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Oxford Dendrochronology Laboratory
Report 2016/20

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM PLAS YN TROFARTH, LLANGERNYW, ABERGELE, CONWY (DENBIGHSHIRE) (SH 859 691)

Summary

Seven timbers from the roof of this house were cross-matched, two probably coming from the same tree. The site master dates well to the period 1386–1490. Although one timber had complete sapwood, this became detached on coring, and it is not clear how many rings may have been lost between the end of the core and the start of the remaining sapwood. The mean heartwood-sapwood boundary date for the group is 1488, giving a likely felling date range of 1499-1529, but this can be modified in light of surviving sapwood rings to **1504–29**.

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A report commissioned by the Discovering Old Welsh Houses Group in collaboration with the Royal Commission on the Ancient and Historic Monuments Wales (RCAHMW)

The Dendrochronological Dating of Timbers from Plas yn Trofarth, Llangernyw, Abergele, Conwy (SH 859 691)

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.

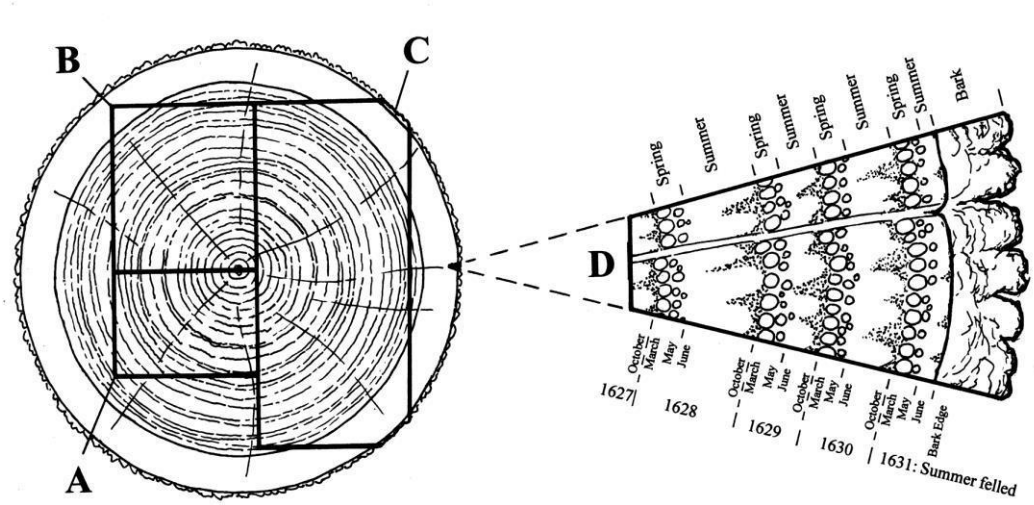
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation 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 1997a).



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 1997a, 42)

Plas yn Trofarth

The Coflein record (NPRN 27800) has the following information:

1. 18th century stone, 2 storey, slated, typical vernacular.

2. A stone A-type house, perhaps originally timber-framed. The roof comprises arch-braced, wind-braced principals with butt-purlins. The lack of smoke blackening suggests that the house may have had an open-roofed chamber and enclosed fireplaces throughout. All openings are modern.

The roof has large, slightly cranked tiebeams with raking queen struts.

SAMPLING

Samples were taken in June 2016. The locations of the samples are described in Table 1, and shown in Fig 1. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **pynt**) and 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 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 samples are given in Table 1. Initial cross-matching between the samples matched a and b sections of both **05** and **06** to each other, allowing new series to be produced for each of these timbers. It also revealed that samples **02** and **04** were most likely from the same tree (t = 11.0 with 98 years overlap) and these series were therefore combined into a single series, **pynt42m**, for subsequent analysis. Sample **07** showed a sudden rapid decline in growth rate after 50 rings, and this series was therefore edited to remove the outer 30 rings for subsequent analysis, the new series being designated **07e**. Cross-matching between the remaining samples is shown in Table 2. The series were combined into a 105-year site master chronology. The relatively weak matches with series **07e** and **08**, were confirmed by independent dating of each of these ring width series This was subsequently dated to the period 1386–1490, the evidence being presented in Table 3.

The mean heartwood-sapwood date for these timbers is 1488, giving a likely felling date range for the group of 1499–1529, which can be modified in light of the surviving sapwood from **08** to **1504–29**. It is unclear how many rings may have been lost between the heartwood-sapwood boundary at the end of **08** and the detached complete sapwood section of 15 rings, but it seems likely that the actual felling date may be towards the earlier part of this range.

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Table 1: Details of samples taken from Plas yn Trofarth .

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
* **pynt01**	Bay 1, common rafter	1437–1487	1487	H/S	51	2.09	0.93	0.22	1498–1528
pynt02	Bay 1, common rafter	1391–1489	1489	H/S	99	1.66	0.69	0.32	1500–1530
* **pynt03**	Truss 1, collar	1428–1490	1490	H/S	63	1.64	0.59	0.19	1501–1531
pynt04	Truss 2, collar	1386–1488	1488	H/S	103	1.75	0.93	0.30	(1500–1530)
pynt05a	Truss 2, rear arch-brace	*1395–1461*	-	-	*67*	*2.58*	*0.73*	*0.22*	
pynt05b	*ditto*	*1428–1459*	-	-	*32*	*1.68*	*0.44*	*0.23*	
* **pynt05**	Mean of **05a** and **05b**	1395–1461	-	-	67	2.37	0.69	0.22	After 1472
pynt06a	Truss 3, front arch-brace	*1409–1487*	*1487*	*H/S*	*79*	*1.39*	*0.58*	*0.24*	
pynt06b	*ditto*	*1393–1467*	-	-	*75*	*1.87*	*0.69*	*0.22*	
* **pynt06**	Mean of **06a** and **06b**	1393–1487	1487	H/S	95	1.63	0.67	0.23	1498–1528
* **pynt07e**	Bay 1, joist (in living room)	1407–1456	*c*1486	-	50 (+30NM to H/S)	2.69	0.70	0.20	After 1495
* **pynt08**	Bay 1, joist (in living room)	1422–1489	1489	+15NMC	68	1.56	0.43	0.21	1504–1530
* **pynt42m**	Mean of **02** and **04** (same tree)	1386–1489	1489	H/S	104	1.73	0.77	0.29	1500–1530
* = included in site master **TROFARTH**		**1386–1490**			**105**	**1.98**	**0.58**	**0.19**	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; C = complete sapwood, winter felled; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

Table 2: Cross-matching between the dated samples (*t*-values above 3.5 are significant)

	t-values					
Sample	**pynt42m**	**pynt03**	**pynt05**	**pynt06**	**pynt07e**	**pynt08**
pynt01	2.8	4.8	*	3.9	*	3.8
pynt42m		3.8	5.5	7.2	2.0	2.8
pynt03			*	3.4	*	2.5
pynt05				4.5	1.9	0
pynt06					4.2	3.2
pynt07e						*

* = overlap less than 35 years, no value calculated, negative values given as zero

Table 3: Dating evidence for the site chronology **TROFARTH AD 1386–1490** against dated reference chronologies

County or region:	***Chronology name:***	***Reference***	***File name:***	***Spanning***	***Overlap: (yrs)***	***t-value:***
Regional Chronologies						
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	105	8.6
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881–1745	105	8.1
England	Southern Central England	(Wilson *et al* 2012)	**SCENG**	663–2009	105	7.7
Site Chronologies						
Herefordshire	White House, Vowchurch	(Nayling 2000)	VOWCH	1364–1602	105	8.9
Merioneth	Rhydywernen, Llanfor	(Bridge *et al* 2015)	RHYDYWRN	1403–1530	88	8.4
Caernarvonshire	Bwthyn Cae-glas, Llanfrothen	(Miles *et al* 2006)	BDGLRT7	1386–1547	105	8.4
Durham	Low Harperley	(Howard *et al* 2006)	LWHBSQ01	1356–1604	105	8.4
Anglesey	60 Castle Street, Beaumaris	(Miles *et al* 2011)	ANGK	1391–1515	100	7.9
Montgomeryshire	Trefrechan barn	(Miles *et al* 2004)	TREFECHN	1423–1606	68	7.9
Merioneth	Cwrt Plas yn Dre	(Bridge *et al* 2013)	CWRTPLAS	1397–1508	94	7.7
Shropshire	Brookgate Farm	(Miles and Haddon-Reece 1993)	BROOKGT	1362–1611	105	7.7
Wales	Cotehele tester	(Miles unpublished)	COTEHELE	1327–1509	105	7.7
Caernarvonshire	Maenan Hall, Llanrwst	(Bridge *et al* 2015)	MAENAN	1374–1508	105	7.6

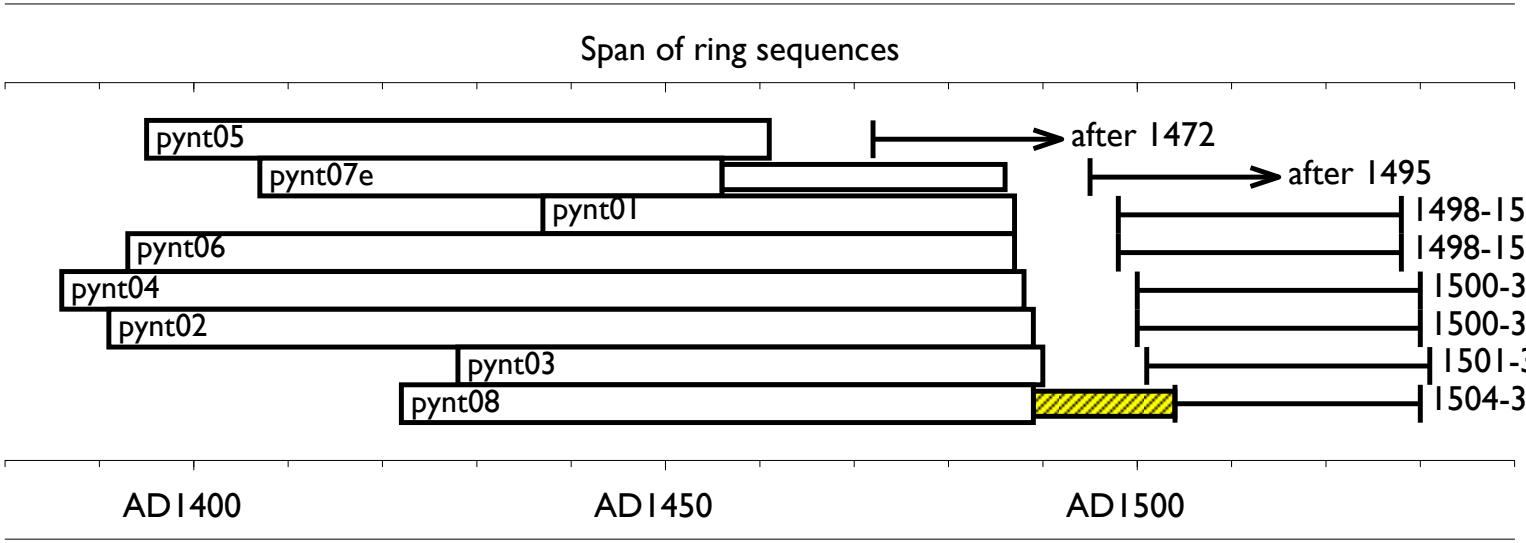

Figure 1: Bar diagram showing the relative positions of overlap of the dated samples, with their actual or likely felling dates / date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood, narrow bars represent additional unmeasured rings.