13. EXTRACTING DATES FROM TREE RINGS

Timber casings of the wells provided accurate dates for the construction and demolition of the two framed wells, and for the occupation of the site.

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The key-year technique* is the basis for a patented dendrochronological method for the study of annual growing seasons and tree species over an extended period of time. The key-year technique relates particularly well to a method of accurately determining the year of construction and authenticity of timbers within historic structures (Heikkenen 1984, Heikkenen and Edwards 1983, 1984).

This study presents the alignment of the oak key-year pattern for selected timbers used in the construction of the Hurd Site (Bloomsbury) wells and the corollary: the last year of tree growth of said timbers used in the construction of these historic structures.

DESCRIPTION OF STUDY AREA

The Hurd Site wells were located in Kent County, Delaware. Within this area is one predominant physiographic region: the Atlantic Coastal Plain. The geological materials are predominantly horizontal unconsolidated beds of marine deposits. Elevation ranges from sea level to 100 feet. The topography has eroded through time to a dissected upland plateau, fringed with flood plains of alluvial deposits. The soils range from sands and sandy loams to silt loams.

The forests within the study area are now mainly second growth white and red oaks (*Quercus* spp.), tulip-poplar (*Liriodendron tulipifera* L.), and sweet gum (*Liquidambar styraciflua* L.). Also there are stands of Atlantic white cedar (*Chamaecyparis thyoides* L.). The pines, especially Virginia (*Pinus virginiana* Mill.) and loblolly (*P. taeda* L.), occur on abandoned farmland and cutover forest land. Present stand composition varies widely with soil drainage and past land use. There are few, if any, old growth stands that have not been partially logged.

The annual precipitation ranges from 44-48 inches per year; the soils usually return to field capacity during the winter, and the annual potential evapotranspiration throughout the study area ranges between 28-36 inches. The area is well known for occasionally extreme moisture deficits and excesses.

AREA KEY YEAR PATTERN

The area oak tree-ring pattern from currently growing trees and historical structures has been derived from previous studies on the Western Shore of Maryland and the lands bordering the Chesapeake Bay. The area oak tree-ring pattern was used to align the tree-ring pattern from the Hurd Site wells. The area oak tree-ring pattern extends from the present back to the 16th century (MDZ10, p = .05).

SAMPLING PROCEDURE

Dating of the timbers from the Hurd Site wells is based on wood samples removed by sawing. A total of 11 samples were sawn from wood members of the east well (1 corner post,

* U.S. Patent No. 4,373,393

Plate 37

Scientific sampling of a log

Dr. Heikkenen removes a sample from the inserted log from the east well with a reciprocating saw.

8 clapboards, 1 siding scrap; also 1 infill log). A total of seven samples were removed from clapboards from the west well. All samples were taken on Thursday, August 29, 1996. The data for each wood sample removed from the Hurd Site wells regarding location, tree species, wane edge, number of years, and comments are given in the table on page 171.

TREE-RING ANALYSIS

The analyses of the disks involved the laboratory preparation of these samples by band sawing, stabilizing, sanding, oiling, measuring each annual ring of each sample, and presenting the data in a form suitable for computerized analyses.

The measurement of the widths of the annual rings was done with a dendrochronometer developed by Dendrochronology, Inc. This machine has a movable stage (24" linear displacement) on which the wood sample is placed. The stage is hand moved, either forward or reverse (accuracy .01 mm). The prepared wood specimens were examined under binocular magnification (variable, 10 - 40X) under direct or transmitted light. When the width of an annual ring had been traversed, the distance was concomitantly measured and entered into the computer data bank. This dendrochronometer is unique regarding linear displacement, variable magnification, and lighting. The automatic recording of the data

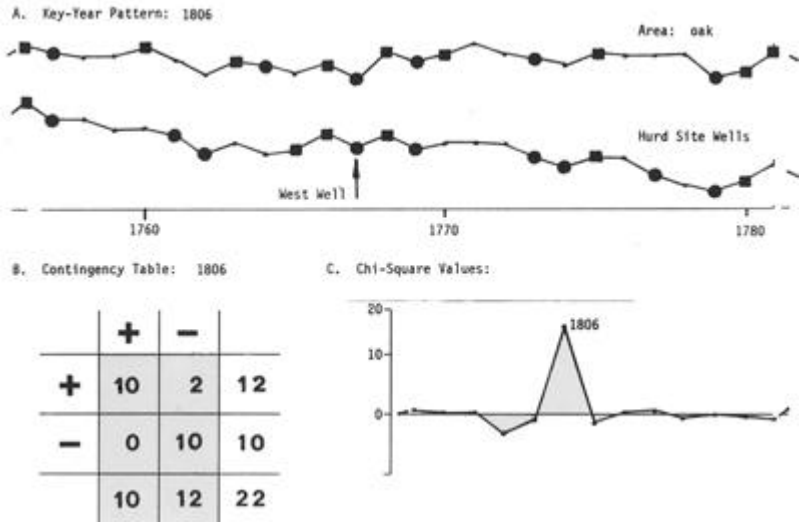

Figure 49

The alignment of the combined oak key year patterns (HSWEWS3, n = 15, p = .05) for the Hurd Site wells with the area oak pattern (MDZ10, p = .05) for the Chesapeake showing the decades of 1760 and 1770. The year of best fit was 1806 (x^2 + 15.3, K = .82).

eliminates human error regarding the transfer of data and the year of occurrence of a given tree ring.

DERIVING KEY-YEAR PATTERN

The dating of the Hurd Site (Bloomsbury) wells is based on the oak key-year (KY) patterns derived from the wood samples taken from the east and west wells.East well: The oak KY pattern for the east well is based on one corner post and eight clapboards. This KY pattern (HSW ES6, n = 9, p = .05) has 19 +KY and 24 -KY and a length of 104 years.

West well: The oak KY pattern for the west well is based on five clapboards. This KY pattern (HSW WS1, n = 5, p = .07) has 8 +KY and 5 -KYand a length of 47 years.

East and west wells: The oak KY patterns from the east and west wells were then aligned, year by year. The year of best fit was minus 31 years for the west well relative to the east well. This alignment was significant having a Chi-square value of 4.3. The oak KY patterns of the east and west wells were then combined to form the oak KY pattern for the Hurd Site wells (HSW EWS2, n = 14, p = .05).

This KY pattern has 15 +KY and 22 -KY and a length of 104 years.

Infill log: The final step regarding the wood samples from the Hurd Site wells was the alignment of the tree-ring pattern of the

infill log from the east well (HSWO1, y = 86). This tree-ring pattern was aligned with the oak KY pattern for the Hurd Site wells (HSW EWS2, n = 14, p =.05). The year of best fit was plus 8 years. This alignment was highly significant, the Chi-square value being 19.0.

Combined Key-Year Pattern: The combined KY pattern for the Hurd Site wells (East, West and infill log) (HSW EWS3, n = 15, p = .05) has 17 +KY and 24 -KY and a length of 112 years.

DATING THE WELLS

The final key-year pattern for the Hurd Site wells (east, west and infill log) (HSW EWS3, n = 15, p = .05) was aligned with the area oak KY pattern (MDZIO, p = .05), year by year, from the present back to 1620. The year of best fit was 1806, having highly significant Chi-square and Kappa values (X2 = 15.3, K = .82).

Last years of tree growth are as follows:

infill log : 1806
east well : 1806 - 8 = 1798
west well : 1798 -31 = 1767

DISCUSSION

The oak clapboards within the west well were well preserved; they had little, if any, rot. However, most of the sapwood was gone. The oak clapboards within the east well were decayed to varying extents. Again, most of the sapwood was gone. The oak corner post andthe infill log were quite solid, with sapwood and bark preserved.

The tree-ring patterns strongly suggest that all wooden members of the Hurd Site wells, including the infill log, came from the same stand. The growth of this stand was normal from 1695 until about 1770 when annual growth became erratic. The reduction in the number of key years during the remaining 36 years (only 5 -KY) could be attributed to logging, beginning in the 1760s.

DENDROCHRONOLOGY SAMPLES FROM WELLS

no.	ER number	Item	Description	lab file	species	type	wane	y	x^2	Comments
1	180z	30	Post from eastern well's destruction debris	HSW01	WO	S	+B	86	0	AER 01 BCEF
2	180z	32	Upright post of eastern well casing	HSW02	WO?	S	?	60	-9	AEER 02 ABCEF
3	182u	1	Clapboard from side of western well	HSW03	WO?	S	+?	50		HSW 03 AB
4	180z	3	Clapboard from side of eastern well	HSW04	RO	S	?	103	0	AER 04 ABC
5	180z	10	Clapboard from side of eastern well	HSW05	RO	S	?	100	-15	AER 05 CDEF
6	180z	13	Clapboard from side of eastern well	HSW06	S	S	-	108	-9	AER 06 AB
7	180z	1	Clapboard from side of eastern well	HSW07	RO	S	-	109	-7	AER 07 AB
8	180z	12	Clapboard from side of eastern well	HSW08	RO	S	+?	30	-14	AER 08 AB rot
9	180z	16	Clapboard from side of eastern well	HSW09	RO	S	+?	25	-1	AER 09 AB
10	180z	21	Clapboard from side of eastern well	HSW10A HSW10B	RO	S -	+? 30	49	-15	AER 10A[12] rot
11	180u	2	Clapboard from side of eastern well	HSW 11	WO?	S	-	114	-7	AER 11 AB
12	180z	11	Scrap of siding from eastern well	HSW12	RO	S	-	43	-18	AER 12 AB
13	182ag-ah	7	Clapboard from AG-AH side of western well	HSW13	RO	S	?	57	-4	AER 13 AB
14	182ag-ah	4	Clapboard from AG-AH side of western well	HSW14	WO?	S				MIA
15	182af-ag	2	Clapboard from AF-AG side of western well	HSW15	RO	S	+?	37	-8	AER 15 AB
16	182af-ag	7	Clapboard from AF-AG side of western well	HSW16	RO	S	+?	60	0	AER 16 AB
17	182af-ag	4	Clapboard from AF-AG side of western well	HSW17	RO	S	?	49	-8	AER 17 AB
18	182ag-ah	9	Clapboard from AG-AH side of western well	HSW18	RO	S	?	41	-5	AER 18 AB