Oxford Dendrochronology Laboratory
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THE TREE-RING DATING OF TIMBERS FROM LOWER HERNES, ROTHERFIELD GREYS, OXFORDSHIRE (NGR SU 741 827)

Summary

A number of elements from bays I and II of this building dated, the timbers having been felled between winter 1556/67 and summer 1567, making the most likely date of construction 1567, or within a year or two after this date. Two samples from the later cross-wing to the south failed to date.

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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 crossmatch 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 crossmatched, 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 crossmatching 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).

LOWER HERNES

Listed as a *16th century hall house with a cross-wing added at the south end*. This is a simply framed building of two bays, with rectangular brick and flint infill panels and curved wall and wind braces. The trusses are of the queen strut and clasped purlin type. There is one original diamond mullioned window in the east wall of the bedroom of bay I, which also has a brick fire place with an arched timber lintel and moulded spandrels. Other first floor mullioned windows have been recreated, where evidence for their former existence was found. The large ceiling/floor beams retain complete sapwood. The joists in bay I (the heated room) are all chamfered and stopped, those in bay II are plain.

It was evidently built as a farm house complete with an upper storey and substantial stack located at the south gable before the southern cross wing was added. – The evidence of the tree ring sampling as well as that from the building itself, shows that it was not a hall house. It was in the ownership of Sir Francis Knollys of Greys Court in 1567 and may have been associated with the large building programme undertaken at the Court at that time, although it is interesting that the farm house was still built in the timber frame tradition, with the very sparing use of bricks for the stack - and mixed with flints – for the infill panels, whilst at the Court whole building ranges went up in bricks, despite their labour intensive production costs.

SAMPLING

Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **lhrg**) 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).

RESULTS AND DISCUSSION

Details of the areas sampled are illustrated in Figure 1 and described in Table 1.

Cross-matching between the samples (Table 2) revealed that the large axial ceiling beams in both the ground floor rooms in bays 1 and 2 were in fact the same tree – a quite impressively large one! The two series were combined into a single sequence **lhrg16m** for subsequent analysis. The matching between these beams and the other elements of the frame shows that the floor is original. A site master chronology was constructed from five series, and was found to date to the period 1470–1566, the best results being shown in Table 3. The relative positions of overlap are shown, along with the felling dates for each timber in Figure 2. Three timbers retained complete sapwood and were found to have been felled in the winter of 1566/67 and the subsequent spring and early summer, making 1567 the most likely year of construction, although it is possible the frame was made one or two years later than this.

Table 1: Timbers sampled from Lower Hernes

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)
Bays I & II									
lhrg01a1	*Main axial ceiling beam bay 2*	*1477-1533*	*-*	*-*	*57*	*2.55*	*0.90*	*0.210*	
lhrg01a2	*ditto*	*1521-1555*	*1541*	*14*	*35*	*1.73*	*0.51*	*0.195*	
lhrg01b	*ditto*	*1510-1533*	*1523*	*10*	*24*	*1.71*	*0.40*	*0.194*	
lhrg01	Mean of 01a1 + 01a2 + 01b	1477-1555	1541	14	79	2.27	0.90	0.208	1556-82
* **lhrg02**	W mid-rail, bay 2	1483-1566	1553	13C	84	1.31	0.55	0.223	winter 1566/67
* **lhrg03**	Girding beam, N end bay 2	1516-1553	1548	5	38	3.40	1.16	0.209	1557-89
lhrg04	Tie, N end bay 2	undated	-	14	45	3.83	1.41	0.240	unknown
* **lhrg05**	Tie, N end bay 1	1509-1566	1547	19½C	58	2.80	0.91	0.239	summer 1567
lhrg06	Main axial ceiling beam bay 1	1470-1566	1537	29¼C	97	1.82	0.87	0.202	spring 1567
* **lhrg07**	Mid-rail S end bay 1	1506-1554	1547	7	49	2.46	1.09	0.224	1556-88
* **lhrg16m**	Mean of 01 + 06	1470-1566	1537	29¼C	97	2.04	0.90	0.205	spring 1567
South Cross-Wing									
lhrg08	Central post bay 4	undated	-	11	52	1.97	0.68	0.151	unknown
lhrg09	Beam bay 4	undated	-	17C	56	1.91	0.88	0.244	unknown
* = included in Site Master **LHERNES1**		**1470-1566**			**97**	**2.32**	**0.84**	**0.213**	

Key: H/S bdry = heartwood/sapwood boundary – last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; C = complete sapwood, winter felled; ¼C = complete sapwood, felled spring the following year; ½C = complete sapwood, felled the following summer. Sapwood estimate of 9 - 41 used for English timbers (Miles 1997).

Table 2: Cross-matching between the dated timbers from Lower Hernes, Rotherfield Greys.

	t-values				
SAMPLE	**lhrg02**	**lhrg03**	**lhrg05**	**lhrg06**	**lhrg07**
lhrg01	8.7	5.8	5.2	12.0	4.8
lhrg02		4.5	6.3	8.3	4.7
lhrg03			7.4	4.9	8.9
lhrg05				5.8	5.9
lhrg06					5.0

Table 3: Dating evidence for the site sequence **LHERNES1** AD 1470–1566 with regional multi-site chronologies in **BOLD**

County or region:	***Chronology name:***	***Short publication reference:***	***File name:***	***Spanning:***	***Overlap (yrs):***	***t-value:***
Oxfordshire	Greys Court, Rotherfield Greys	(Miles *et al* 2004)	GREYSCT2	1417-1587	97	8.6
Southern England	Southern England Master	(Bridge 1998)	**SENG98**	944-1790	97	8.3
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443-1972	97	8.3
Oxfordshire	Bodleian Library	(Miles and Worthington 1999)	BDLEIAN4	1436-1570	97	8.2
Kent	Cobham Hall	(Arnold *et al* 2003)	COBHSQ01	1317-1662	97	8.1
Hampshire	Wymering Manor	(Miles *et al* 2008)	WYMERING	1451-1580	97	7.9
Oxfordshire	Chazey Court	(Miles *et al* 2004)	CHAZEY1	1507-1614	60	7.7
Buckinghamshire	Medmenham	(Miles and Worthington 2001)	MEDMNHM1	1430-1564	95	7.5
Berkshire	Shaw House, Newbury	(Miles *et al* 2004)	SHAW1	1391-1579	97	7.5
Buckinghamshire	Chenies Manor	(Miles *et al* 2004)	CHENIES1	1370-1551	82	7.4

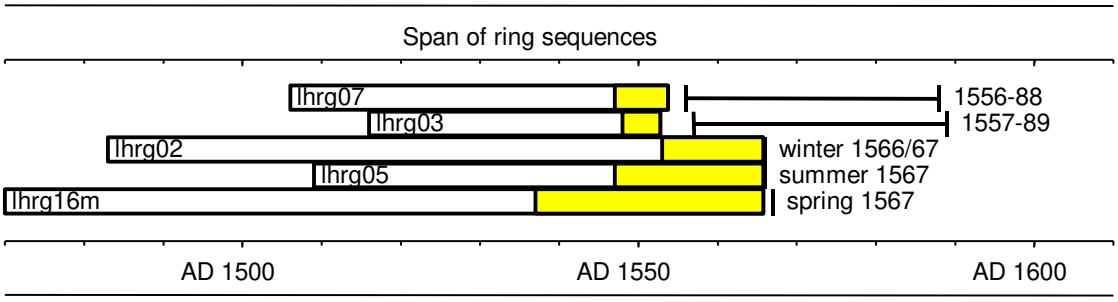

Figure 2: Bar chart showing the relative positions of overlap of the dated samples along with their likely felling date ranges. Yellow sections of the bars represent sapwood rings

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