A Dendrochronological Analysis
of the

Jonathan Pyne House
Cape May, Cape May County, New Jersey

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Introduction

This is the final report on the dendrochronological analysis of the Jonathan Pyne House, located at 609 Sea Grove Avenue, Cape May, Lower Township, Cape May County, New Jersey. In an effort to confirm the construction history of this house, and working on behalf of the present owners of the house, Mr. And Mrs. David Clemens, Historic Preservation Consultant Joan Berkey, 1003 Bartlett Avenue, Linwood, NJ 08221-1137, tele: 609-927-7950, requested that dendrochronologists William Callahan and Dr. Edward Cook perform a tree-ring analysis of its structural timbers. Together with Ms. Berkey, Callahan visited the house on 19 October, 2005, and Cook and Callahan visited the house on 2 January, 2006, and collected wood core samples for the dendrochronological analysis of the timbers. Of the 14 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 Jonathan Pyne 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 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 Jonathan Pyne House study, a regional composite master dating chronology from living trees and historical structures in the New Jersey region was 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 dating as reported here was verified as correct.

Results and Conclusions

The results of the dendrochronological dating of the Jonathan Pyne House timbers are summarized in **Table 1** and **Figure 1**. A total of 14 oak samples were analyzed in the laboratory, with only 4 of the 14 oak samples providing firm dendrochronological dates. In addition to the samples taken and analyzed and listed in the following table, 3 samples were collected but discarded before analysis due to the obvious poor quality of the materials. 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 structure, the redundancy of the indicated relative cross-datings, and the eventual existence of sapwood and bark/waney edges demonstrating cutting year, provide 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. These individual correlations vary in statistical strength, but all are in the minimum range that is expected for correctly cross-dated timbers from buildings in the eastern United States. Of the 4 samples that cross-dated well between themselves, and also dated well against local oak historical dating masters (see **Table 1**, column 6), 3 had absolutely verifiable bark edge at the time of sampling, and the single exception exhibited strong evidence of the presence of sapwood, i.e., those anatomically specialized wood cells in active trees that comprise one or more of the outermost growth rings. In the absence of verifiable bark edges on oak samples, the presence of sapwood indicates that the outermost extant rings must lie close to the lost wane edge.

From the datings that were achieved, there emerged no certain evidence of the earliest construction period that produced the original structure. The 4 dated samples, all of oak from a later addition to the structure, the so-called "period 2" section, indicate a construction phase for this unit sometime soon after the end of the year 1844. Interestingly, the relative statistical strength of this particular cross-dating suggests a provenience for the timbers in the interior of south-central Pennsylvania or in the Shenandoah region of north-central Virginia.

However, in the absence of collaborating dates from the remainder of the structure, it must be emphasized that this "period 2" construction is not representative of the entire Jonathan Pyne House in its present configuration. No datings were obtained from those samples taken from that part of the structure purported to be "period 1", i.e., the older/original section.

Of the remaining 10 samples: these undated materials produced no statistically significant indications of cross-dates, even between themselves. All but one (JPCMNJ 08, see below) had so few rings and such weak t-correlations when compared with each other and with the master chronologies that any intimations suggested by COFECHA were statistically unsustainable. These samples also tended to be so short in length that a cross-over dating "bridge" with the samples from "period 2" was not possible.

The above mentioned JPCMNJ 08 also remains undated. In this unfortunate case the sample contained a number of rings (>100) often more than sufficient for dating purposes, but the sample's integrity was compromised by severely deformed ring structures that made accurate laboratory measurement (or even an accurate ring count) of the sample unattainable. Speculatively, this may represent the physiological inconsistency of limb wood (that is, tight-growth branch wood), or it may be evidence of environmental stress, such as poor soil and/or other determinative growth factors, on the tree throughout its lifetime,. It is the opinion also of the authors that peculiar local environmental factors likely explain at least part of of the general failure of the "period 1" materials to cross-date.

Table 1. Dendrochronological dating results for all samples taken from the Jonathan Pyne House, Cape May, New Jerser. 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. All correlations are Spearman rank correlations of each series against the mean of all of the others of the same oak 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
JPCMNJ01	Oak	Period 1, 2nd floor ceiling joist, 1st from east end-plate	+BE	68	No Date	-.--
JPCMNJ02	Oak	Period 1, 2nd floor east end-plate, sapwood only, no bark	-BE	58	No Date	-.--
JPCMNJ03	Oak	Period 1, Southwest corner post, 2nd floor, marked IIII	-BE	58	No Date	-.--
JPCMNJ04	Oak	Period 2, Corner post, southwest corner addition, abutting samp 05	+BE	52	1737 1844 comp.	0.33
JPCMNJ05	Oak	Period 1, corner post, southeast corner, abutting Period 2 samp 04	-BE	50	No Date	-.--
JPCMNJ06	Oak	Period 1, corner post, northwest corner	-BE	48	No Date	-.--
JPCMNJ07	Oak	Period 1, cellar, basement entrance header/north sill	-BE	63	No Date	-.--
JPCMNJ08	Oak	Period 1, girt, 1st floor east gable adjoining stairway -- too suppressed to measure --	+BE	100+	No Date	-.--
JPCMNJ09	Oak	Period 1, cellar, east side sill	-BE	70	No Date	-.--
JPCMNJ10	Oak	Period 1, post in closet, 1st floor, too few rings	Discarded	<25	No Date	-.--
JPCMNJ11	Oak	Period 2, crawl space joist, 1st from east wall entrance	+BE	86	1758 1843	0.38
JPCMNJ12	Oak	Period 2, crawl space, east wall sill	+BE	93	1752 1844 comp.	0.44
JPCMNJ13	Oak	Period 2, crawl space, sill accessed from Period 1 cellar	-BE	110	1720 1829	0.48
JPCMNJ14	Oak	Period 1, hallway post, too few rings	Discarded	ca. 10	No Date	-.--

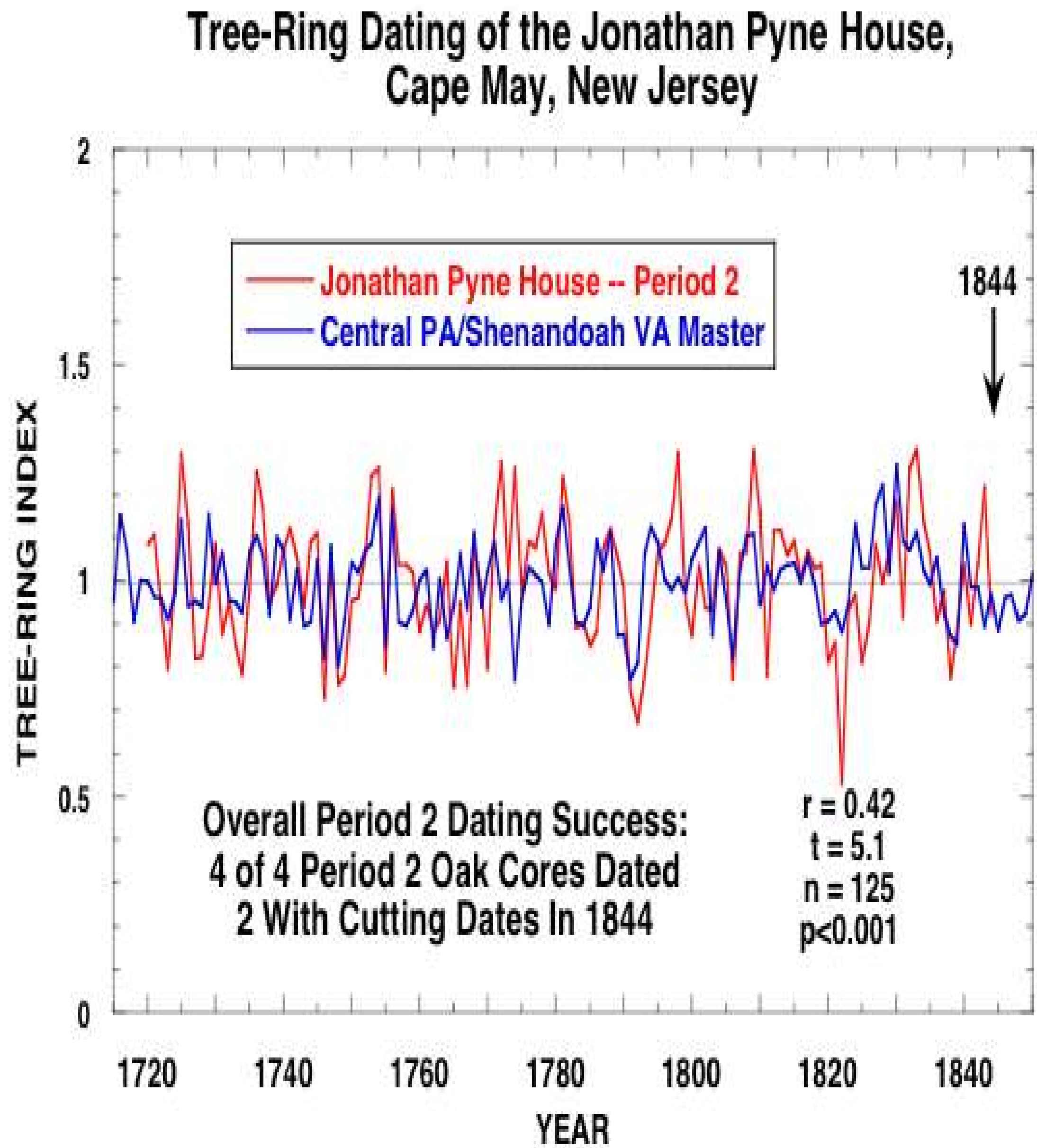

Figure 1. Comparison of the cross-dated oak master chronology for Period 2 of the Jonathan Pyne House with an historical oak dating master derived from trees and historical structures in the Shenandoah Valley of Virginia and central Pennsylvania. The Spearman rank correlation between the series (r=0.42) is highly significant (p<0.001) with an overlap of 125 years and a t-statistic of 5.1.

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 ($t=7.1$) associated with the correlation between these two series ($r=0.54$) is highly significant ($p<<0.001$) for a 125-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