A Dendrochronological Analysis of the

John Bowne House
Flushing, Queens, New York

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Introduction

This is the final report on the dendrochronological analysis of the John Bowne House, located at 3701 Bowne Street, Flushing, Queens, New York 11354. 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, Paul Krusic and Dr. Edward Cook perform a tree-ring analysis of its structural timbers. Walter Wheeler was working on behalf of the present stewards of the house, the Bowne House Historical Society. The Bowne House is listed on the National Register of Historic Places and is designated a New York City landmark. The Bowne House has been a museum since 1947.

Together with Mr. Wheeler, Callahan visited the house on 24 February, 2006, and collected wood core samples for the dendrochronological analysis of the timbers. Of the 10 samples acquired and analyzed, all were 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 John Bowne House were processed in the Tree-Ring Laboratory by Paul Krusic, 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 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 John Bowne House study, two regional composite master dating chronologies from living trees and historical structures in the Middle Atlantic region were referenced primarily. 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 datings as reported here were verified as correct.

Results and Conclusions

The results of the dendrochronological dating of the John Bowne House timbers are summarized in **Table 1** and **Figure 1**. A total of 10 oak samples were analyzed in the laboratory, with all 10 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 sapwood and 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 oak 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 10 oak samples that cross-dated well between themselves, and also dated well against the local oak historical dating master (see **Table 1**, column 6), 2 had absolutely verifiable bark edge at the time of sampling.

From the datings that were achieved, there emerged firm evidence of (at least) one intrinsic construction period that produced the John Bowne House. The two absolutely dated bark-edged samples (JBH04 and JBH09), taken from rafters from the west end of the attic, indicate a construction phase for this section of the Bowne House shortly after the end of the growth season 1668 (that is, the trees were cut during dormancy after the end of the growth season late in the autumn of 1668 or immediately before the beginning of the growth season of the spring of 1669, i.e., approximately November 1668 through February 1669), with very strong redundant evidence from other attic timbers. Evidence from some cellar timbers (**Figure 1**, see JBH01, JBH02, JBH03) suggest other potential construction period(s), but insufficient numbers of samples from this structural unit, as well as the absence of bark edge, preclude certitude in this interpretation.

Table 1. Dendrochronological dating results for all samples taken and analyzed by Callahan, Cook and Krusic from the John Bowne House, Flushing, Queens, New York. For WANEY, +BE means the bark edge was present and recovered at the time of sampling; -BE means that the bark edge was not recovered or was completely missing on the timber. 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. For example, +BEcomp 1668 means cutting took place during the winter period of 1668 or into the pre-spring period of 1669.

ID	SPECIES	DESCRIPTION	WANEY	RINGS	DATING	CORREL
JBH01	Oak	Cellar 5th Joist from East Side	-BE,	1536-1628	93	0.501
JBH02	Oak	Cellar 2nd Joist from East end	-BE,	1544-1643	100	0.566
JBH03	Oak	Cellar 7th Joist from E Wall	-BE,	1583-1680	98	0.597
JBH04	Oak	2nd Rafter pair from West wall, North side of pair?	+BEcomp	1595 1668	74	0.567
JBH05	Oak	North side Rafter pair, 5th from East end	-BE,	1515-1616	102	0.536
JBH06	Oak	North side Rafter pair, 4th from East end	-BE,	1532-1645	114	0.560
JBH07	Oak	South side Rafter pair, 4th Rafter from East end	-BE,	1509-1639	131	0.554
JBH08	Oak	South side Rafter pair, 6th Rafter from East end	-BE,	1541-1609	69	0.379
JBH09	Oak	Rafter @chimney 7th from West end	+BEcomp	1609-1668	60	0.414
JBH10	Oak	4th Rafter pair from W end of house	-BE,	1587-1655	69	0.38

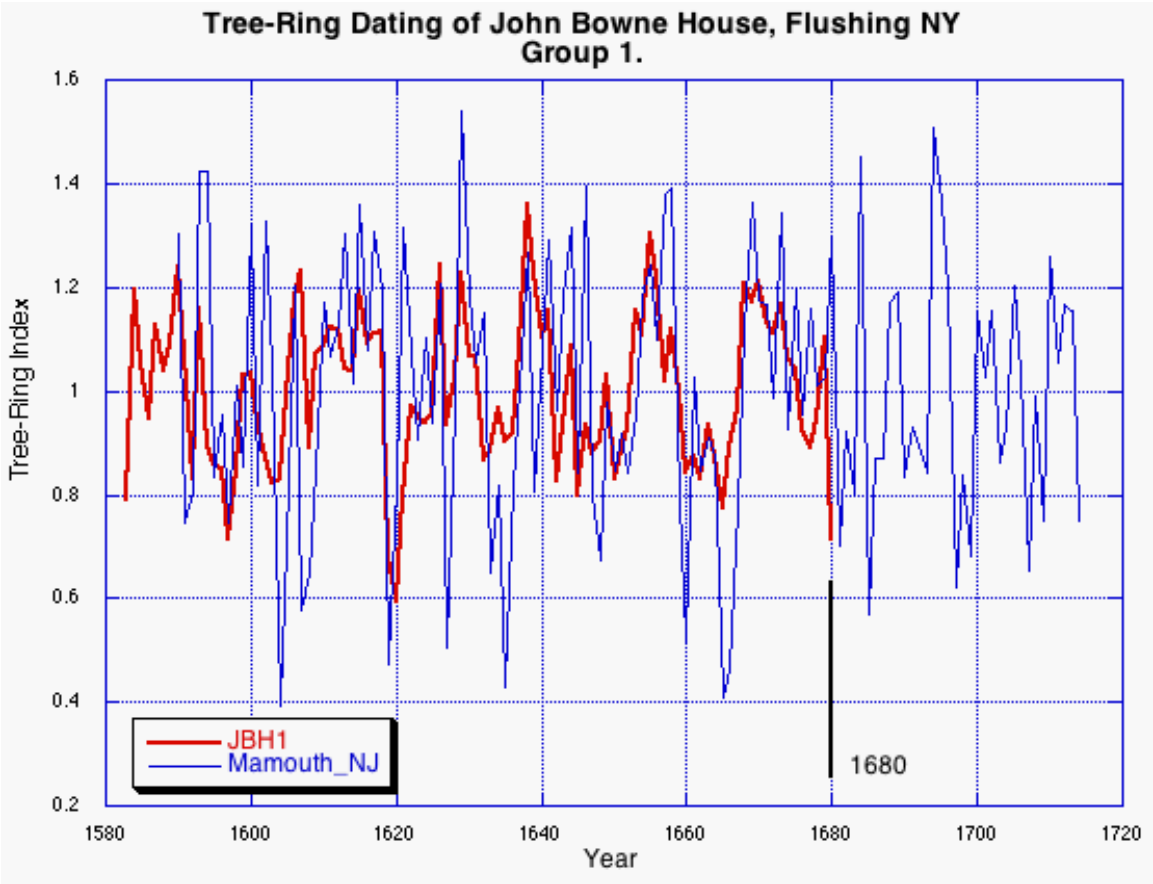


Figure 1. Comparison of the cross-dated oak master chronology for the John Bowne House with a locally derived historical oak dating master from north central New Jersey. The Spearman rank correlation between the series (r=0.41) is highly significant (p<<0.001) with an overlap of 98 years and a t-statistic of 4.5. All 10 dated samples from the Bowne House are compiled in the site chronology labeled JBH1, including the absolutely dated attic samples that indicate a construction phase shortly after the end of the growth season of 1668.

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.

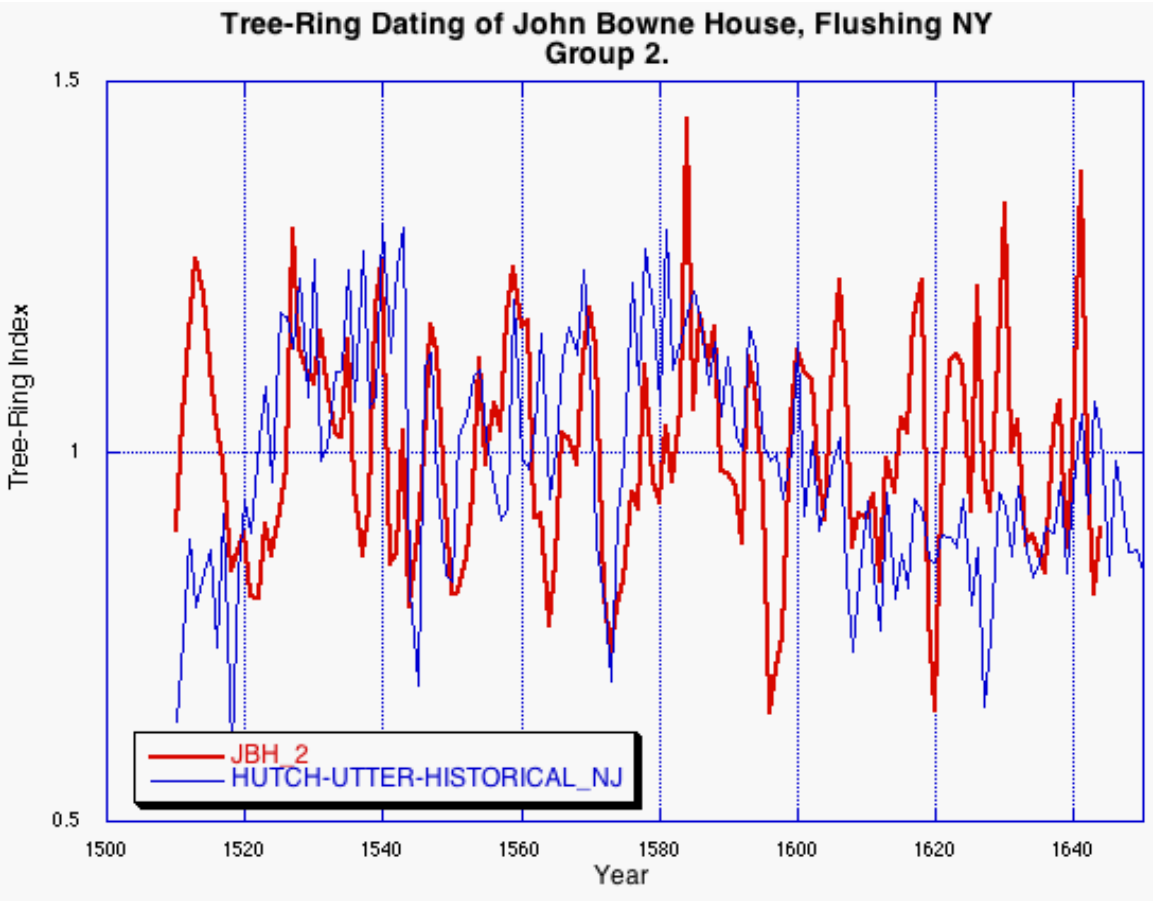
The t-statistic (t=4.5) associated with the correlation between these two series (r=0..41) is highly significant (p<<0.001) for a 98-year overlap. For that reason, there can be no doubt that the dates presented here are very strongly valid, and that the statistical chance of the cross-dates being incorrect is much, much less than 1 in 1000.

Addendum

To complement, these results from an earlier dendrochronological study are included in this report as **Addendum, Table 2,** with associated graph, **Addendum, Figure 2**. This study was conducted in the late 1980's, independently of the current project, and its results are not considered in this report. The results are presented as known, without analysis or further commentary. Presently nothing can be related about the provenience or wane edge of these samples, although it is assumed that some or all of them may have been re-sampled and included in the current study under different ID numbers.

Addendum, Table 2. Dendrochronological dating results for dendrochronological samples taken by Joel Snodgrass et alia from the John Bowne House, Flushing, Queens, New York, during the late 1980's. This independent study does not fall under the auspices of the present project. The dates and sample information are fully reported; nothing is presently known about the provenience or wane edge of these samples. All correlations are Spearman rank correlations of each series against the mean of all of the others of the same species. Note variation in ID.

ID	SPECIES	DESCRIPTION	WANEY	RINGS	DATING	CORREL
JB005	Oak			1508-1607	100	0.631
JB027	Oak			1587-1678	92	0.554
JB029	Oak			1538-1648	111	0.571
JB031	Oak			1556-1645	90	0.65



Addendum, Figure 2. Comparison of the cross-dated relative chronology for undocumented samples listed in Addendum, Table 2, with a locally derived historical oak dating master from north central New Jersey. The Spearman rank correlation between the series (r=0..37) is highly significant (p<<0.001) with an overlap of 136 years and a t-statistic of 4.6.

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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.

Paul Krusic was born in Middletown, Connecticutt in 1958. He received his BSc in Forest Science from the University of New Hampshire in 1980, and was a Forester for the Bureau of Indian Affairs and for the US Forest Service for 11 years before joining the staff of the Tree-Ring Laboratory at Lamont-Doherty Earth Observatory in 1991. He has done field sampling in many parts of the globe to compile materials for climate sensitive tree-ring chronologies, created historical dating masters for various regions of the northeastern US, and has written a number of tree-ring analysis programs used around the world.

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