A Dendrochronological Analysis of the "Old Parsonage, Dutch Reformed Church", Kinderhook, Columbia County, New York.

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Introduction

This is the final report on the dendrochronological analysis of a structure known as the "Old Parsonage, Dutch Reformed Church" (also variously known as the Heermance-Farrar House and the Heermance-Farrar-Schnapper House) which stands at 15 Hudson Street, Kinderhook, Columbia County, New York 12106 (42°23'39"N 73°41'49"W). The house and grounds are owned and occupied by Dr. Jon Michael Varese, who intends to carefully preserve the historical integrity of the property. For convenience, in this report the site will be known throughout as the "Old Parsonage".

In an effort to establish a precise history of the building, Dr. Varese requested that dendrochronologists William Callahan and Dr. Edward Cook perform a tree-ring analysis of selected representative structural timbers. Callahan visited the site and collected samples for the dendrochronological analysis of the timbers on 10 November, 2016.

Of the 14 field samples taken, 10 were deemed of sufficient quality for submission for laboratory analysis. Five of the submitted samples were of oak (Quercus sp.), one was chestnut (Aesculus sp.), and four were of pine (Pinus sp.). The four samples taken but not submitted were judged after extraction to be methodologically and/or conditionally unsuitable and were discarded.

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 this analysis, the core 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 Old Parsonage were processed in the Tree-Ring 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. 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, 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.

In the Old Parsonage study, species specific, regional composite master chronologies from living trees and historical structures from New York, eastern and central Pennsylvania, Massachusetts, and New Jersey, and other near-lying regions were referenced primarily. All dating results were verified finally by subsequent comparison with other independent dating masters from surrounding areas. In each case, the datings as reported here were confirmed as correct.

Results and Conclusions

The results of the dendrochronological dating of the Old Parsonage timbers are summarized in **Table 1** and **Figures 1 & 2**. A total of 10 samples were analyzed in the laboratory, with all 10 of the 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**, 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 thus 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 stood near.

Of the 4 pine samples that cross-dated well between themselves, and also dated well against the local historical pine dating master (see **Table 1**, column 6), three (OPHKNY01, 02, 04) had field verified bark edge at the time of sampling. Of the 5 oak samples that cross-dated well between themselves, and also dated well against the local historical oak dating master (see **Table 1**, column 6), two (OPHKNY 06, 09) had field verified bark edge at the time of sampling. Evidence of sapwood remained on several of the non-wane samples, strengthening a reasoned evaluation of the cutting date for the structural unit as a whole.

For both the pine and oak samples, analysis of the degree of development of the outermost wane rings indicates that cutting of the bark-edged timbers occurred during the regional period of winter dormancy following the end of the growth season, i.e. cutting took place during approximately November to February when no wood growth occurs (see **Table 1**). The outermost extant ring on any of the analyzed pine samples is 1727; the pines employed in the construction of the steep-pitch roof trusses were harvested during dormancy between 1727/1728. The outermost extant ring on any of the analyzed oak samples is from 1728; the oaks employed in the construction of the tested cellar joist system were harvested during dormancy between 1728/1729.

Initial usage of the materials took place not long after harvesting, for *in situ* inspection of the timbers indicated that most if not all were worked soon after cutting, in keeping with historical woodworking and carpentry techniques. The degree of chronological congruency in the collective set of datings of the selected cellar oak and attic pine timbers from the building indicates that a significant construction phase for the Old Parsonage took place no earlier than the laying down of the cellar oak timbers, arguably completed during calendar year 1729. Of course, final construction may possibly have continued for some few years later. Moreover, the dates of the pine pitched-roof trusses suggest that some preparatory work may have been performed during the very late autumn of 1727 or the winter of 1727/1728, hinting at least that some specific timber harvesting may have occurred in advance of a planned construction.

Although not suggested by any of the timbers analyzed in this project, other construction phases prior or subsequent to the dates identified by this investigation cannot be empirically supported or discounted. Furthermore, re-use of individual older timbers in any construction phases, although not evidenced directly in the materials, cannot be excluded absolutely and must be considered when purporting the site's construction history. However, given the uniformity of the dating of the tested timbers, selected as structurally representative after deliberate inspection, it is likely that the dates are demonstrative of the history of the existing building.

Table 1. Dendrochronological dating results for pine, oak, chestnut samples from the "Old Parsonage", Kinderhook, Columbia County, New York. All correlations are Spearman rank correlations of each series against the mean of all of the others of the same species. For WANEY, +BE means the bark edge ring 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 strong likelihood that sapwood rings are present; if so, the outermost date will be close to the cutting date. 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. "Inc" means that the outermost ring was not fully formed, meaning that the tree was felled during the spring/summer growing season of the indicated calendar year.

ID	SPECIES	DESCRIPTION	WANEY	RINGS	DATING	CORREL
OPHKNY 01	Pine	Attic, "steep" rafter, 2nd from south gable, west side	BE? (at start)	72	1656 1727	0.42
OPHKNY 02	Pine	Attic, "steep" rafter, 3rd from south gable, west side	BE? (at start)	49	1679 1727	0.31
OPHKNY 03	Pine	Attic, "steep" rafter, 2nd from south gable, east side	+BE?? (shaped, true BE?)	63	1663 1725	0.37
OPHKNY 04	Pine	Attic, "steep" rafter, 3rd from south gable, east side	+BE comp	49	1679 1727	0.23
OPHKNY 05	Oak	Cellar, joist, 1st from Period 1 south wall	-BE, +SP	82	1634 1715	0.40
OPHKNY 06	Oak	Cellar, joist, 2nd from Period 1 south wall	+BE comp	114	1615 1728	0.50
OPHKNY 07	Oak	Cellar, joist, 6th from Period 1 south wall	-BE, +SP	80	1644 1723	0.41
OPHKNY 08	Oak	Cellar, joist, 5th from Period 1 south wall	-BE, +SP?	48	1668 1715	0.64
OPHKNY 09	Oak	Cellar, joist, 4th from Period 1 south wall	+BE comp	69	1660 1728	0.32
OPHKNY 10	Chestnut	Cellar, joist, 3rd from Period 1 south wall	-BE, -SP, heavily squared	76	1638 1713	0.61

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 exponentially increasing, stronger statistical certitude.

The t-statistics (t=5.4) associated with the correlation between the Old Parsonage pine series and the regional pine master chronology (r=0.54) is statistically very significant (p<<0.001) for a 72-year overlap. The t-statistics (t=8.5) associated with the correlation between the Old Parsonage oak series and the regional oak master chronology (r=0.63) is statistically very significant (p<<0.001) for a 114-year overlap. For that reason, there can be no doubt that the dates presented here for the sampled oak elements of the structure are robustly valid, and that the statistical chance of the cross-dates being incorrect is exponentially far less than 1 in 1000.

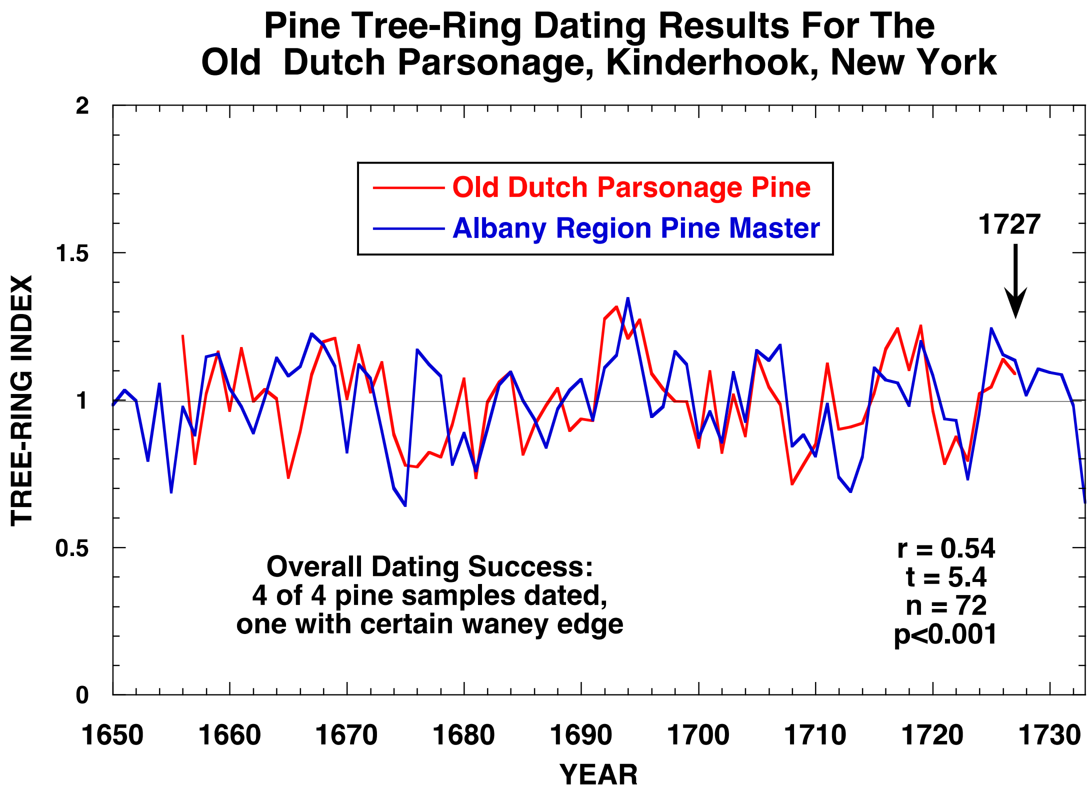


Figure 1. Comparison of the cross-dated, site compiled pine chronology for The Old Parsonage against a historical pine dating master for the Albany region. The Spearman rank correlation between the series (r=0.54) is highly significant (p<0.001) with an overlap of 72 years and a t-statistic of 5.4.

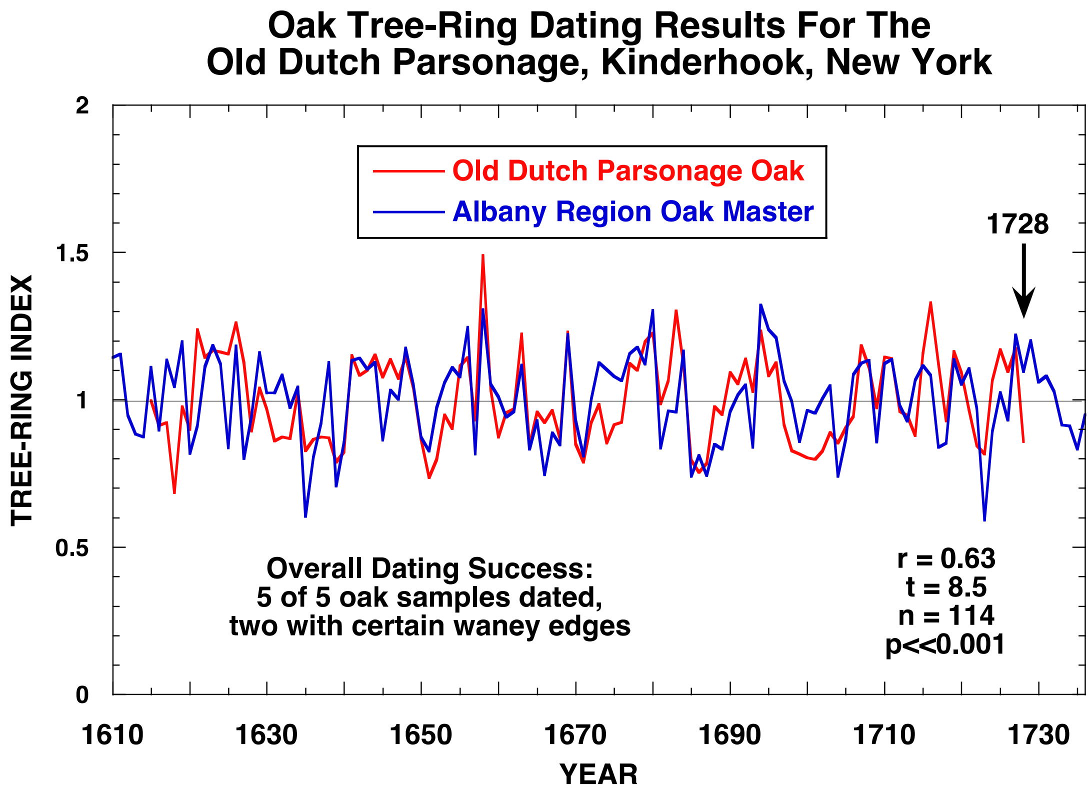
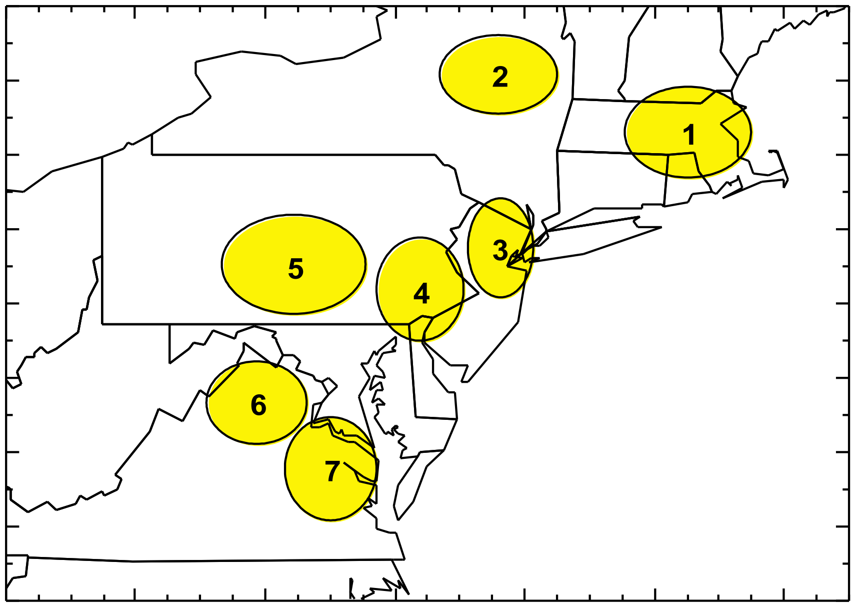
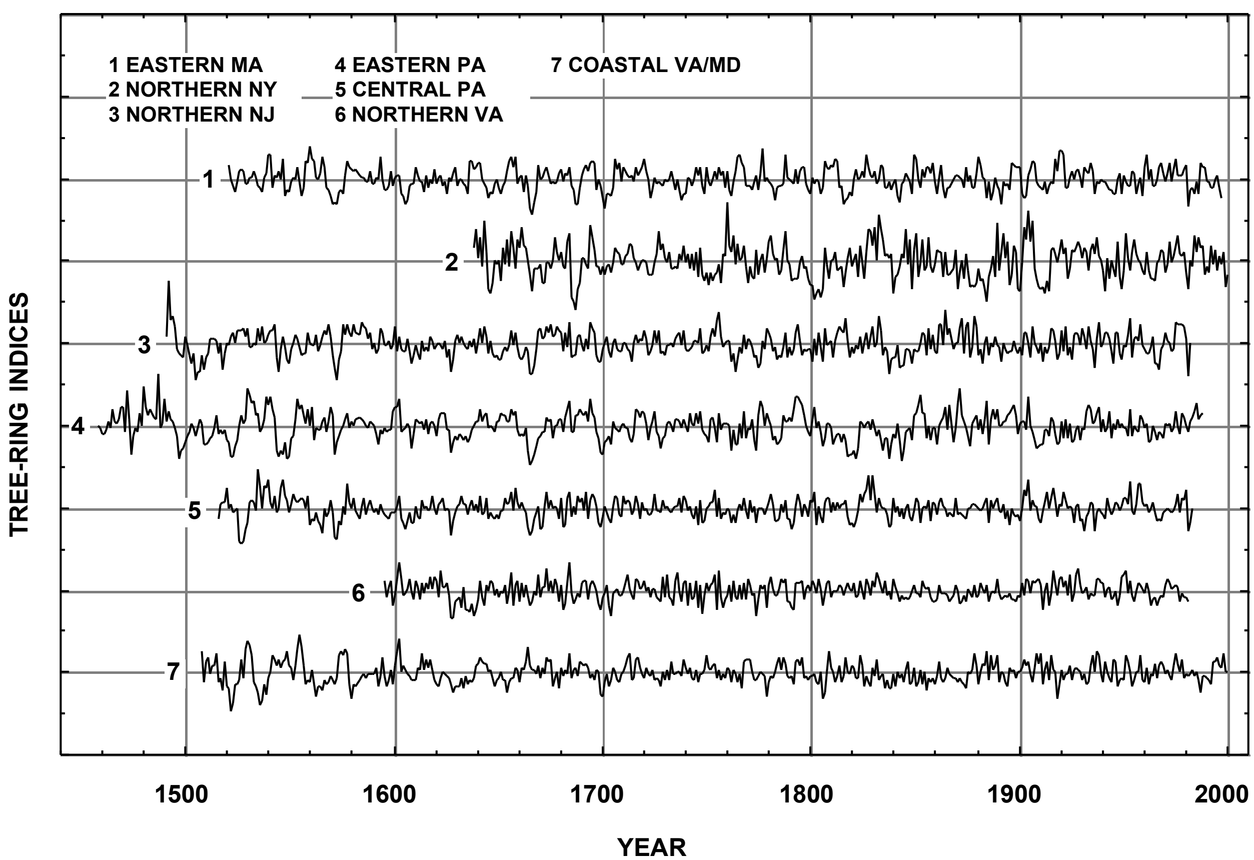


Figure 2. Comparison of the cross-dated, site compiled oak chronology for The Old Parsonage against a historical oak dating master for the Albany region. The Spearman rank correlation between the series (r=0.63) is highly significant (p<<0.001) with an overlap of 114 years and a t-statistic of 8.5.

MODERN/HISTORICAL OAK CHRONOLOGIES
REGIONAL LOCATIONS OF SAMPLES



MODERN/HISTORICAL OAK TREE-RING CHRONLOGIES



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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