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Oxford Dendrochronology Laboratory
Report 2018/29

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM THE BARN AT HENDRE, GWYDDELWERN, DENBIGHSHIRE

(SJ 171 493)

Summary

Six out of nine samples from the primary phase timbers in this barn were dated, producing a 102-year long site chronology dating to the period 1433–1534. This matched very strongly with other sites within the immediate area around the site, suggesting the trees were grown locally to the site, although poor inter-sample matching suggests they may have come from several sources locally. The mean heartwood-sapwood boundary date produces a likely felling date range for the group of dated timbers of 1534–64, modified in the light of rings on two samples to **1547–64**. One sample retained complete sapwood, but with a break. It is thought few, if any, rings were lost in this break, which would suggest felling in the earlier part of this range.

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The Dendrochronological Dating of Timbers from the barn at Hendre, Gwyddelwern, Denbighshire (SJ 171 493)

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 is often 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. These include chronologies made by colleagues in other countries, most notably areas such as modern Poland, which have proved to be the source of many boards used in the construction of doors and chests, and for oil paintings before the widespread use of canvas.

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.

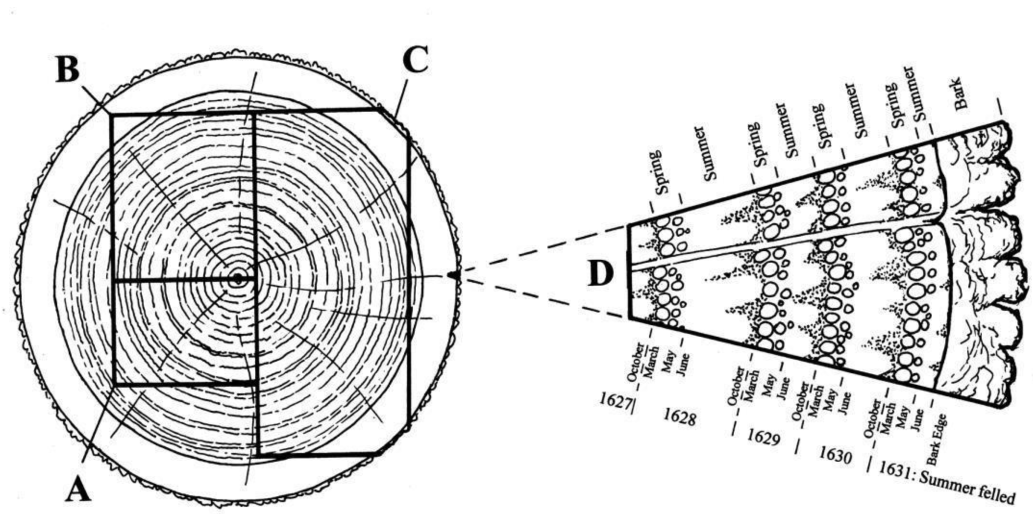
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation to the variation in the data, and is an established statistical technique for looking at the significance of matching between two datasets that has been adopted by dendrochronologists. 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 in oak studies. Higher values are usually found with matching pine sequences. 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 be successfully dated, particularly if it has a long ring sequence.

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 11 – 41 (Miles 1997).



Section of tree with conversion methods showing three types of sapwood retention resulting in **A** *terminus post quem*, **B** a felling date range, and **C** a precise felling date. Enlarged area **D** shows the outermost rings of the sapwood with growing seasons (Miles 1997, 42)

The Barn (from Cadw Listed Buildings record)

A threshing barn, probably dating from the 16th century, built of slatey rubblestone with a slate roof repaired with corrugated iron sheets. The roof is supported by cruck frames, and a small section of timber framing survives, indicating that the whole building may once have been timber framed.

<u>SAMPLING</u>

Eight samples were taken from timbers in the roof during August 2018. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled with the prefix **hndi**, and taken away for subsequent analysis, where they were glued to laths.

The samples were 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 purposebuilt moving stage with a linear transducer, attached to a desktop computer. Measurements and subsequent analysis were carried out using programs by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

The locations and details of the samples are described in Table 1. The first step in dating is usually to find internal matches between the samples and build a site chronology. This proved difficult in this case as the internal cross-matching was rather poor in most cases (Table 2). A step-wise process was undertaken, in which the best matching pairs of series were combined, and then the remaining samples matched to those, incorporating more series in a series of steps, to reach the site master. Individual samples were also matched independently to the reference database as a confirmation of the matches found. Samples **07** and **08** were both from a purlin, but did not each other strongly enough to be considered from the same tree, so it is assumed there was an unnoticed join in this purlin. The resulting site master chronology incorporates six of the nine samples, with samples **01**, **02** and **09** not being dated. Series **01** was just 44 years long, so this is no surprise, and series **09** has a rapid growth change mid-series, so again it is no surprise that this did not date. In the case of **02**, there is no obvious reason as to why this sample did not either match the other series from the site, nor did it match the reference material.

The poor internal matching may suggest that trees were sought from several different sources. When combined into a 102-year site chronology however, the matching to the database is very strong (Table 3) with very local matches being the strongest, underlining the usefulness of having a network of local material against which to date. The relative positions of overlap of the dated samples are shown, along with their likely felling date ranges, in Fig 1.

No complete sapwood remained intact, and therefore a felling date range has been derived. The mean heartwood-sapwood boundary date is 1523, giving a likely range of 1534–64, which can be modified in light of samples **05** and **08** to **1547-64.** Although there is a break in the sapwood for sample 08, it looks on the sample as if few if any rings were lost, and it is therefore felt likely that the actual felling date for this sample is likely to be in the first part of this statistically derived range.

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REFERENCES

Baillie, M.G.L. and Pilcher, J.R. (1973) *A simple cross-dating program for tree-ring research.* **Tree Ring Bulletin**, 33, 7-14.

Bridge, M. C. (1988) *The dendrochronological dating of buildings in southern England*, **Medieval Archaeology**, 32, 166-174.

Bridge, M. C., Miles, D., Suggett, R. and Dunn, M. (2014) Tree-Ring Dating Lists, **Vernacular Architecture**, 45, 125-126.

Bridge, M. C., Miles, D., Suggett, R., and Dunn, M. (2015) Tree-Ring Dating Lists, **Vernacular Architecture**, 46, 112-116.

Bridge, M. C., Miles, D., Suggett, R., Cook, R., Dunn, M. and Thompson, P. (2016) Tree-Ring Dating Lists, **Vernacular Architecture**, 47, 96-101.

English Heritage (1998) *Guidelines on producing and interpreting dendrochronological dates,* **English Heritage, London.**

Miles, D. (1997) *The interpretation, presentation, and use of tree-ring dates*, **Vernacular Architecture**, 28, 40-56.

Miles, D. H. and Worthington, M. J. (2000) Tree-ring dates, **Vernacular Architecture**, 31, 90-113.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2003) Tree-ring dates, **Vernacular Architecture**, 34, 109-113.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2006) Tree-ring dates, **Vernacular Architecture**, 37, 118-132.

Miles, D. H., Worthington, M. J., Bridge, M. C., Suggett, R. and Dunn, M. (2010) Tree-ring dates, **Vernacular Architecture**, 41, 110-118.

Miles, D. H., Bridge, M. C., Suggett, R. and Dunn, M. (2011) Tree-ring dates, **Vernacular Architecture**, 42, 109-116.

Tyers, I. (2004) *Dendro for Windows Program Guide 3rd edn*, **ARCUS Report,** 500b**.**

Table 1: Details of samples taken from the barn at Hendre, Gwyddelwern.

Sample number	Timber and position	Date of series	H/S boundary date	Sapwood complement	No of rings	Mean width (mm)	Std devn (mm)	Mean sens	Felling date range
hndi01	Cruck blade B2	-	-	H/S	44	2.35	1.50	0.26	-
hndi02	Tiebeam B	-	-	37 +3NM	117	1.10	0.53	0.18	-
* hndi03	Queen post B	1444–1528	1528	H/S	85	1.74	0.75	0.21	1539–69
* hndi04	Horn	1448–1530	1530	H/S	83	2.31	1.14	0.21	1541–71
* hndi05	Tiebeam A	1444–1533	1513	20 +6NM	90	2.17	1.37	0.23	1539–54
* hndi06	Cruck blade A2	1466–1534	1524	10	69	1.91	0.83	0.22	1535–65
* hndi07	Purlin, bay 3 side 1	1449–1519	1519	H/S	71	2.62	1.72	0.23	1530–60
* hndi08	*ditto*	1433–1532	1526	6 +15NM	100	1.63	0.59	0.25	1547–67
hndi09	Mid-rail	-	-	H/S	62	2.29	1.37	0.33	-
* = included in site chronology **HENDREBN**		**1433–1534**	**1523**		**102**	**2.03**	**0.63**	**0.17**	**1547–64**

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; ¼C = complete sapwood, felled the following spring; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured. [1] based on mean H/S date for two timbers.

Table 2: Cross-matching between the dated samples in site master **HENDREBN**

	t - values				
Sample	**hndi04**	**hndi05**	**hndi06**	**hndi07**	**hndi08**
hndi03	3.3	2.9	4.4	2.4	3.3
hndi04		2.0	3.0	2.0	3.2
hndi05			1.7	3.5	4.6
hndi06				1.9	1.6
hndi07					3.9

Table 3: Dating evidence for the site chronology **HENDREBN AD 1433–1534** against dated reference chronologies

County or region:	***Chronology name:***	***Reference***	***File name:***	***Spanning***	***Overlap: (yrs)***	***t-value:***
Site Chronologies						
Denbighshire	Ucheldref Rhug, Corwen	(Miles *et al* 2010)	DENBY4	1373–1597	102	10.0
Denbighshire	Tyn-Llan Gwyddelwern	(Miles *et al* 2010)	DENBY5	1410–1518	86	9.9
Denbighshire	Glas Hirfryn,	(Bridge *et al* 2014)	GHN	1404–1557	102	9.7
Denbighshire	Rose and Crown, Gwyddelwern	(Miles and Worthington 2000)	GWYDWN	1411–1571	102	9.5
Shropshire	Dutch Cottage, Clunbury	(Miles *et al* 2006)	DUTCHCOT	1424–1549	102	9.4
Denbighshire	Caerfallen, Ruthin	(Bridge *et al* 2015)	CAERFLLN	1415–1559	102	9.1
Montgomeryshire	St Idloes Church, Llanidloes	(Miles *et al* 2003)	LNYDLOS2	1384–1593	102	9.0
Shropshire	Clungunford Master Chronology	(Miles 2002 unpubl)	**CLNGNFRD**	1273–1653	102	8.7
Merioneth	Hendre Faerdref, Cynwyd	(ODL 2018 unpubl)	HFLx1	1354–1502	70	8.6
Denbighshire	Ty Cerrig, Llanfwrog	(Miles *et al* 2011)	DENBY7a	1420–1500	68	8.5
Merioneth	Cae'r March, Llanfachreth	(Bridge *et al* 2016)	CAERMCH1	1405–1541	102	8.4

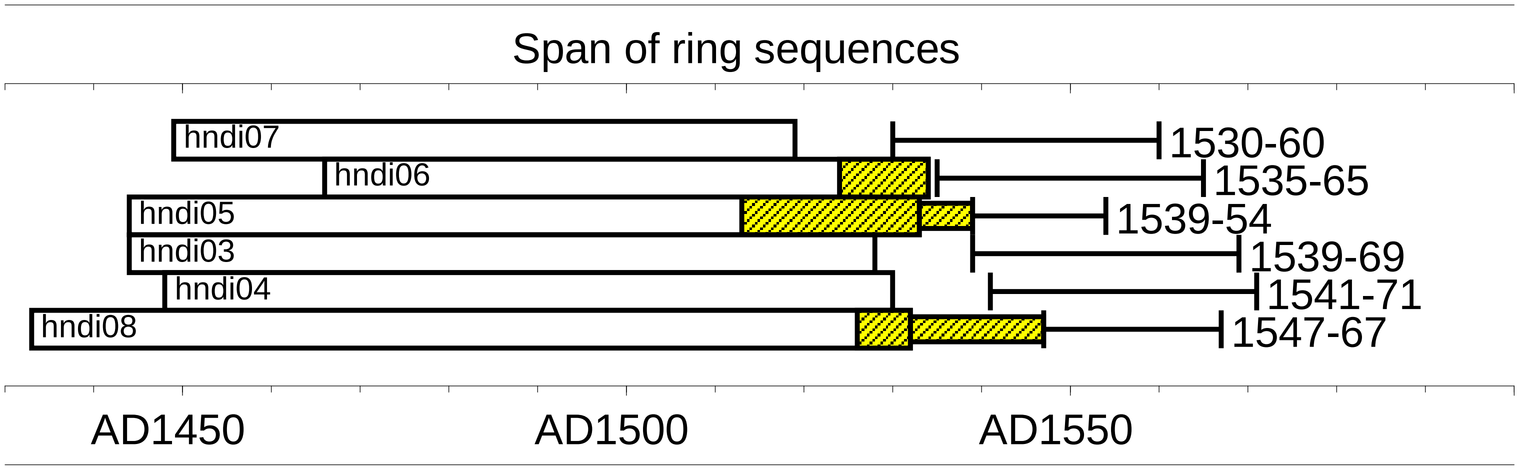

Figure 1: Bar diagram showing the relative positions of overlap of the dated samples, with their likely felling date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood, narrow bars represent additional unmeasured rings.