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Oxford Dendrochronology Laboratory
Report 2011/7

**THE TREE-RING DATING OF
BRYN BERLLAN
CYNWYD,
CORWEN,
DENBIGHSHIRE
(NGR SJ 054 413)**



Summary

Ten timbers were sampled from this site, nine from the roof, and one from a ground-floor screen. That from the screen failed to date, as did one other timber. An arch-brace and a principal rafter from the same truss were found to almost certainly have come from the same parent tree. The roof timbers included a collar from a tree felled in winter 1525/26, whereas all the remaining dated roof timbers appear to form a single group, most likely felled at the same time. One of these retained complete sapwood, and was from a tree felled in the winter of 1552/53, making construction of the roof most likely in **1553**, or within a year or two after this date. The site chronology gave very strong matches with a number of very local chronologies.

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A report commissioned by The North West Wales Dendrochronology Project in partnership with The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

The Tree-Ring Dating of Bryn Berllan, Cynwyd, Corwen, Denbighshire (NGR SJ 054 413)

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.

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. 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.

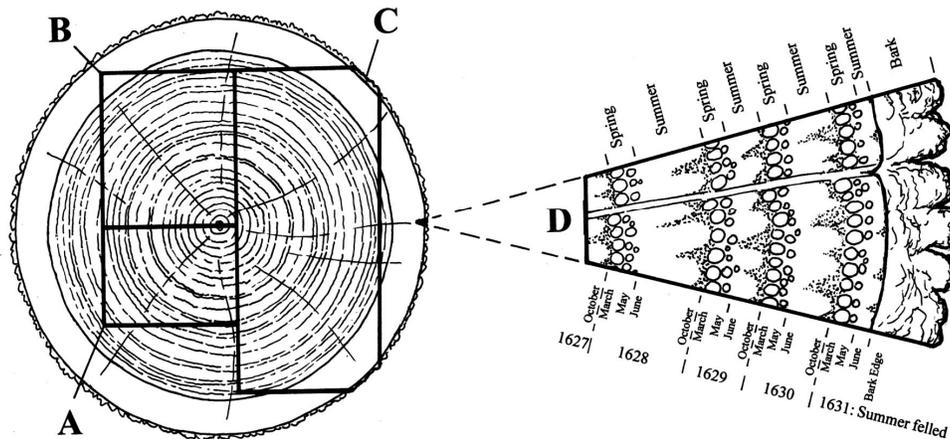
It follows from what has been stated above that the chances of matching a single sequence are not as great as for matching a tree-ring series derived from many individuals, since the process of aggregating



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)

BRYN BERLLAN, CYNWYD

An early storeyed house of two bays with two principal phases. The house as first built was timber-framed; mortices in the wallplate show that it was close studded. The roof-trusses survives more-or-less intact. The end truss at the kitchen/hall end has herringbone framing with some suggestion of a lost fireplace hood. The central truss is arch-braced with raking struts above the collar and a post-and-panel



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partition with two doorways below the tie-beam. The post-and-panel partition is boldly numbered with numerous holes for the supports of a dais bench between two doorways. The principal doorhead (to the parlour) is pointed; the doorhead to the stair is flat. The closed truss at the parlour end was close-studded. The roof is windbraced to the lower purlin. The roof timbers are not smoke blackened from an open fire.

In a second phase the timber walls were rebuilt in stone and a stone fireplace replaced the earlier fireplace. The plan of the first phase is irrecoverable (although an end-chimney lobby entrance may be suggested because of the dais seat) but the second stone-walled phase was of Snowdonian plan-type. In a third phase the outer room has been replanned and a stair passage constructed behind the partition. (RFS/RCAHMW/APRIL 2011)

SAMPLING

Sampling took place in November 2010. All the samples were of oak (*Quercus* spp.). Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were numbered using the prefix **deng**. The samples were removed for further preparation and analysis. Cores were mounted on wooden laths and then these were polished using 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. The ring-width series were measured and other analyses were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

Ten timbers were sampled from this building – details of the samples and their locations are given in Table 1. Two series did not match the others, nor could they be dated independently – these were from the screen, and a principal rafter. Cross-matching between the remaining eight samples (Table 2) revealed that the series from **deng05** and **deng06**, a principal rafter and an arch-brace on the same truss, were almost certainly from the same tree ($t = 11.2$), and their ring-widths were combined to form a single new series **deng56m**, used in subsequent analysis. Sample **deng09** was in two parts, each of which were dated, and therefore eight series from seven timbers were combined into a 177-year site master chronology **DENG**, which was subsequently dated to the period 1376–1552, the evidence being presented in Table 3. This shows a very strong localised matching with a number of sites dated previously in this project, showing the importance of having local chronologies.

The relative positions of overlap of the dated samples are shown in Figure 1.

Sample **deng02**, from a collar, was from a tree felled in winter 1525/26, whilst the other timbers appear to form a single group of timbers from trees most likely felled at the same time. One of these retained complete sapwood and was from a tree felled in **winter 1552/53**. It seems likely therefore that the building was constructed in **1553**, or within a year or two after this date, incorporating a single timber from a tree felled a generation or so before.



Table 1: Details of samples taken from Bryn Berllan, Cynwyd.

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
* deng01	East principal rafter, truss 1	1376-1552	1518	34C	177	0.99	0.54	0.19	Winter 1552/53
* deng02	Collar, truss 1	1397-1525	1480	45C	129	1.29	0.80	0.26	Winter 1525/26
* deng03	West principal rafter, truss 1	1452-1514	1512	2	63	1.29	0.47	0.23	1523-53
* deng04	East purlin, bay 1 - 2	1400-1540	1514	26	141	0.83	0.2	0.22	1541-55
deng05a	East principal rafter, truss 2	1415-1523	1523	H/S	109	0.83	0.34	0.29	-
deng05b	<i>ditto</i>	1463-1522	1522	H/S+27NM	60	0.98	0.38	0.28	-
deng05	Mean of 05a and 05b	1415-1523	1523	H/S+27NM	109	0.84	0.34	0.28	1550-64
deng06a	West arch brace, truss 2	1429-1512	1511	1	84	0.86	0.33	0.23	-
deng06b	<i>ditto</i>	1468-1522	1522	H/S+12NM	55	1.06	0.48	0.22	-
deng06	Mean of 06a and 06b	1429-1522	1522	H/S12NM	94	0.91	0.35	0.21	1550-64
* deng56m	Mean of 05 and 06	1415-1523	1522		109	0.85	0.33	0.24	1550-64
* deng07	West queen strut, truss 3	1378-1511	1511	H/S	134	1.35	0.71	0.30	
deng08	East principal rafter, truss 3	undated	-	-	<30	NM	-	-	unknown
* deng09i	Collar, truss 3	1406-1456	-	-	51	1.95	0.92	0.29	-
* deng09ii	<i>ditto</i>	1460-1527	1526	1	68	1.41	0.81	0.30	
deng10	3 rd muntin from East, screen	undated	-	?C	138	1.04	0.64	0.25	unknown
* = included in Site Master DENG		1376-1552			177	1.14	0.53	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.



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Table 2: Cross-matching between dated samples

t - values								
Sample	deng02	deng03	deng04	deng05	deng06	deng07	deng09i	deng09ii
deng01	3.6	4.4	9.9	4.5	5.2	4.9	4.5	4.7
deng02		3.9	3.7	6.0	4.5	5.8	5.6	3.5
deng03			5.0	5.8	6.9	5.8	-	3.5
deng04				6.3	6.8	6.3	4.3	4.3
deng05					11.2	5.9	3.3	4.8
deng06						5.1	-	3.6
deng07							5.1	3.9

- = no value calculated (less than 20 rings overlap)

Table 3: Dating evidence for the site master **DENG AD 1376–1552** against dated reference chronologies, regional chronologies in **bold**

County or region:	Chronology name:	Short publication reference:	File name:	Spanning:	Overlap (yrs):	t-value:
Wales	Pengwern Old Hall	(Miles <i>et al</i> 2003)	PENGWERN	1353-1521	146	11.4
Wales	Bryn yr Odyn, Gwynedd	(Miles and Bridge 2010)	BRYNRDYN	1388-1586	165	11.2
Wales	Gelli, Llanfrothen	(Miles <i>et al</i> 2006)	BDGLRT8	1391-1662	162	10.2
Wales	Bodwrda, Aberdaron	(Miles and Bridge 2010)	LYNA	1384-1527	144	9.1
Wales	Cae'nycoed-uchaf, Maentwrog	(Miles <i>et al</i> 2006)	BDGLRT17	1407-1592	146	8.5
Wales	Derwyn-bach, Dobenmaen	(Miles <i>et al</i> 2006)	BDGLRT15	1385-1548	164	8.5
Wales	Bwthyn Cae-glas, Llanfrothen	(Miles <i>et al</i> 2006)	BDGLRT7	1386-1547	162	8.5
Wales	Parc Llanfrothen	(Miles <i>et al</i> 2006)	BDGLRT22	1386-1669	167	8.3
Wales	Y Gesail Gyfarch, Dolbenmaen	(Miles <i>et al</i> 2006)	BDGLRT6	1384-1609	169	8.0
Surrey	Apple Tree Cottage, Elstead	(Tyers 2000)	ELSTEAD	1396-1591	157	7.6
Wales	Welsh Master Chronology	(Miles 1997b)	WALES97	404-1981	177	7.5
Wales	Pant-glas-uchaf, Clynnog	(Miles <i>et al</i> 2006)	BDGLRT14	1413-1573	140	7.4
Wales	Clenennau, Dolbenmaen	(Miles <i>et al</i> 2006)	BDGLRT10	1406-1570	147	7.1
Wales	Ty-mawr, Nantmor	(Miles <i>et al</i> 2006)	BDGLRT3	1425-1528	104	6.9



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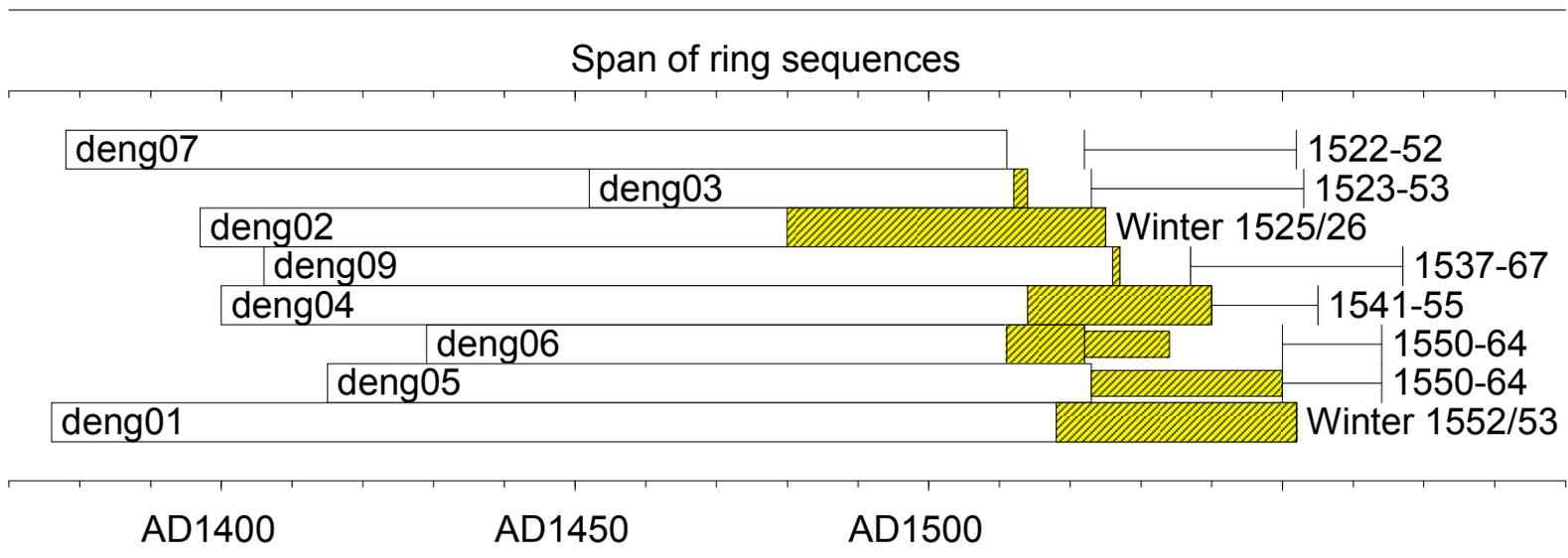


Figure 1: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings



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