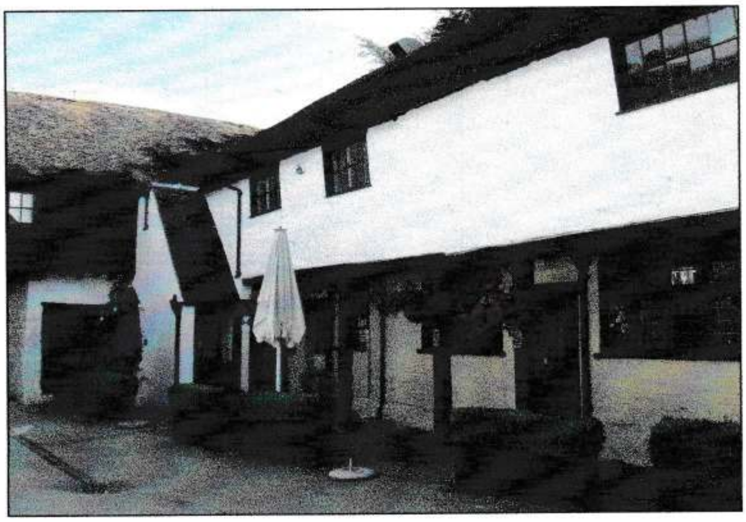
Oxford Dendrochronology Laboratory
Report 2008/35

THE TREE-RING DATING OF TIMBERS FROM THE OLD WHITE HART COMPLEX, HART STREET, HENLEY-ON-THAMES, OXFORDSHIRE (NGR SU 761 827)



Summary

Twenty-five samples were taken from three ranges, the offices on the west side of the courtyard (19b), the rear cross range, and the long east range. A total of eight samples dated. Two timbers retained complete sapwood, one in the offices of the west range building (19b) and one in the rear (north) cross range, producing felling dates of **winter 1530/31** and **spring 1531** respectively. The other six dated timbers have likely felling date ranges incorporating these dates. It seems likely therefore that the three ranges was constructed within a short period of time, most likely in **1531**, or within one or two years after this date. The south range, fronting onto Hart Street, was not sampled.

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The Tree-Ring Dating of Timbers from the Old White Hart Complex, Hart Street, Henley-on-Thames, Oxfordshire (NGR SU 761 826)

BACKGROUND TO DENDROCHRONOLOGY

The basis of dendrochronological dating is that trees of the same species, growing at the same time, in similar habitats, produce similar ring-width patterns. These patterns of varying ring-widths are unique to the period of growth. Each tree naturally has its own pattern superimposed on the basic 'signal', resulting from genetic variations in the response to external stimuli, the changing competitive regime between trees, damage, disease, management etc.

In much of Britain the major influence on the growth of a species like oak is, however, the weather conditions experienced from season to season. By taking several contemporaneous samples from a building or other timber structure, it should be possible to cross-match the ring-width patterns, and by averaging the values for the sequences, maximise the common signal between trees. The resulting 'site chronology' may then be compared with existing 'master' or 'reference' chronologies.

This process can be done by a trained dendrochronologist using plots of the ring-widths and comparing them visually, which also serves as a check on measuring procedures. It is essentially a statistical process, and therefore requires sufficiently long sequences for one to be confident in the results. There is no defined minimum length of a tree-ring series that can be confidently cross-matched, but as a working hypothesis most dendrochronologists use series longer than at least fifty years.

The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's t test. The values of '*t*' which give an acceptable match have been the subject of some debate; originally values above 3.5 being regarded as acceptable (given at least 100 years of overlapping rings) but now 4.0 is often taken as the base value. It is possible for a random set of numbers to give an apparently acceptable statistical match against a single reference curve - although the visual analysis of plots of the two series usually shows the trained eye the reality of this match. When a series of ring-widths gives strong statistical matches in the same position against a number of independent chronologies the series becomes dated with an extremely high level of confidence.

One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence of unknown date to this reference material.

It follows from what has been stated above that the chances of matching a single sequence are not as great as for matching a tree-ring series derived from many individuals, since the process of aggregating individual series will remove variation unique to an individual tree, and reinforce the common signal resulting from widespread influences such as the weather. However, a single sequence can often be successfully dated.

Growth characteristics vary over space and time, trees in south-eastern England generally growing comparatively quickly and with less year-to-year variation than in many other regions (Bridge, 1988).

This means that even comparatively large timbers in this region often exhibit few annual rings and are less useful for dating by this technique.

When interpreting the information derived from the dating exercise it is important to take into account such factors as the presence or absence of sapwood on the sample(s), which indicates the outer margins of the tree. Where no sapwood is present it may not be possible to determine how much wood has been removed, and one can therefore only give a date after which the original tree must have been felled. Where the bark is still present on the timber, the year, and even the time of year of felling can be determined. In the case of incomplete sapwood, one can estimate the number of rings likely to have been on the timber by relating it to populations of living and historical timbers to give a statistically valid range of years within which the tree was felled. For this region the estimate used is that 95% of oaks will have a sapwood ring number in the range 9 - 41 (Miles 1997).

Whenever possible, a *group* of precise felling dates should be used as a more reliable indication of the *construction period*. It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure under study. However, it is common practice to build timber-framed structures with green or unseasoned timber and that construction usually took place within twelve months of felling (Miles 2005).

THE WHITE HART COMPLEX

The complex consists of four ranges enclosing a courtyard. The short south range fronts onto the street (Hart Street) and has a carriageway through into the yard. The west range is under different ownership (No 19b) and consists of offices. There is a north cross range, and a long east range, the latter being in use as a restaurant.

SAMPLING

Sampling was undertaken at various times in spring and summer 2008. Some of the sampling positions are shown in Figures 1 – 3. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **owh**) and removed for further preparation and analysis. Cores were mounted on wooden laths and polished with progressively finer grits down to 400 to allow the measurement of ring-widths to the nearest 0.01 mm.

The samples were measured under a binocular microscope on a purpose-built moving stage with a linear transducer, attached to a desktop computer. Measurements and subsequent analysis were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

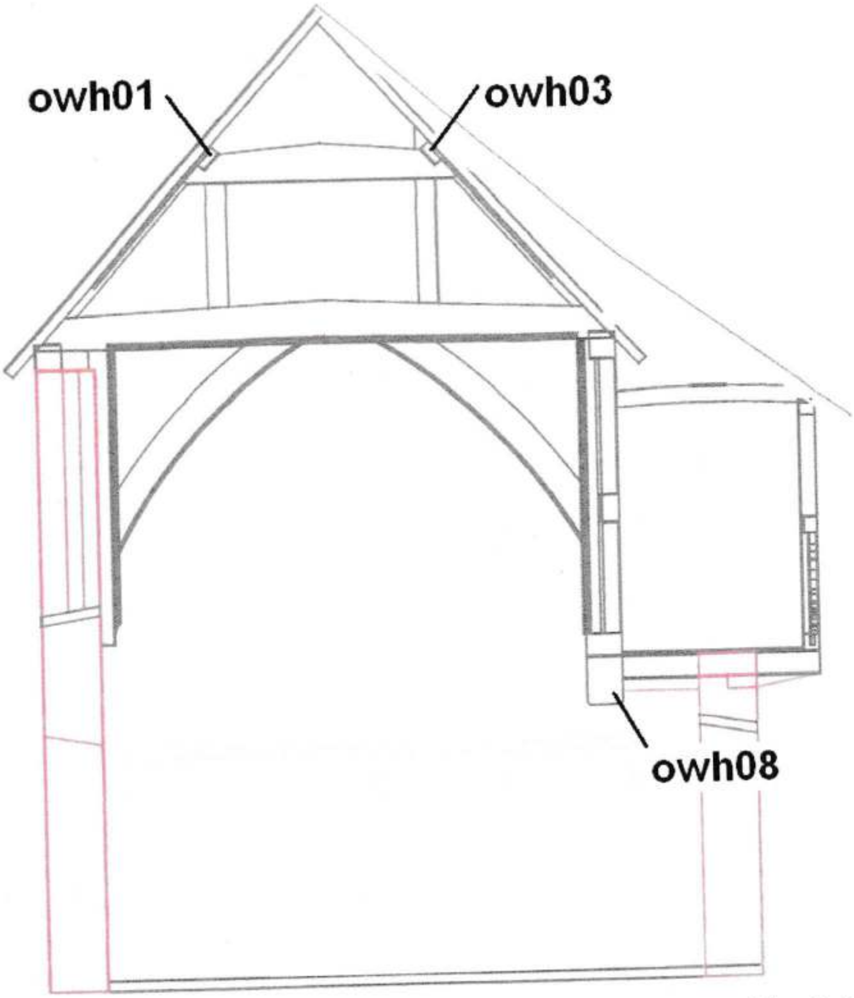

Figure 1: Cross-section of part of the west range, (No. 19b) showing some of the timbers sampled for dendrochronology. Adapted from an original drawing by K. F. Hume.

Figure 2: Drawing of the west facing side of the east range, showing timbers sampled for dendrochronology. Adapted from an original drawing by ~~P. Clark~~.

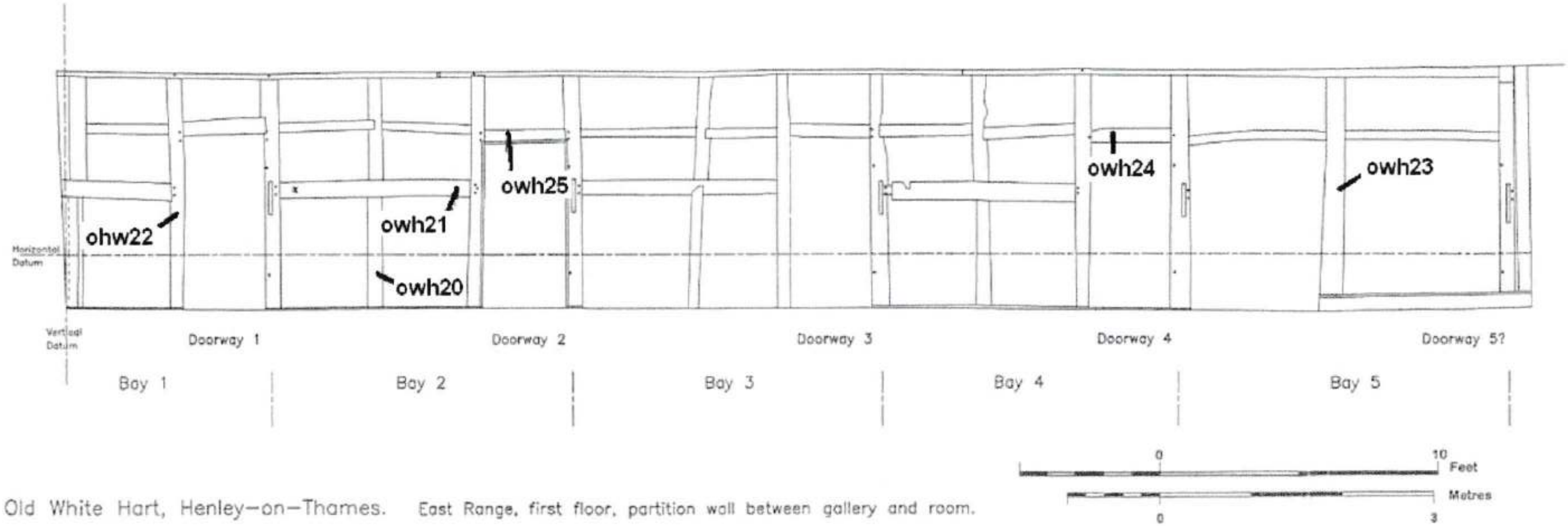

Figure 3: Drawing of the internal first floor partition wall in the east range, originally separating the gallery from rooms, showing the timbers sampled for dendrochronology. Adapted from an original drawing by P. Clark.

RESULTS AND DISCUSSION

All the timbers sampled were of oak (*Quercus* spp.). The locations of the samples are given, along with other basic information, in Table 1, and some are illustrated in Figures 1 - 3. Cross-matching between some of the samples was good (Table 2) and intermediate site masters formed allowed further timbers to be included. As some of the matches shown in Table 2 are rather weak, timbers were dated independently against the reference data as a check on the quality of dating. Eight timbers were dated and their series combined into an 85-year site master chronology, **WHITEHRT**, which dated to the period 1446–1530, the strongest matches being shown in Table 3. The relative positions of overlap of the dated timbers are shown, along with their actual or interpreted likely felling date ranges in Figure 4. Two timbers retained complete sapwood, one in the offices of the west range building (19b) and one in the rear cross range, one being felled in winter 1530/31 and the other in spring 1531. the remaining dated samples all had likely felling date ranges spanning this period, and it seems likely that all the timbers were cut within a few years of each other at most, and may have all been felled in one campaign, making the most likely date of construction of all three ranges **1531** or within a year or two after this date.

Table 1: Timbers sampled from the Old White Hart complex, Hart Street, Henley, Oxfordshire

Sample number	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
West Range (19b)									
owh01	South-west purlin	undated	-	17	50	2.02	0.74	0.202	unknown
owh02	Common rafter, SW quadrant	undated	-	-	NM				unknown
owh03	South-east purlin	undated	-	15	64	1.91	1.19	0.249	unknown
owh04	East post, central truss	undated	-	16C	104	1.98	0.84	0.241	unknown
owh05	Mid-rail, NE quadrant	undated	-	-	34	2.52	1.47	0.293	unknown
owh06	East principal rafter, central truss	undated	-	11	41	2.73	1.03	0.279	unknown
owh07a1	South-east corner post	undated	-	-	33	2.08	0.74	0.203	
owh07a2	*ditto*	undated	-	18	62	1.52	0.55	0.216	unknown
* owh08	Beam carrying jetty joists	1457-1530	1510	20C	74	2.39	1.09	0.228	winter 1530/31
owh09	Jetty joist	undated	-	11	76	1.81	0.67	0.258	unknown
Rear Cross Range									
owh11	Jetty beam	undated	-	-	49	3.71	1.04	0.180	unknown
* owh12	Jetty joist	1454-1511	1511	H/S(+9NM)	58	2.03	0.77	0.280	1520-1552
* owh13	Jetty joist	1450-1527	1509	18	78	1.67	0.45	0.202	1527-1550
owh14a1	Jetty joist	undated	-	-	24	2.97	1.44	0.257	
owh14a2	*ditto*	undated	-	-	30	2.80	0.77	0.248	unknown
owh15	Tie beam	undated	-	30½C	116	1.29	0.59	0.218	unknown
* owh16	Post	1460-1530	1509	21¼C	71	1.78	0.65	0.217	spring 1531
East Range									
owh17	Jetty joist	undated	-	-	NM	-	-	-	unknown
* owh18	Principal jetty joist	1449-1507	1507	H/S	59	2.39	0.55	0.180	1516-1548
* owh19	Principal jetty joist	1450-1514	1514	H/S	65	1.75	0.51	0.189	1523-1555
owh20a	Upright in partition wall	*1468-1508*	*1508*	*H/S*	*41*	*1.79*	*0.52*	*0.218*	
owh20b	*ditto*	*1446-1508*	*1508*	*H/S*	*63*	*1.64*	*0.62*	*0.219*	
* owh20	Mean of 20a and 20b	1446-1508	1508	H/S	63	1.66	0.62	0.220	1517-1549
* owh21	Mid-rail in partition wall	1457-1521	1515	6	65	2.21	0.80	0.220	1530-1562
owh22	Upright in partition wall	undated	-	12	32	2.62	0.61	0.135	unknown
owh23	Upright in partition wall	undated	-	-	NM	-	-	-	unknown
owh24	Door head in partition wall	undated	-	3	69	1.58	0.93	0.246	unknown
owh25	Door head in partition wall	undated	-	1(+14NM)	64	1.17	0.54	0.215	unknown
*** = included in Site Master**	**WHITEHRT**	**1446-1530**			**85**	**1.91**	**0.41**	**0.159**	

Key: H/S bdry = heartwood/sapwood boundary – last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured; C = complete sapwood, winter felled; Sapwood estimate of 9 - 41 used for English timbers (Miles 1997).

Table 2: Cross-matching between the dated samples.

	t-values						
SAMPLE	**owh12**	**owh13**	**owh16**	**owh18**	**owh19**	**owh20**	**owh21**
owh08	5.9	5.9	4.2	4.6	4.5	1.9	3.9
owh12		3.7	3.2	2.8	4.0	2.1	2.5
owh13			3.6	2.1	2.1	1.8	2.5
owh16				3.2	3.6	1.8	3.3
owh18					5.2	4.5	3.0
owh19						2.2	3.8
owh20							2.8

Table 3: Dating evidence for the site sequence **WHITEHRT** AD 1446–1530 with regional multi-site chronologies in **BOLD**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Hertfordshire	Priory Barn, Lt Wymondley	(Bridge 2001)	LWYMON2 *	1450-1540	81	8.1
East Anglia	East Anglia Master Chronology	(Bridge 2003)	**ANGLIA03**	944-1789	85	7.8
Essex	Gosfield Hall	(Bridge 1998)	GOSFIELD *	1449-1537	82	7.5
Oxfordshire	Bodleian Library	(Miles and Worthington 1999)	BDLEIAN4	1436-1570	85	7.3
Wiltshire	Wilbury House, Newton Tony	(Miles and Worthington 1999)	WILBURY1	1449-1579	82	7.0
Buckinghamshire	West Wycombe	(Miles and Worthington 2000)	WWYCOMB1	1395-1531	85	6.9
London	Westminster School	(Miles *et al* 2007)	LIDDELLS	1346-1540	85	6.9
Hampshire	Home Farm Barn, Braemore	(Miles and Haddon-Reece 1996)	BREMORE1	1409-1581	85	6.9
Hampshire	Mary Rose 'refit' timbers	(Bridge and Dobbs 1996)	REFIT	1372-1535	85	6.8

* included in ANGLIA03

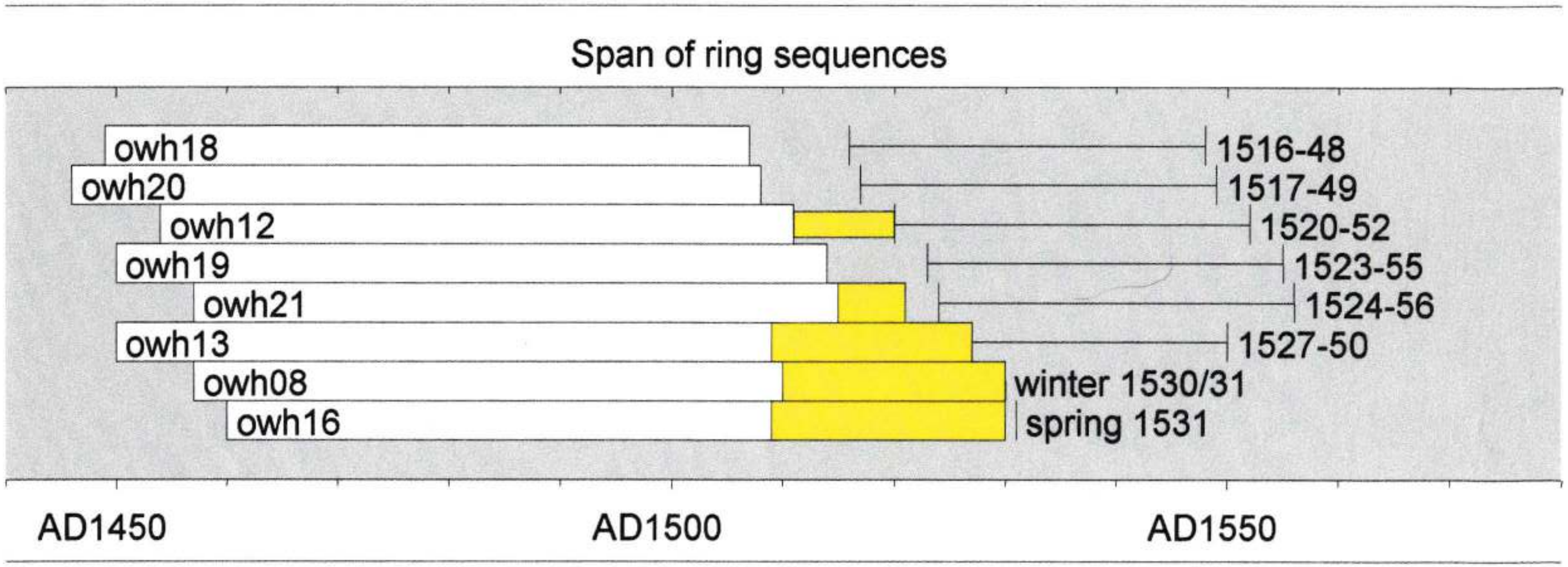

Figure 4: Bar chart showing the relative positions of overlap of the dated timbers. Narrow sections of the bars represent additional unmeasured rings. Yellow sections represent sapwood rings.

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