representing 1753 and 1 representing 1752.

Finally, there is a single coniferous sample that remains undated. The particular species is anatomically unidentified and therefore unspecified in this report. This sample was taken from a loose column or beam from the collapsed superstructure of a ruined barn associated with West Camp house. Because this sample is not essential to the dating of West Camp house itself, and because of its own uncertain interpretative value, no further effort in dating or identifying the wood species is intended. Although the physical integrity of the core was good, the limited number of rings (69) makes its eventual dating unlikely in the present sample configuration. Although not considered of sufficient value to warrant additional attention at this time, the core will be archieved with the other samples from West Camp house for possible use in future dendrochronological studies.

Table 1. Dendrochronological dating results for all samples taken from the West Camp house, Ulster County, New York. For WANEY, +BE means the bark edge was present and recovered and –BE means that bark edge was either not present or not recoverable. All correlations are Spearman rank correlations of each series against the mean of all of the others of the same species, in this case oak (*Quercus sp.*), except for WCHMNY11 (a conifer). If the outermost recovered +BE ring is completely formed, it is indicated as "comp", meaning that the tree was felled in the dormant season following that last year of growth. If the +BE ring is not completely formed, it is indicated as "inc", meaning that the tree was felled during the active growing season of that year of growth. Those samples with questionable felling dates due to sapwood degradation or bad breaks/possible lost rings are indicated by "?".

ID	SPECIES	DESCRIPTION	WANEY	RINGS	DATING	CORREL
WCHMNY 01	Oak	West cellar, cellar joist, 3rd from west wall	+BE comp	106	1649 1754	0.57
WCHMNY 02	Oak	West cellar, cellar joist, 2nd from west wall	+BE comp	128	1627 1754	0.57
WCHMNY 03	Oak	West cellar, cellar joist, 1st from west wall	+BE comp	130	1624 1753	0.58
WCHMNY 04	Oak	West cellar, cellar end joist on west stone wall	+BE inc?	87	1668 1754	0.34
WCHMNY 05	Oak	First floor, east room, end joist over east wall	+BE comp	38	1717 1754	0.58
WCHMNY 06	Oak	First floor, east room, end joist over west wall behind fireplace	+BE comp	111	1644 1754	0.42
WCHMNY 07	Oak	First floor, west room, 3rd beam from west wall	+BE comp	175	1580 1754	0.34
WCHMNY 08	Oak	Attic, 2nd story, west end, 3rd collar from west wall, face of chimney	+BE? degraded	81	1673 1753	0.38
WCHMNY 09	Oak	Attic, area over 2nd story chamber, 5th collar tie from west wall	+BE? bad break	46	1707 1752	0.46
WCHMNY 10	Oak	Attic, west end, top plate over west wall	+BE? bad break	86	1668 1753	0.46
WCHMNY 11	Conifer sp.	Barn ruin, collar or beam from collapsed superstructure	+BE	69	No Date	-.--

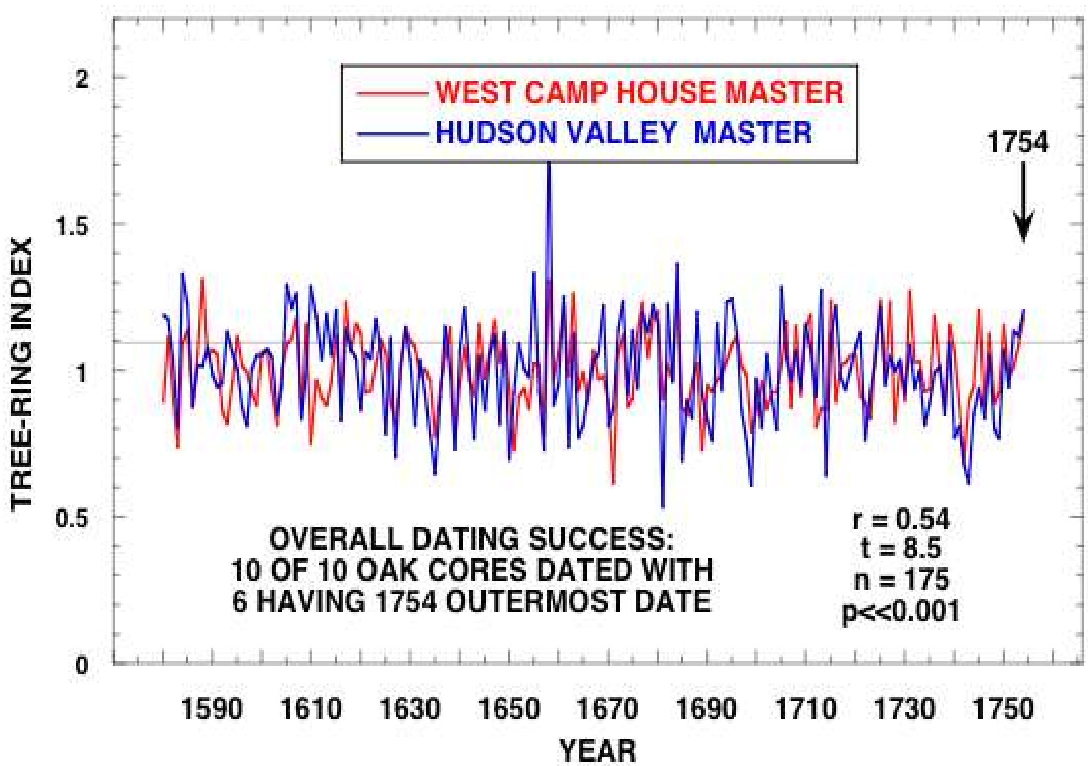

Figure 1. Comparison of the cross-dated oak master chronology for the West Camp house, Ulster County, New York with the best regional oak dating master developed from living trees and historical structures in and around the Hudson Valley, NY. The Spearman rank correlation between the series (r=0.54) is highly significant (p<<0.001) with an overlap of 175 years.

The reliability of the dating is succinctly illustrated in **Figure 1**. It shows the mean of the "internal" oak chronology developed from the 10 dated West Camp house oak samples compared with the local, independently dated oak historical dating master from the Hudson Valley region of New York.

The "r-factor" is the Spearman rank correlation coefficient, a measure of relative agreement between two groups of measurements or data. It can range from -1 (perfect opposite agreement) to +1 (perfect direct agreement). The "t-value" is Student's distribution test for determining the unique probability distribution for "r", i.e. the likelihood of its value occurring by chance alone. As a rule, a t=3.5 has a probability of about 1 in 1000 or 0.001 of being invalid. Higher "t" values indicate increasingly stronger statistical certitude.

The t-statistic (t=8.5) associated with the correlation between these two series (r=0.54) is highly significant (p<0.001) for a 175-year overlap. For that reason, there can be no doubt that the dates presented here are very strongly valid, and that the statistical chance of the cross-dates being incorrect is much, much less than 1 in 1000.

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Edward Cook was born in Trenton, New Jersey, in 1948. He received his PhD. from the Tucson Tree-Ring Laboratory of the University of Arizona in 1985, and has worked as a dendrochronologist since 1973. Currently director of the Tree-Ring Laboratory at the Lamont-Doherty Earth Observatory of Columbia University, he has comprehensive expertise in designing and programming statistical systems for tree-ring studies, and is the author of many works dealing with the various scientific applications of the dendrochronological method.

William Callahan was born in West Chester, Pennsylvania, in 1952. After completing his military service he moved to Europe, receiving his MA from the University of Stockholm in 1979. He began working as a dendrochronologist in Sweden in 1980 at the Wood Anatomy Laboratory at the University of Lund, and returned to the United States in 1998. A former associate of Dr. Cook at the Tree-Ring Laboratory of Lamont-Doherty, he has extensive experience in using dendrochronology in dating archaeological artifacts and historic sites and structures.

Some regional historical dendrochronological projects completed by the authors:

Abraham Hasbrouck House, New Paltz, NY
Carpenter's Hall, Philadelphia, PA
Christ's Church, Philadelphia, PA
Conklin House, Huntington, NY
Customs House, Boston, MA
Daniel Pieter Winne House, Bethlehem, NY
Ephrata Cloisters, Lancaster County, PA
Fawcett House, Alexandria, VA
Gadsby's Tavern, Alexandria, VA
Gilmore Cabin, Montpelier, Montpelier Station, VA
Gracie Mansion (Mayor's Residence), New York, NY
Hanover Tavern, Hanover Courthouse, VA
Harriton House, Bryn Mawr, PA
Hollingsworth House, Elk Landing, MD
Independence Hall, Philadelphia, PA
John Browne House, Forest Hills, NY
Log Cabin, Fort Loudon, PA
Lower Swedish Log Cabin, Delaware County, PA
Morris Jumel House, Jamaica, NY
Old Swede's Church, Philadelphia, PA
Panel Paintings, National Gallery, Washington, DC
Pennock House & Barn, London Grove, PA
Powell House, Philadelphia, PA
Spangler Hall, Bentonville, VA
St. Peter's Church, Philadelphia, PA
Strawbridge Shrine, Westminster, MD
Thomas & John Marshall House, Markham, VA
Varnum's HQ, Valley Forge, PA
William Garrett House, Sugartown, PA
Yew Hill, Fauquier County, Virginia