Oxford Dendrochronology Laboratory
Report 2012/14

THE TREE-RING DATING OF BRYNGWYLAN, LLANGERNYW, ABERGELE, CONWY (NGR SH 889 699)

Summary
Six timbers were sampled from this property. The main downstairs room contains a timber carved with the date 1589, and this timber dated, along with a tie from the central truss, found to have been felled in Winter 1586/87. A small stave from a partition in the attic dated some six decades before this, but this was in the truss that dated, so does not alter interpretation of the date of the building.

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May 2012

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).

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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 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.

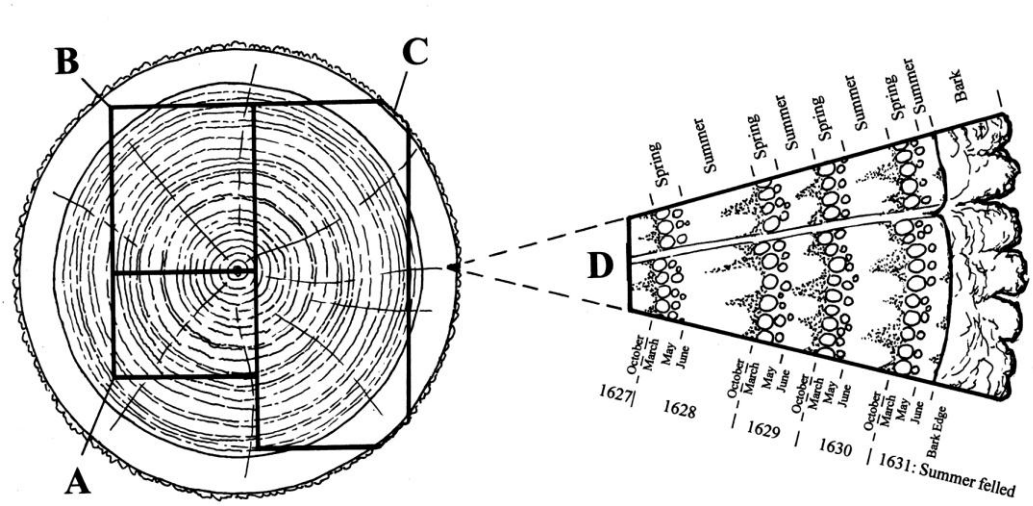
One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence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

BRYNGWYLAN

Bryngwylan is a stone-built storeyed house of hearth-passage plan-type with a prominent central chimney and good timber detail internally. The central hall is set between outer-room (enlarged as a back kitchen) with passage and inner-room. The hall has an arched fireplace beam with straight-cut stops, and a splendid ceiling of six panels with chamfered beams and joists having curved stops and fillets. The ceiling is dated by an inscription facing the restored dais-end partition: ANNO : DOMINI :

1589. RCAHMW plan with drawing of the ceiling in *Houses of the Welsh Countryside*, fig. 103b and 155b. NPRN 26858

SAMPLING

Sampling took place in January 2012. 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 **bgw**. 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. The samples were measured under a binocular microscope on a purpose-built moving stage with a linear transducer, attached to a desktop computer allowing the measurement of ring-widths to the nearest 0.01 mm using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004), which was also used for subsequent analysis, along with other programs written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1. Figure 1 shows the plan of the house from Smith (1988), the central truss being in line with the main parlour timber sampled, which are both next to the H label. Independent dating of the samples and cross-matching between the series (Table 2) resulted in three series being dated. The carved parlour ceiling beam (Figure 2) bearing the date 1589 matched very well with the tie from the central truss, which retained complete sapwood, and was found to have been from a tree felled in Winter 1586/87. The third timber that dated was a small cross-section of a stave (Figure 3) in the partition of the central truss. This retained many sapwood rings, and was from a tree most likely felled many decades earlier (1503-24). This is of interest in that it may show the re-use or stock-piling of these almost insignificant small timbers used in wattle and daub partition work. It is of interest dendrochronologically, as it shows that small sections with many rings can be more easily dated than large beams with fewer rings, emphasising the need for careful assessment of the timbers.

A site chronology formed from all three series matches well with local chronologies (Table 3), and the relative dates of each series is shown, along with their actual or interpreted felling dates in Figure 4.

The date obtained is within two years of the carved date on the main beam in the parlour, which presumably marks the completion of the building and is consistent with the felling date of 1586/87 obtained from the collar-beam trusses.

ACKNOWLEDGEMENTS

This study was commissioned by Margaret Dunn of the North-West Wales Dendrochronology Project. I am grateful to the owners, Mr and Mrs Vaughan, for allowing access to this building and for their hospitality, and to Richard Suggett of the Royal Commission on Ancient and Historic Monuments of Wales who assisted in the interpretation on site, and provided useful background information.

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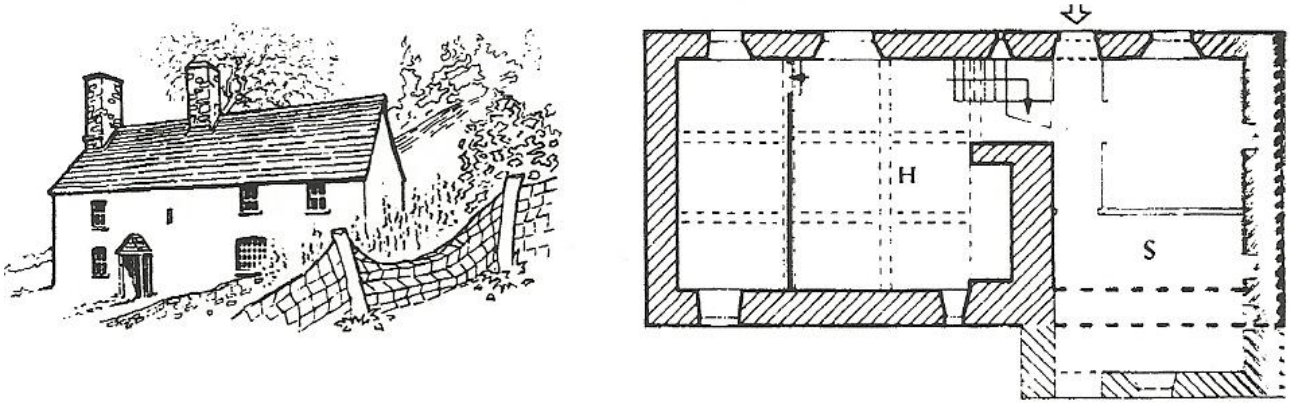

Figure 1: Illustration from P. Smith, Houses of the Welsh Countryside. The three trusses looked at are over the Hall (H).

Figure 2: Carving on the main ceiling beam in the parlour, bearing the date 1589.

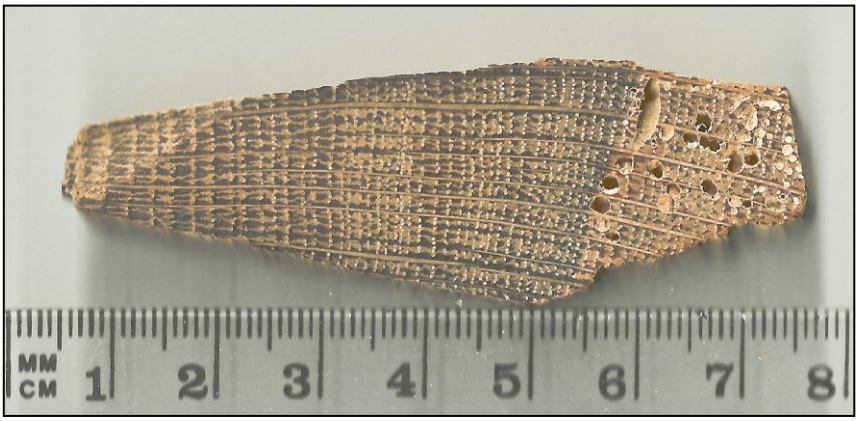

Figure 3: Photograph of sample **bgw03** showing how this small sample contained many rings and sapwood.

Table 1: Details of samples taken from Bryn Gwylan, Llangernyw, Abergele, Conwy.

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
bgw01	South principal rafter to central truss	undated	-	36 ?C	76	1.96	1.64	0.27	-
bgw02	Collar to central truss	undated	-	16	44	2.01	1.14	0.24	-
*** bgw03**	Stave in partition, central truss	1443–1502	1483	19	60	1.12	0.44	0.20	1503–24
bgw04a	*Tie, central truss*	*1514-1586*	*1542*	*44C*	*73*	*0.58*	*0.41*	*0.20*	
bgw04b	*ditto*	*1498–1547*	-	-	*50*	*1.03*	*0.66*	*0.19*	
*** bgw04**	Mean of **04a** and **04b**	1498–1586	1542	44C	89	0.78	0.58	0.19	Winter 1586/87
bgw05	South upper purlin, east of central truss	undated	-	-	44	2.12	0.86	0.25	-
bgw06a	*Main parlour ceiling beam*	*1430–1545*	-	-	*116*	*1.65*	*0.89*	*0.26*	
bgw06b	*ditto*	*1430–1548*	-	-	*119*	*1.79*	*0.90*	*0.21*	
*** bgw06**	Mean of **06a** and **06b**	1430–1548	-	-	119	1.70	0.84	0.23	after 1559
*** =** included in Site Master **BRYNGWYL**		**1430-1586**			**157**	**1.19**	**0.69**	**0.20**	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; C = complete sapwood, winter felled; std devn = standard deviation; mean sens = mean sensitivity.

Table 2: Cross-matching between the dated samples

	***t*-values**	
	bgw04	**bgw06**
bgw03	*	4.6
bgw04		8.2

* = overlap less than 10 years, *t*-value not calculated

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Table 3: Dating evidence for the site master **BRYNGWYL AD 1430–1586** against dated reference chronologies.
Regional multi-site chronologies are shown in **bold**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales/borders	Hillside oaks	(Siebenlist-Kerner 1978)	**GIERTZ**	1341-1636	157	9.8
Wales	St Idloes Church, Llanidloes	(Miles *et al* 2003)	LNYDLOS2	1384-1593	157	9.7
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881-1745	157	9.4
Wales	Welsh Master Chronology	(Miles 1997)	**WALES97**	404-1981	157	9.3
Wales	Rose and Crown, Gwydwn	(Miles and Worthington 2000)	GWYDWN	1411-1571	142	8.5
Gloucestershire	Swan House, Blakeney	(Miles *et al* 2009)	SWANHS	1386-1628	157	8.4
Shropshire	Clungunford Master Chronology	(Miles 2002 unpublished)	CLNGNFRD	1273-1653	157	8.1
Wales	Kerry Church	(Miles *et al* 2011)	KERRY	1402-1567	138	8.0
Shropshire	Buildwas Abbey	(Miles 2002)	BUILDWS2	1374-1547	118	7.8
Shropshire	Nine Worthies, Great Binnal	(Miles and Haddon-Reece 1996)	GTBINNAL	1321-1529	100	7.8
Wales	Branas-Uchaf, Llandrillo	(Miles *et al* 2010)	DENBY6	1388-1763	157	7.8
Wales	Lower Cill, Berriew	(Miles *et al* 2006)	BERRIEW	1428-1583	154	7.8
Wales	Rhos-fawr-isaf, Meifod	(Miles *et al* 2005)	RHOSFAWR	1430-1576	147	7.8
Lancashire	Worden Old Hall, Chorley	(Bridge 2003)	OLDWORD2	1415-1531	102	7.7
Staffordshire	Sinai Park	(Tyers 1997)	SINAI	1227-1750	157	7.7

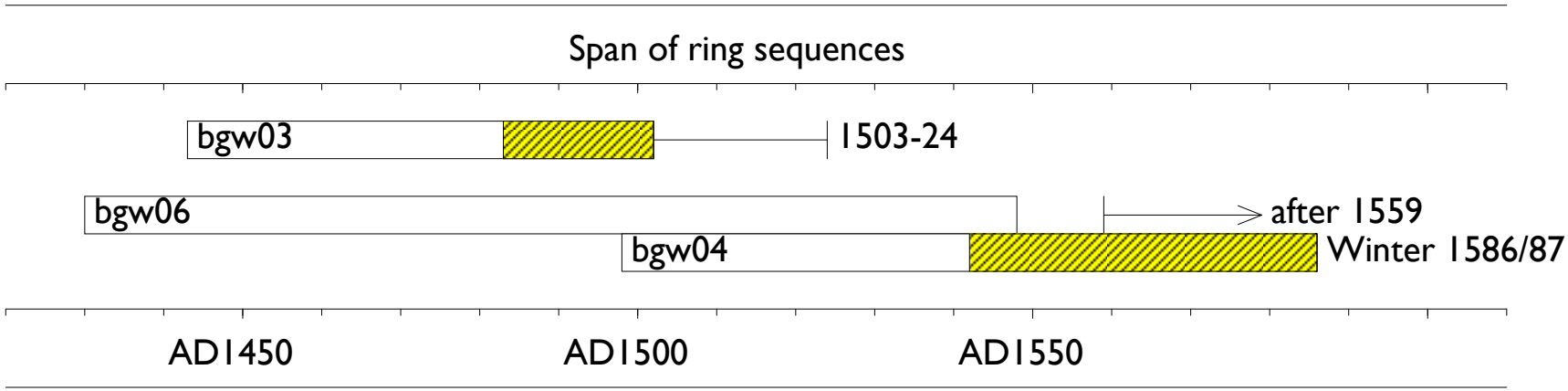

Figure 4: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings