Dendrochronological Analysis of *Freer-Low House*, Huguenot Street, New Paltz, Ulster County, New York

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Introduction

This is the final report on the dendrochronological analysis of the structure known as the *Freer-Low House*, located at Huguenot Street, New Paltz, Ulster County, New York, 12561 (Latitude: N41º 45' 10"/Longitude: W74º 05' 18"). The building is currently owned by Huguenot Historical Society, 18 Broadhead Avenue, New Paltz, NY 12561-1403.

In an effort to confirm the construction history of this building, architectural historian Neil Larson, acting on behalf of the Historical Society, requested that dendrochronologists William Callahan and Dr. Edward Cook perform a tree-ring analysis of its structural timbers.

Together with Mr. Larson, Callahan visited the house on 15 October 2008, and collected wood core samples for the dendrochronological analysis of the timbers. Of the 10 samples acquired and analyzed, all were of oak (Quercus sp.). 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 Freer-Low 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 trees growing in the northeastern United States, this method of cross-dating is greatly 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 Freer-Low House study, regional composite master dating chronologies from living trees and historical structures in the Hudson Valley region were referenced primarily. All dating results were verified finally by comparison with independent dating masters from surrounding areas in New England, New Jersey and central and eastern Pennsylvania. In each case, the datings as reported here were verified as correct.

Results and Conclusions

The results of the dendrochronological dating of the Freer-Low House timbers are summarized in **Table 1** and **Figure 1**. A total of 10 oak samples were analyzed in the laboratory, with 9 oak samples providing firm dendrochronological dates.

To achieve these datings 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 eventual existence of bark/waney edges demonstrating cutting year, provides the essential constraints necessary for establishing cross-dating, both within a site and with absolute chronological masters.

The strength of the cross-dating of the samples is indicated by the Spearman rank correlations in the seventh column ("CORREL") of **Table 1**. These statistical correlations, produced by the COFECHA program, indicate how well each sample cross-dates with the mean of the others in the group. The 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 9 oak samples that cross-dated well between themselves, and also dated well against the local oak historical dating masters (see **Table 1**, column 6), 6 had verifiable bark-edge at the time of laboratory analysis, 2 had apparent bark-edge that could not be verified with certainty, and 1 was lacking demonstrable bark-edge. Microscopically in the laboratory, 2 of the bark-edged samples were determined to have a complete growth ring in their cutting year (indicating felling during winter dormancy, that is, the trees were cut during dormancy after the end of the growth season, late in the autumn or immediately before the beginning of the growth season of the spring, i.e., approximately November through February), and 4 were determined to have an incomplete ring (indicating felling during the early growth season, i.e., approximately February through April).

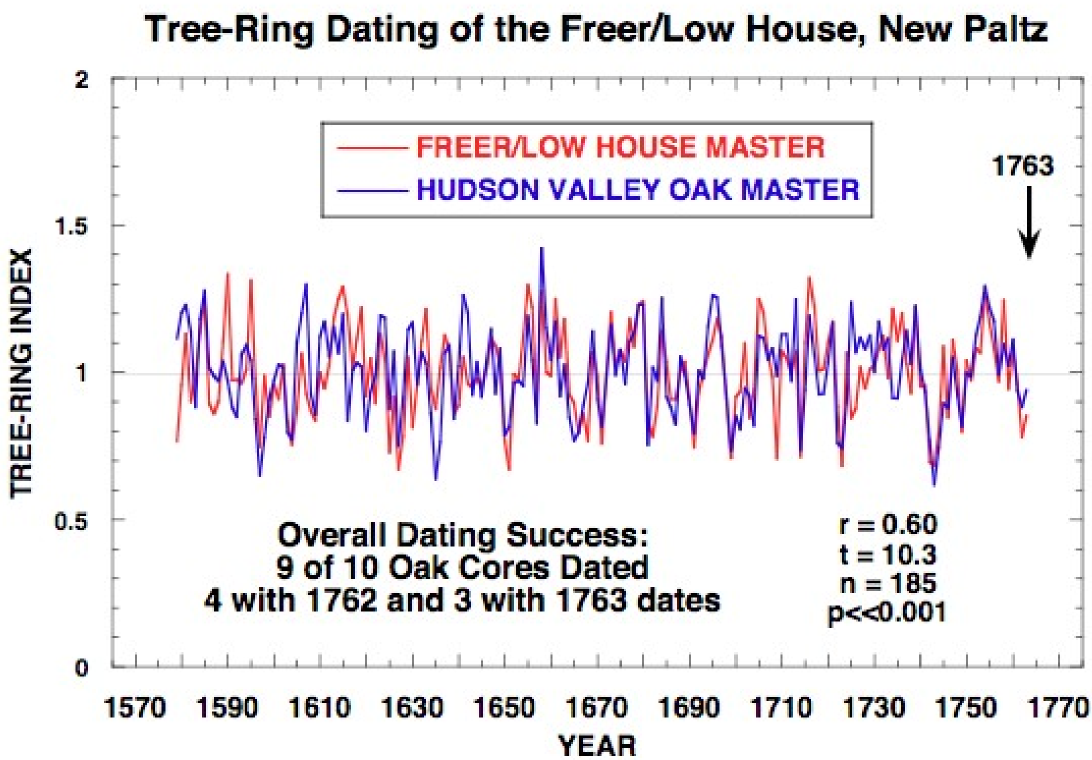
From the datings that were achieved, there emerged evidence of an intrinsic construction period for Freer-Low House. The absolutely dated, bark-edged samples FLNPNY 01, 02, 03, 04, 06, 07, redundantly supported by the datings of FLNPNY 08 & 10, indicate a construction phase for the house some time immediately around or perhaps shortly after the end of the growth season 1763. Four joists presently located in the "North Cellar" area were felled during parts of 1762; three joists in the "South Cellar" were felled during various seasons of 1763, and one joist with unverifiable edge condition was felled also during 1763. One joist in the "South Cellar", lacking bark-edge altogether, exhibited an outermost existent ring dated to 1699: this timber may be re-used from an earlier structure or construction, or may merely be an example of a degraded timber contemporaneous with its 1762/63 neighbors. This sample lost portions of its outermost edge during sampling due to degradation.

Close *in situ* inspection of the timbers indicated that the materials were initially utilized soon after cutting, in keeping with historical woodworking and carpentry techniques. Possible re-use of the timbers in subsequent construction phases, although not evidenced, cannot be excluded. However, the chronological homogeneity of the dated samples makes eventual re-use of timbers of no germane consequence to the present dendrochronological dating analysis.

Table 1. Dendrochronological dating results for all samples taken from the Freer-Low House, Ulster County, New York. For WANEY, +BE means the bark-edge was present and thought to be recovered at the time of sampling; -BE means that the bark-edge was not recovered or was completely missing on the timber. SP refers to sapwood being recovered (+) or not (-). All correlations are Spearman rank correlations of each series against the mean of all of the others of the same species. 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.

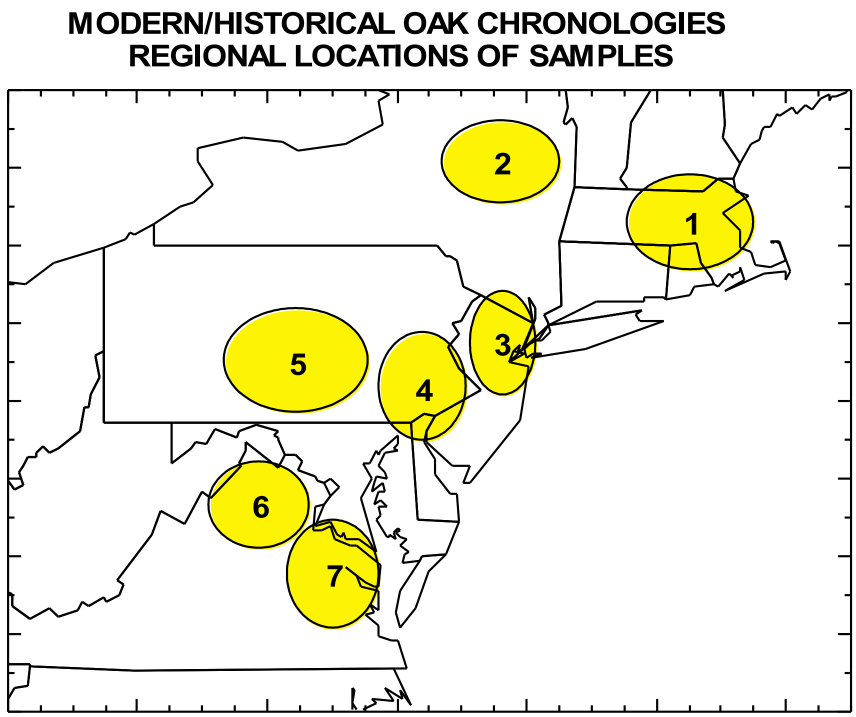
ID	SPECIES	DESCRIPTION	WANEY	RINGS	DATING	CORREL
FLNPNY 01	Oak	North cellar, 3rd joist from north wall	+BE comp	88	1675 1762	0.67
FLNPNY 02	Oak	North cellar, 2nd joist from north wall	+BE incomp	53	1710 1762	0.37
FLNPNY 03	Oak	North cellar, 1st joist from north wall	+BE incomp	183	1580 1762	0.41
FLNPNY 04	Oak	North cellar, 4th joist from north wall, above center wall	+BE incomp	45	1718 1762	0.80
FLNPNY 05	Oak	North cellar ledger above north wall	+BE	104	No date, growth too suppressed	-.--
FLNPNY 06	Oak	South cellar, 4th joist from center wall/north wall	+BE comp	185	1579 1763	0.59
FLNPNY 07	Oak	South cellar, 3rd joist from center wall/north wall	+BE incomp	94	1670 1763	0.48
FLNPNY 08	Oak	South cellar, 5th joist from center wall	BE? comp	54	1708 1761	0.42
FLNPNY 09	Oak	South cellar, 2nd joist from center wall/north wall	-BE, SP??	119	1580 1699	0.35
FLNPNY10	Oak	South cellar, 1st joist from center wall/north wall	+BE?	100	1664 1763	0.55

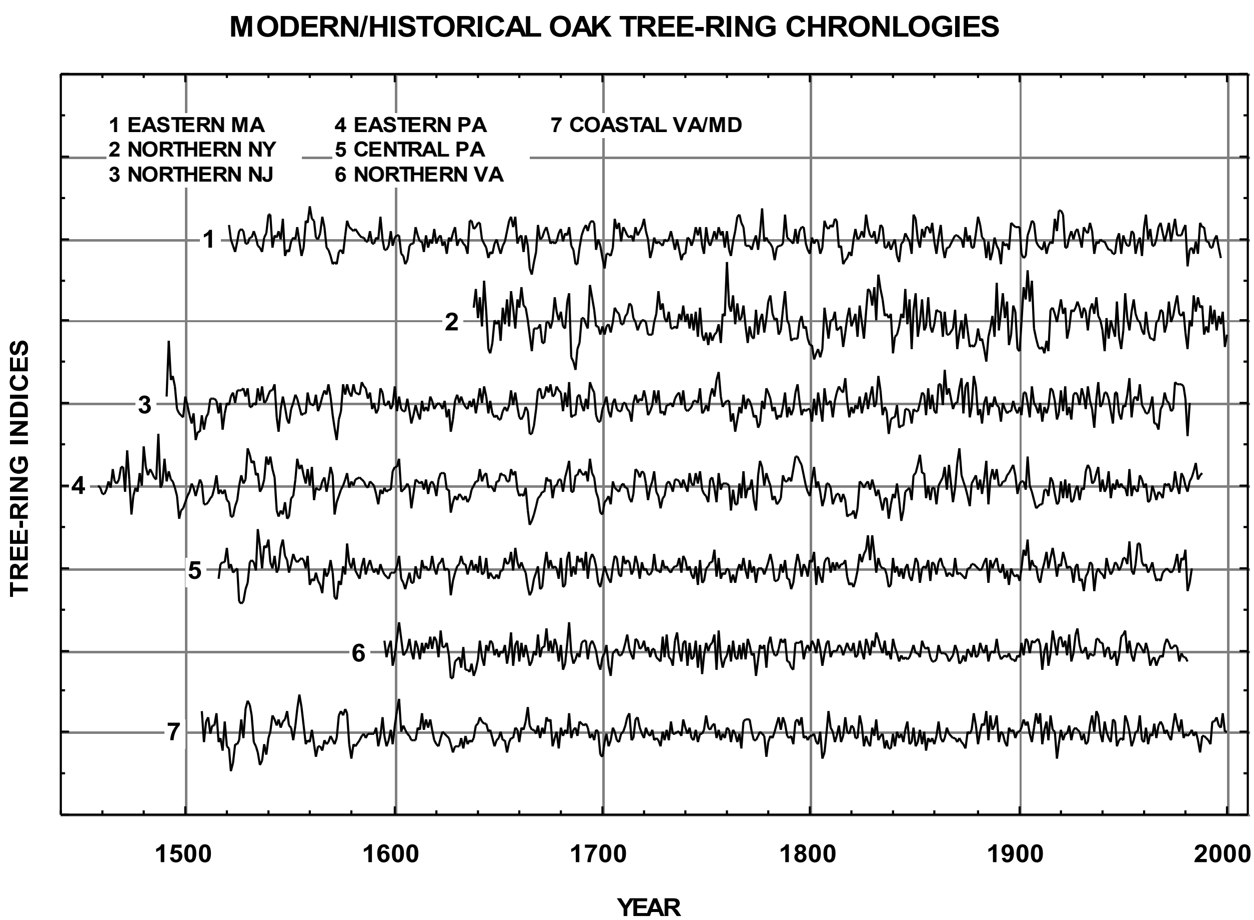
Figure 1. Comparisons of the cross-dated internal chronology of the Freer-Low House with an independently dated, regional oak master chronology for the Hudson Valley. The Spearman rank correlations between the Freer-Low House site master chronology and the Hudson Valley master (r=0.60) is highly significant (p<<0.001) with t-statistics of 10.3.



The "r-factor" is the Spearman rank correlation coefficient, a measure of relative statistical agreement between two groups of measurements or data. It can range from +1 (perfect direct agreement) to -1 (perfect opposite 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-statistics (t=10.3) associated with the correlation between the series (r=0.60) is statistically highly significant (p<<0.001) for a 185-year overlap. For that reason, there can be no doubt that the dates presented here for the sampled sections of the Freer-Low House are very strongly valid, and that the statistical chance of the cross-dates being incorrect is much, much less than 1 in 1000.


MODERN/HISTORICAL OAK CHRONOLOGIES
REGIONAL LOCATIONS OF SAMPLES
1
2
3
4
5
6
7


MODERN/HISTORICAL OAK TREE-RING CHRONLOGIES
1 EASTERN MA
2 NORTHERN NY
3 NORTHERN NJ
4 EASTERN PA
5 CENTRAL PA
6 NORTHERN VA
7 COASTAL VA/MD
TREE-RING INDICES
1500
1600
1700
1800
1900
2000
YEAR

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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. Edward 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
Allen House, Shrewsbury, NJ
Belle Ilse, Lancaster County, VA
Bowne House, Queens, NY
Carpenter's Hall, Philadelphia, PA
Christ's Church, Philadelphia, PA
Conklin House, Huntington, NY
Customs House, Boston, MA
Daniel Boone Homestead, Birdsboro, PA
Daniel Pieter Winne House, Bethlehem, NY
Ditchley, Northumberland County, VA
Ephrata Cloisters, Lancaster County, PA
Fallsington Log House, Bucks 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 Bowne House, Forest Hills, NY
Log Cabin, Fort Loudon, PA
Lower Swedish Log Cabin, Delaware County, PA
Marmion, King George County, VA
Merchant's Hope Church, Prince George County, VA
Morris Jumel House, Jamaica, NY
Frederick Muhlenberg House, Trappe, PA
Old Caln Meeting House, Thorndale, PA
Old Swede's Church, Philadelphia, PA
Panel Paintings, National Gallery, Washington, DC
Pennock House & Barn, London Grove, PA
Podrum Farm, Limekiln, PAPowell House, Philadelphia, PA
Pyne House, Cape May, NJ
Radcliff van Ostrade, Albany, NY
Rippon Lodge, Prince William County, VA
Rural Plains, Hanover County, VA
Sabine Hall, Richmond County, VA
Spangler Hall, Bentonville, VA
St. Peter's Church, Philadelphia, PA
Strawbridge Shrine, Westminster, MD
Thomas & John Marshall House, Markham, VA
Thomas Grist Mill, Exton, PA
Thomas Thomas House, Newtown Square, PA
Tuckahoe, Goochland County, VA
Updike Barn, Princeton, NJ
Varnum's HQ, Valley Forge, PA
West Camp House, Saugerties, NY
Westover, Charles City County, VA
William Garrett House, Sugartown, PA
Yew Hill, Fauquier County, VA