A Dendrochronological Analysis of the Smith-Voorhees-Covenhoven House, Fultonville, Montgomery County, New York.

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Introduction

This is the final report on a dendrochronological analysis of the Smith-Voorhees-Covenhoven House, which stands at 141 Reynolds Road, Fultonville, Montgomery County, New York 12072 (42°53'04" N 74°20'35" W). In an effort to establish a more precise chronology of the structure's history, the owners Barbara & Glenn Ferraro 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 and 17 November 2020, and collected samples for dendrochronological analysis. Of 18 field samples taken, 16 were deemed methodologically and conditionally of sufficient quality for submission for laboratory analysis. The submitted samples were of oak (*Quercus* sp.), chestnut (*Castanea* sp), and ash (*Fraxinus* sp.). For the sake of brevity, "SVC House" will be used in this report.

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 SVC 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 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), 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 SVC House study, species specific, regional composite master chronologies from living trees and historical structures from 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 thus 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.

The results of the dendrochronological dating of the timbers collected from the SVC House are summarized in **Table 1** and **Figure 1**. A total of 16 samples from 15 timbers were analyzed in the laboratory: 7 oak (*Quercus* sp.), 2 chestnut (*Castanea* sp.), 7 ash (*Fraxinus* sp.); 10 samples provided firm dendrochronological dates: 7 oaks, 2 chestnuts, 1 ash. Of the 10 dated samples, 5 had bark/wane indicating the precise cutting year: 3 oaks, 2 chestnuts.

Of the 7 oak samples that cross-dated well between themselves, and also dated well against the local historical dating master (see **Table 1**, column 6), three (SVCHNY01, 02, 03) had field assessed bark edge remaining after sampling, and three (SVCHNY13, 15, 16) had clear evidence of sapwood, an indication that the original yet now missing bark edge once had been near. Initial usage of these oakwood materials, but also including the two bark-edged chestnuts employed as attic rafters, 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. The evidence of these datings in aggregate suggests several construction phases for those building sections represented by the tested materials: one indicated by attic timbers -including the two chestnuts- for the first portion of the decade of the 1790's, and a second indicated by assorted cellar and kitchen oak timbers for the latter half of the decade of the 1790's, a phase likely stretching into the first years of the 1800's.

Although all of the collected oak and chestnut samples were dated successfully, only one of the 7 cellar timbers herein designated as ash provided a scientifically viable date (SVCHNY10, see comments following). Unfortunately, wildly anomalous growth patterns precluded analysis of the other 6 *Fraxinus* cores, in spite of their many rings. Robust, reliable measurements of these series in the laboratory were not possible due to repeated asymmetric growth, i.e. by multiple cases of extreme ring suppression followed by sudden explosive growth release. No specific limiting factors can be demonstrated in this particular case, but similar growth inhibitions are common wood anatomical responses to drought, forest fires, crowding, etc. Moreover, the minimal surface-width provided by core samples made ocular discernment of the highly irregular ring boundaries even more problematic. It is possible that having access to a broader surface, such as would be available with a wedge or disc cut from the timbers, would allow the ring structures to be traced under the microscope over the entire circumference, in a manner not possible with only a narrow core to scan, and thus would permit more accurate determination of the ring boundaries, which in turn would allow secure measurement series.

The single successful dating achieved (SVCHNY10) from the materials in this section of the cellar was post-1806. The outermost extant ring was dated to that year but, although field observation suggested that it was originally close, the wane edge was completely absent. As a single dating within a complex and extensive section of the structure, the historical value of this date is limited by the lack supportive redundancy, i.e. chronologically similar dates from associated timbers. Furthermore, the timber's location within the structural unit, on the unit's periphery and abutting an entrance stairway, makes it questionable as to whether it is truly representative of the remaining timbers in the space. Therefore this post-1806 dating should be considered with heedful caution: one dated timber alone should not be expected to represent anything about a construction history, for unresolved is always whether its date actually genuinely represents something historical, or is it just some random piece of old wood someone at some point grabbed to use in filling a need.

Table 1. Dendrochronological dating results for samples from the Smith-Voorhees-Covenhoven House near Fultonville, Montgomery 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
SVCHNY 01	Oak	Cellar, N crawlspace, central N/S beam	+BE comp	120	1680 1799	0.661
SVCHNY 02	Oak	Cellar, N crawlspace, E/W beam, 3rd from S wall	+BE comp	101	1699 1799	0.666
SVCHNY 03	Oak	Cellar, N crawlspace, E/W beam, 4th from S wall	+BE comp	116	1685 1800	0.683
SVCHNY 04	Oak	Cellar, N crawlspace, E/W beam, 1st from S wall	-BE, +SP?	74	1695 1768	0.768
SVCHNY 05	Ash	Cellar, E section, N/S joist, 1st from E wall, same tree as SVCHNY 11	-BE	250?	No Date	-.---
SVCHNY 06	Ash	Cellar, E section, N/S joist, 2nd from E wall, BE near?	-BE	95	No Date	-.---
SVCHNY 07	Ash	Cellar, E section, N/S joist, 3rd from E wall	-BE	93	No Date	-.---
SVCHNY 08	Ash	Cellar, E section, N/S joist, 4th from E wall	+BE	90	No Date	-.---
SVCHNY 09	Ash	Cellar, W section, N/S joist, 2nd from W wall, beaded edge	-BE	83	No Date	-.---
SVCHNY 10	Ash	Cellar, W section, N/S joist, 4th from W wall, W side of stairway, beaded edge	-BE	143	1664 1806	0.329
SVCHNY 11	Ash	Cellar, E section, N/S joist, 1st from E wall, same tree as SVCHNY 05	-BE	240?	No Date	-.---
SVCHNY 12	Chestnut	Attic, rafter, 2nd from SE corner, S side	+BE	155	1636 1790	0.509
SVCHNY 13	Oak	Attic, plate, S side, joined by rafter SVCHNY12	-BE, +SP	55	1729 1783	0.610
SVCHNY 14	Chestnut	Attic rafter, 2nd from NW corner, N side,	+BE	134	1657 1790	0.379
SVCHNY 15	Oak	Kitchen, ceiling joist, 3rd from N side fireplace	-BE, +SP	94	1704 1797	0.734
SVCHNY 16	Oak	Kitchen, ceiling joist, 2nd from N side	-BE, +SP	108	1688 1795	0.636

Table 1. Dendrochronological dating results for samples taken from the Smith-Voorhees-Covenhoven House located near Fultonville, Montgomery County, 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. 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

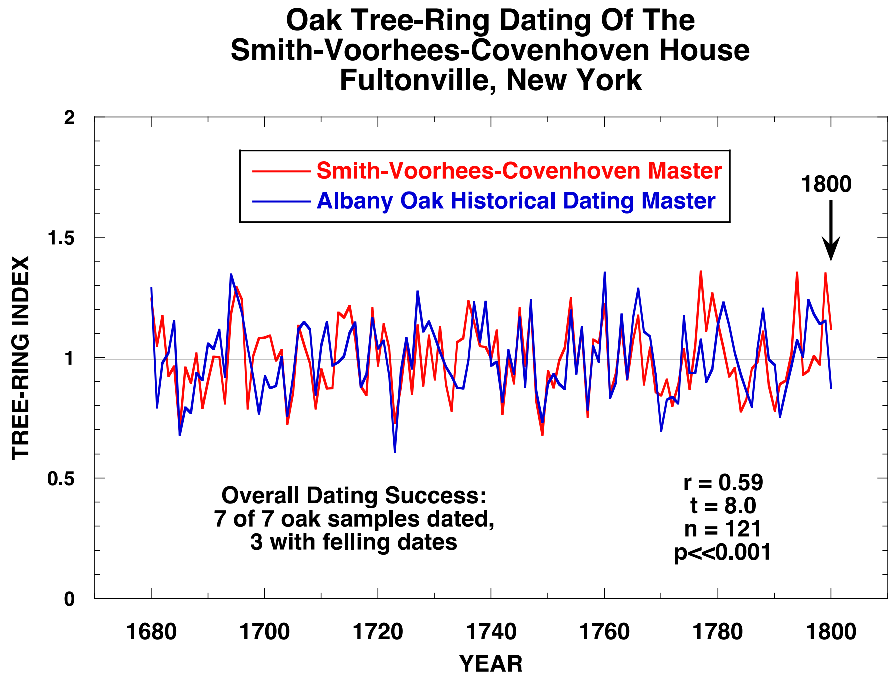
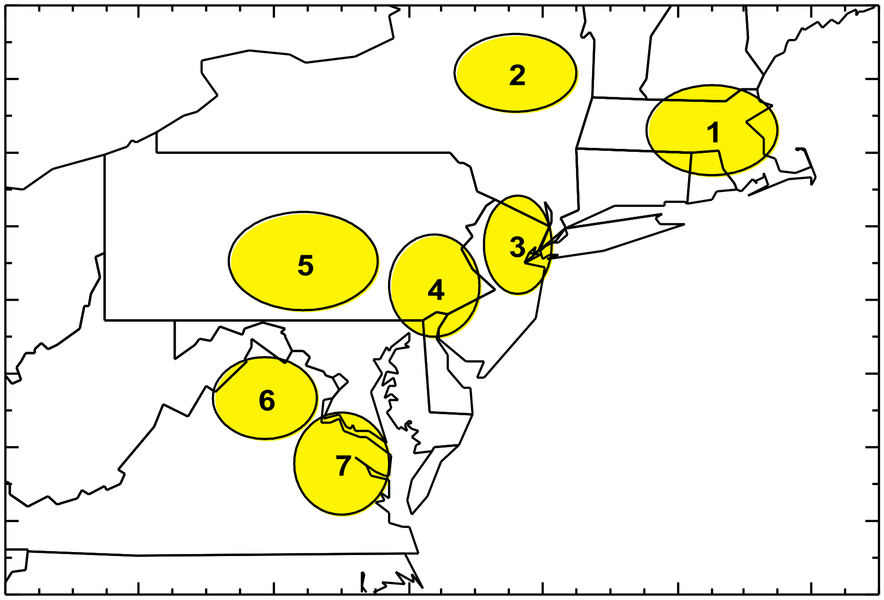


Figure 1. Comparison of the cross-dated, compiled site oak chronology for the Smith-Voorhees-Covenhoven House (red plot) against a regional historical oak dating master from upstate New York (blue plot). Three of the seven sampled oak timbers from the unit provided felling dates: two of 1799 indicating that the tree was felled in the growth dormancy period of 1799/1800 (fall/winter months between the calendar years);.one of 1800 with the outermost annual rings complete, indicating that the trees were felled in the growth dormancy period of 1800/01 (fall/winter months between the calendar years).

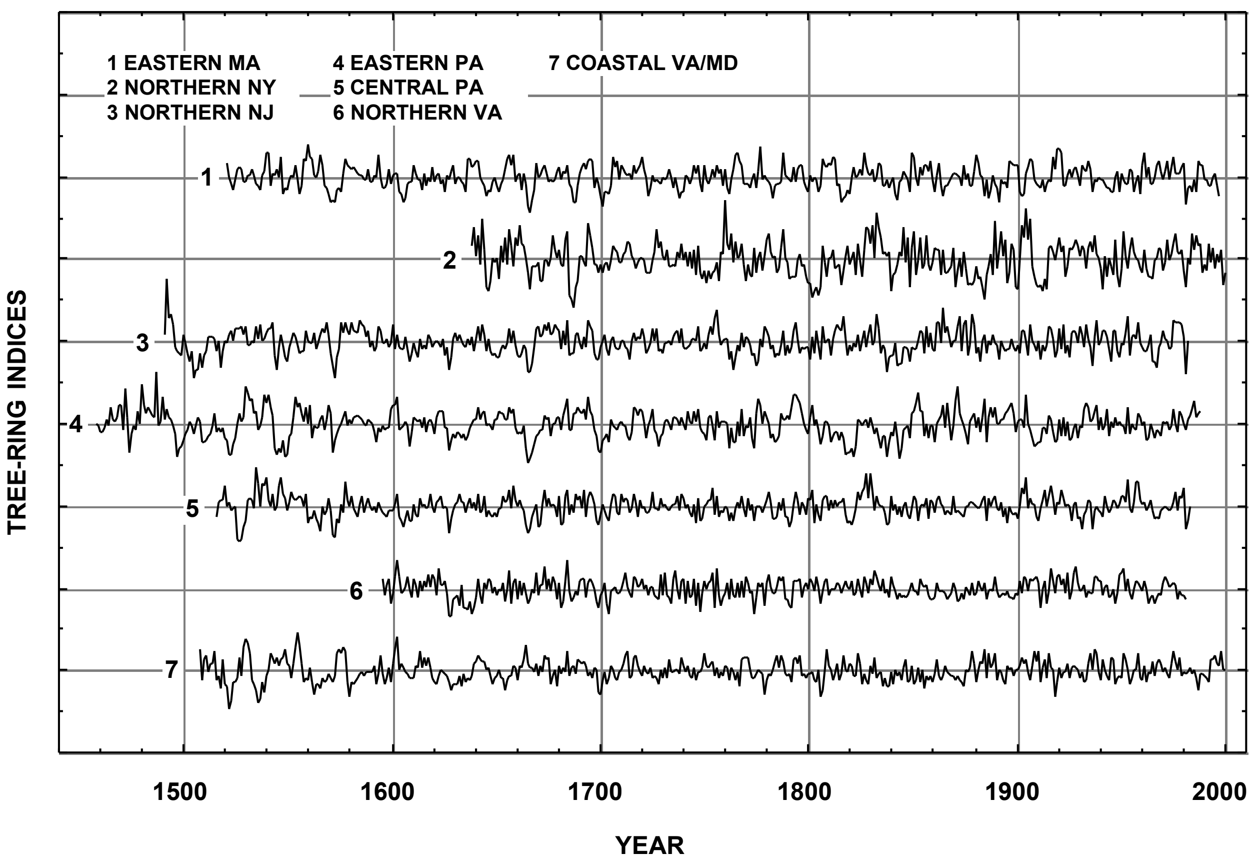
The Spearman rank correlation between the series (t=8.0) associated with the correlation between the SVC House compiled oak series and the regional oak master chronology (r=0.59) is statistically very significant ($p << 0.001$) for a 121-year overlap. For that reason, there can be no doubt that the dates 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.

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.

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