A Dendrochronological Analysis of the Sanders-Ellice House, Schenectady, New York.

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Introduction

This is the final report on a dendrochronological analysis of the Sanders-Ellice House, which stands at 205 Union Street, Schenectady, New York 12305 (42°48'60"N 73°56'06"W). In an effort to establish a more precise chronology of the structure's history, historic architect Walter Wheeler, acting on behalf of the owners Christopher Marney and Christopher White, requested that dendrochronologists William Callahan and Dr. Edward Cook perform a tree-ring analysis of selected representative structural timbers.

Callahan visited the site on 16 &17 November 2021, and collected samples for dendrochronological analysis. Of 12 field samples taken, all 12 were deemed methodologically and conditionally of sufficient quality for submission for laboratory analysis. The submitted samples were 11 pitch pine (*Pinus* rigida) and one white pine (*Pinus* strobus).

Every effort was made on site to locate bark or waney edges on the sampled timbers in order to ascertain the absolute cutting date, or dates, of the trees used in the construction. After the completion of this analysis, the core and cut samples and their associated measurement series will be permanently archived at the Tree Ring Research Laboratory, Lamont-Doherty Earth Observatory, Columbia University, under the sample reference numbers listed in Table 1, column 1.

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 Sanders-Ellice House were processed in the laboratory by Dr. Edward Cook following well-established dendrochronological methods. The core samples were carefully glued onto grooved mounts and were sanded to a high polish to reveal the annual tree rings clearly; cut samples were similarly surfaced . The rings widths were measured under a microscope to a precision of ±0.001 mm. The cross-dating of the obtained measurements utilized a revised and modernized 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), now disused. 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 itself. 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, one or more internally cross-dated series are compiled from the individual site samples, and these are compared in turn with independently established tree-ring master chronologies compiled from living trees and dated historical tree-ring material. All of the regional "master chronologies" are based on completely independent tree-ring samples.

During the Sanders-Ellice House study, species specific, regional composite master chronologies from living trees and historical structures from northern and central New York state, and other near-lying regions, were referenced primarily. All dating results were verified finally by subsequent comparison with other independent dating masters from surrounding regions. In each case, the datings as reported here were confirmed as correct.

Results and Conclusions

To achieve these datings required attention during analysis to the previously recorded structural context of the samples (see **Table 1**, column 3). The contextual association of samples from within the structure, 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.

The outermost ring on a waney, bark-edged sample identifies the absolute cutting year. Absence of the bark edge (interchangeably called the wane) on a sample indicates that the outermost extant ring is not the year of cutting, but some identifiable year preceding the cutting. In the absence or loss of wane, field observations of wood anatomical factors often permit close approximation of the number of missing rings, and thereby reasoned estimation of the cutting date. In particular the presence of sapwood, a physiologically active wood found immediately within the bark on the outer portion of the trunk, is an indication that the original wane was near. In some species sapwood is easily and regularly discernible, while in others it is practically imperceptible.

At Sanders-Ellice several of the timbers were judged to have bark/wane when initially examined, which was subsequently lost in varying degrees during extraction due to surface degradation. Such surface loss is not unusual. In no case here was the depth of loss estimated post-sampling to be more than circa 3/4 of an inch from the interpreted wane edge.

The results of the dendrochronological dating of the timbers collected from the Sanders-Ellice House are summarized in **Table 1** and **Figure 1**. A total of 12 samples from 12 timbers were analyzed in the laboratory: 11 pitch pine (*Pinus* rigida.), and 1 white pine (*Pinus* strobus.). Of these, 10 of the pitch pine samples provided absolute dates, and 5 of these had bark/wane indicating the precise cutting year. The singleton white pine sample provided no viable date. The remaining 5 pitch pine samples had outermost extant rings lying chronologically congruent with the indicated cutting year; field notes indicate that several of these had bark and/or wane present at the start of sampling, lost due to surface degradation during extraction.

In aggregate, the evidence of the datings of the tested material suggests a construction phase for those building sections tested. Completed ring growth for the year 1771 indicates that the pines collectively were harvested during growth dormancy of 1771/72, i.e that the trees were cut after 1771 growth ended and before 1772 growth started, approximately between November 1771 and February 1772. See **Table 1,** column 6.

Initial usage of these materials took place not long after harvesting, for inspection of the timbers indicated that most if not all were worked very soon after cutting, in keeping with historical woodworking practices and carpentry techniques. However, it must be remembered that re-usage of timbers is possible without leaving any clear evidence of subsequent preparatory workings, and that other construction phases prior to or subsequent to the dates identified by this investigation cannot be excluded absolutely and should be considered when purporting the site's construction history.

Table 1. Dendrochronological dating results for the wood samples taken from the Saunders-Ellice House, Schenectady, 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. If –BE, SP refers to the likelihood that sapwood rings are present. If so, the outer date may be close to the cutting date. 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. "Incomp" means that the outermost ring was not fully formed, meaning that the tree was felled during the spring/summer growing season. None means inconclusive outer ring

ID	SPECIES	DESCRIPTION	WANEY	RINGS	DATING	CORREL
SEHSNY 01	Pitch Pine	Attic over kitchen wing, collar tie, 5th rafter from N wall	-BE[a]	91	1677 1767	0.571
SEHSNY 02	Pitch Pine	Main attic, floor beam, 2nd "bent" from E wall	-BE[a]	151	1640 1765[c]	0.477
SEHSNY 03	White Pine	Main attic, lower rafter, 4th truss from E wall	+BE[b] comp	99	No Date	-.---
SEHSNY 04	Pitch Pine	Main attic, upper rafter, 3rd truss from E wall, S side	BE??	100	1663 1762	0.443
SEHSNY 05	Pitch Pine	1st floor, kitchen wing, 3rd "bent" from S end	+BE comp	98	1674 1771	0.542
SEHSNY 06	Pitch Pine	1st floor, kitchen wing, 2nd "bent" from S end, white painted	+BE comp	117	1655 1771	0.475
SEHSNY 07	Pitch Pine	Cellar, SE section, beam, 4th from E wall	-BE[a]	150	1640 1757[c]	0.518
SEHSNY 08	Pitch Pine	Cellar, SE section, beam, 6th from E wall	+BE comp	118	1648 1765	0.525
SEHSNY 09	Pitch Pine	Cellar, SW section, beam, 3rd from W wall	+BE comp	121	1651 1771	0.573
SEHSNY 10	Pitch Pine	Cellar, kitchen wing,, beam, 1st S from N face of fireplace support (i.e. 5th beam from S)	+BE comp?	152	1640 1771[c]	0.524
SEHSNY 11	Pitch Pine	Cellar, kitchen wing, S end beam, (core with severely distorted rings)	---	---	No Date	-.---
SEHSNY 12	Pitch Pine	Cellar, kitchen wing, 2nd beam from S wall	-BE[a]	103	1663 1765	0.483

[a] Bark edge (BE) present at start, but several rings (typically 3-5) were lost at the start of coring, due to surface degradation.
[b] Singleton white pine sample, produced ambiguous dating against regional white pine dating master, no dating assigned.
[c] Rings prior to 1640 not used in final dating because of severe ring suppression and likely missing rings.

Table 1. Dendrochronological dating results for all samples taken from the Sanders-Ellice House located in Schenectady, New York. For interpreted felling dates of the trees used for construction, +BE means that the bark edge was present and believed 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 the Spearman rank correlations of each series

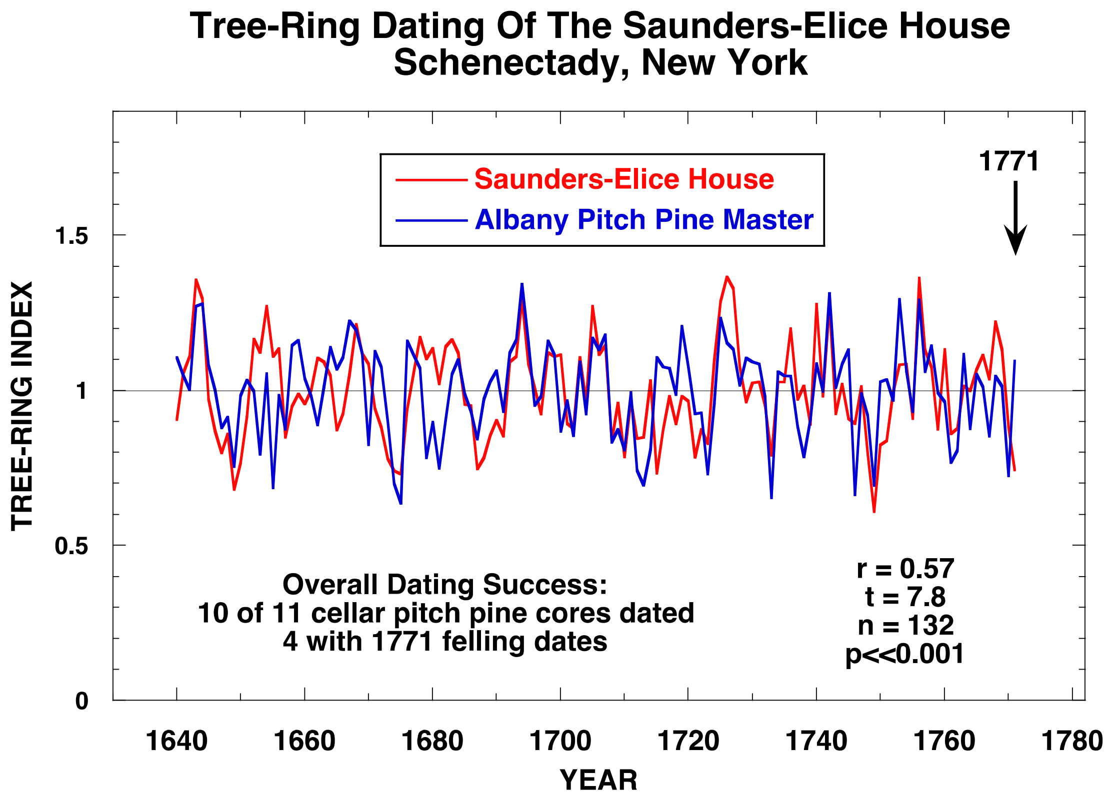
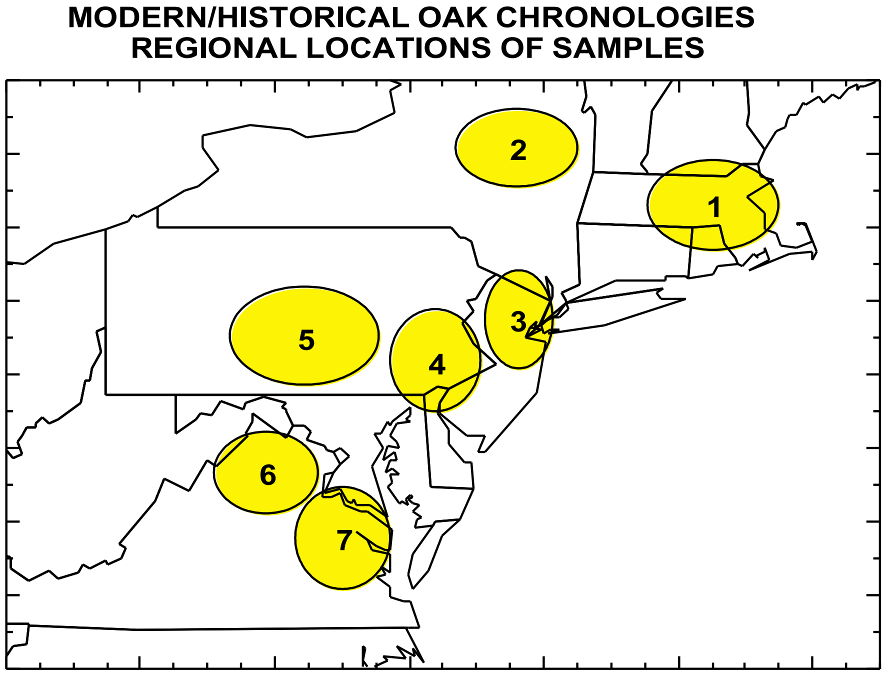
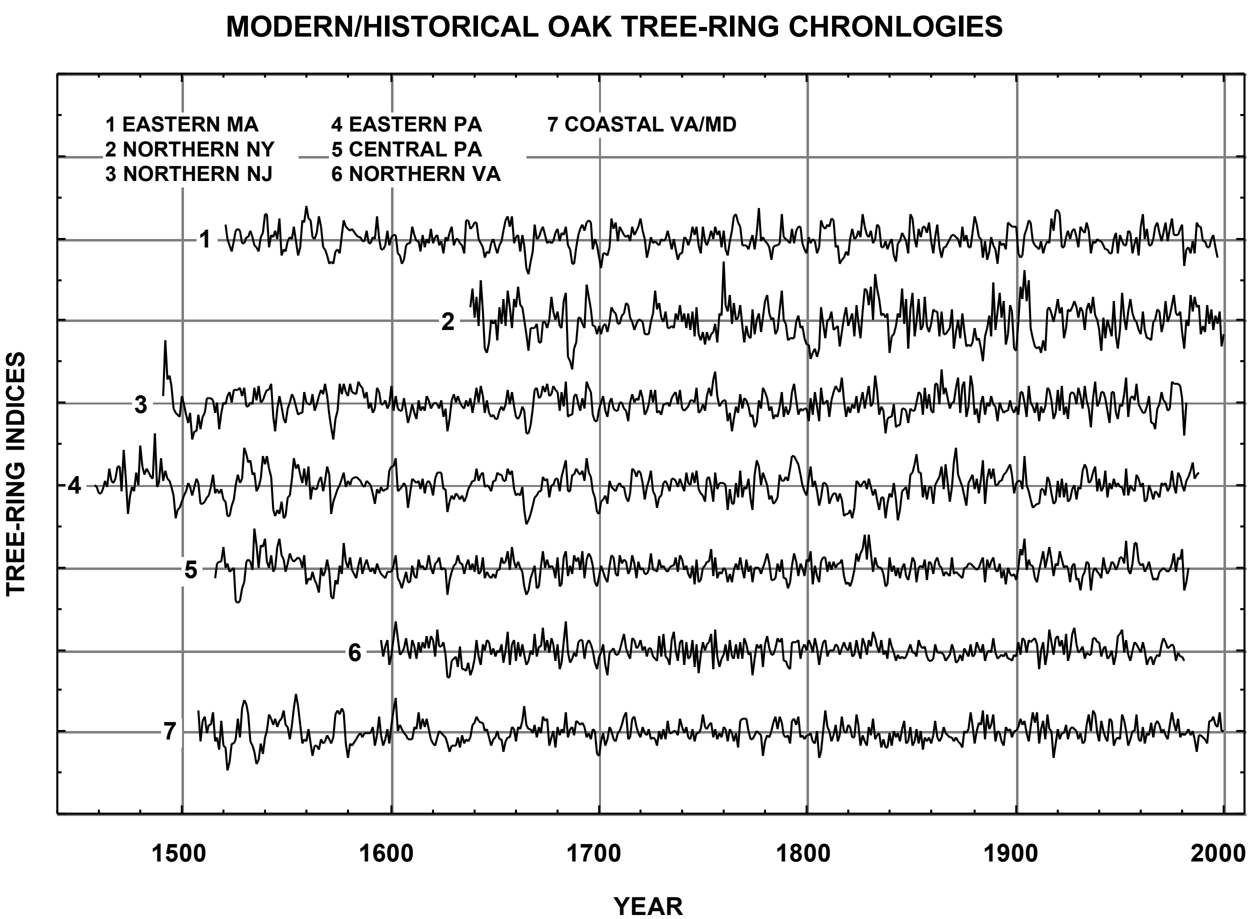


Figure 1. Comparison of the cross-dated pitch pine chronology from the Saunders-Ellice House in Schenectady, New York against an independent pitch pine historical dating master from from the Schenectady Sand Plains region. The cross-dating indicated here is strong (t<3.5), thus indicating that the timbers used to construct the Saunders-Ellice House were probably felled during growth dormancy 1771/72, i.e. between November 1771 and February 1772.

The Spearman rank correlation between the series (t=7.8) associated with the correlation between the Sanders-Ellice House compiled pitch pine series and a regional pitch pine historical master chronology (r=0.57) is strongly secure (p<<0.01) for a 132-year overlap. For that reason, the dates presented here for the sampled pine elements of the structure are robustly valid, and the statistical chance of the cross-dates being incorrect is exponentially far less than 1 in 1000.

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 circa 1 in 1000, or 0.001, of being invalid. Higher "t" values, as in this case, indicate exponentially increasing, stronger statistical certitude.


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 research 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 Isle, Lancaster County, VA
Bowne House, Queens, NY
Carpenter's Hall, Philadelphia, PA
Charpentier House, Philadelphia PA
Christ's Church, Philadelphia, PA
Clifton, Northumberland County, VA
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
Ferris House, Old Greenwich, Fairfield County, CT
Fawcett House, Alexandria, VA
Gadsby's Tavern, Alexandria, VA
Garrett House, Sugartown PA
Gilmore Cabin, Montpelier, Montpelier Station, VA
Gracie Mansion (Mayor's Residence), New York, NY
Grove Mount, Richmond County, VA
Hanover Tavern, Hanover Courthouse, VA
Harriton House, Bryn Mawr, PA
Hills Farm, Accomack County, VA
Hollingsworth House, Elk Landing, MD
Indian Banks, Richmond County, VA
Indian King Tavern, Haddonfield NJ
Independence Hall, Philadelphia, PA
John Bowne House, Forest Hills, NY
Kirnan, Westmoreland County, VA
Linden Farm, Richmond County, VA
Log Cabin, Fort Loudon, PA
Lower Swedish Log Cabin, Delaware County, PA
Lummis House, Ipswich MA
Marmion, King George County, VA
Martin Cabin, New Holland PA
Menokin, Richmond County, VA
Merchant's Hope Church, Prince George County, VA
Millbach House, Lebanon County, PA
Monaskon, Lancaster County, VA
Morris Jumel House, Jamaica, NY
Frederick Muhlenberg House, Trappe, PA
Nottingham DeWitt House, NY
Old Barn, Madison VA
Old Caln Meeting House, Thorndale, PA
Old Parsonage, Kinderhook NY
Old Swede's Church, Philadelphia, PA
OTB House, West Nyack, NY
Panel Paintings, National Gallery, Washington, DC
Pennock House & Barn, London Grove, PA
Penny Watson House, Greenwich, NJ
Podrum Farm, Limekiln, PA
Powell House, Philadelphia, PA
Pyne House, Cape May, NJ
Radcliff van Ostrade, Albany, NY
Reese's Corner House, Rock Hall, MD
Rippon Lodge, Prince William County, VA
Rochester House, Westmoreland County, VA
Rockett¨s, Doswell VA
Rural Plains, Hanover County, VA
Sabine Hall, Richmond County, VA
Shirley, Charles City County, VA
Sisk Cabin, Culpeper VA
Stiles Cabin, Sewickely PA
Spangler Hall, Bentonville, VA
Springwater Farm, Stockton, NJ
St. Peter's Church, Philadelphia, PA
Strawbridge Shrine, Westminster, MD
Sweeney-Miller House, Kingston, NY
Thomas & John Marshall House, Markham, VA
Thomas Grist Mill, Exton, PA
Thomas Thomas House, Newtown Square, PA
Ticonderoga Pavilion, Ticonderoga, NY
Tuckahoe, Goochland County, VA
Tullar House, Egremont MA
Updike Barn, Princeton, NJ
Varnum's HQ, Valley Forge, PA
Verville, Lancaster County, VA
West Camp House, Saugerties, NY
Westover, Charles City County, VA
White Plains House, King George, VA
Wilton, Westmoreland County, VA
Yew Hill, Fauquier County, VA