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Discovering Old Welsh Houses

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Oxford Dendrochronology Laboratory
Report 2016/13

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM DYFFRYN GWYN, TYWYN, MERIONETH (NGR SN 632 983)

Summary

Three principal rafters and a purlin were sampled from the original timbers within this property. The purlin had few rings and could not be dated. The three other timbers cross-matched and produced a site chronology dated to the period 1415–1585. Although complete sapwood was present on two of the timbers, it was not possible to distinguish the individual rings in the outer parts of either of these timbers, perhaps the trees were dying, or badly diseased, before being felled. The best estimate of the ring numbers suggests a felling date range of **1607–17**, although the trees may possibly have been standing dead for a few years before felling.

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The Dendrochronological Dating of Timbers from Dyffryn Gwyn, Tywyn, Merioneth (SN 632 983)

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.

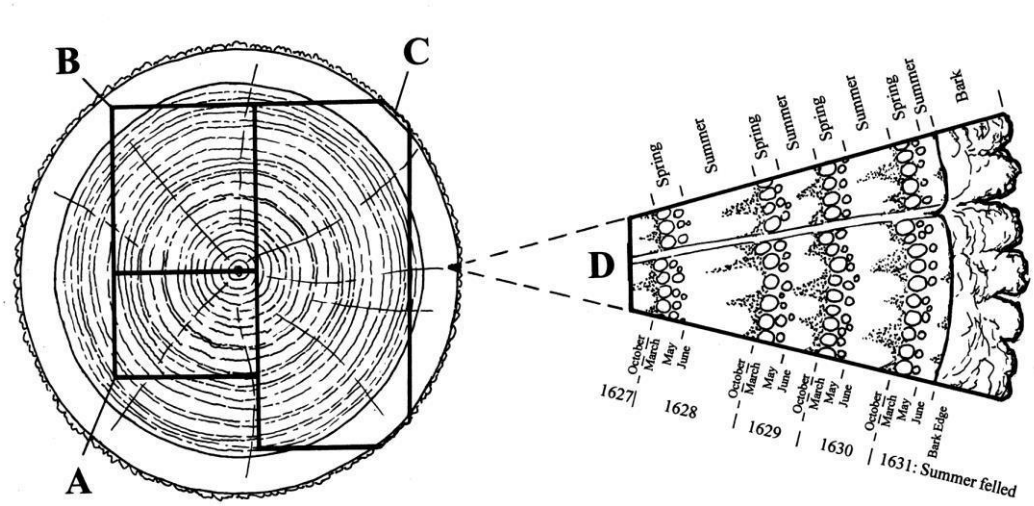
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation 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 1997a, 42)

DYFFRYN GWYN (notes by Richard Suggett)

Dyffryn-gwyn (Hen Dyfryn Gwyn) is an impressive house of developed Snowdonian plan-type with good timber detail and a characteristic principal doorway with a head of voussoirs. The unusually wide entrance passage flanked by moulded post-and-panel partitions is explained by the former accommodation of a service-room at the end of the passage. As originally planned Dyffryn-gwyn had a passage and service-room between hall (with fireplace stair) and outer parlour. The service-room was lit by a window where one would expect a cross-passage doorway. The reed-moulding of the partitions is repeated in the ceiling on the joists, and plan and timber detail belong to the original building phase. The first floor was divided into two chambers by a post-and-panel partition with a doorway with double ogee door-head. These chambers were lit by hipped dormers. A date inscription on the prominent three-light ovolo hall window reads 1640. Tree-ring dating now shows that the collar-beam trusses are somewhat earlier. It seems therefore the house was built in the earlier C17th but refitted with

fashionable ovolo windows (and no doubt with other improvements) in 1640. A further inscription of 1772 dates a phase of modernisation, which probably included the insertion of a stair in the passage, superseding the hall fireplace stair, and the construction of the rear detached kitchen/bake-house. R.F. Suggett/RCAHMW/March 2016. Extract from Coflein (NPRN 28367).

SAMPLES

Samples were of oak (*Quercus* spp.). Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **hvdg**) 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. The outer parts of the samples **01** and **02** had very narrow rings, perhaps representing trees that were dying, making individual rings largely impossible to distinguish. Although there was complete sapwood on **01**, it was not possible therefore to give a precise felling date, and a range of 10 years has been given because of the uncertainty in sapwood numbers. With two cores from each of **01** and **02**, it was possible to cross-match parts of the sequences from both cores in each timber, to make composite series for each timber. These were then cross-matched (Table 2), and a site master of 171 years was made from three timbers, the fourth short sequence from the purlin (**04**) remaining undated. The site master, **DYFFGWYN**, matched well with local chronologies (Table 3) establishing its date range as 1415–1585.

The ten year range attributed to the felling date of timber **01** of 1607–17 is as close as it is possible to reasonably apply, given the indistinguishable nature of many of the sapwood rings, and indeed the tree may have been standing dead for a few years before felling. The likely felling date range of the other tree with sapwood is 1593–1623 (Figure 1). There remains a little uncertainty about the best estimate of the felling dates for the trees used, but **1607–17** seems a reasonably conservative range to give.

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Table 1: Details of samples taken from Dyffryn-Gwyn, Tywyn

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
hvdg01a	Rear right-hand principal rafter	*1515-1585*	*1585*	*H/S (+22CNM)*	*71*	*1.21*	*0.47*	*0.24*	-
hvdg01b	*ditto*	*1505-1584*	*1584*	*H/S*	*80*	*1.11*	*0.56*	*0.21*	-
* **hdvg01**	Mean of **01a** and **01b**	1505-1585	1585	H/S (+22CNM)	81	1.16	0.46	0.19	1607–17
hvdg02a	Front right-hand principal rafter	*1480-1574*	*c1582*	*H/S*	*95 +8NM*	*1.22*	*0.55*	*0.22*	-
hvdg02b	*ditto*	*1493-1552*	*c1580*	*H/S*	*60+28NM*	*1.31*	*0.37*	*0.25*	-
* **hvdg02**	Mean of **02a** and **02b**	1480-1574	*c*1582	H/S	95 +8NM	1.20	0.49	0.21	1593–1623
* **hvdg03**	Front left-hand principal rafter	1415-1530	-	-	116	2.11	1.05	0.27	after 1541
hvdg04	Front lower left-hand purlin	-	-	13C	44	2.66	1.18	0.41	-
* = included in site master **DYFFGWYN**		**1415-1585**			**171**	**1.76**	**1.01**	**0.22**	

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 dated samples (values of *t* greater than 3.5 are statistically significant)

	***t*-values**	
Sample	**hvdg02**	**hvdg03**
hdvg01	4.0	*
hvdg02		8.1

* = no value calculated, overlap less than 30 years

Table 3: Dating evidence for the site master **DYFFGWYN AD 1415–1585** 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	171	7.1
Northern England	Northern England Master	(Hillam and Groves 1994)	**NORTH**	440–1742	171	6.7
Site Chronologies						
Montgomeryshire	Royal House, Machynlleth	(Miles *et al* 2004)	ROYALHS1	1363–1560	146	8.5
Denbighshire	Rose and Crown, Gwyddewern	(Miles and Worthington 2000)	GWYDWN	1411–1571	157	7.8
Denbighshire	Glas Hirfryn,	(Bridge *et al* 2014)	GHN	1404–1557	143	7.7
Monmouthshire	St Woolos Cathedral, Newport	(Miles *et al* 2011)	WOOLOS2	1318–1482	68	7.7
Merioneth	Cefn Caer Pennal	(Miles and Worthington 1999)	CEFNCAR1	1404–1525	111	7.5
Cardiganshire	St Padarn's Church, Llanbadarn Fawr	(Miles *et al* 2011)	STPADRNS	1416–1489	74	7.4
Montgomeryshire	Llwyn Llandrinio	(Miles *et al* 2003)	LLWYN	1413–1551	137	7.2
Worcestershire	Bower Court, Rock	(Bridge 2002)	BOWERCT	1359–1475	61	7.2
Herefordshire	Cradley Village Hall	(Miles *et al* 2004)	CRADLEY	1347–1530	116	7.1

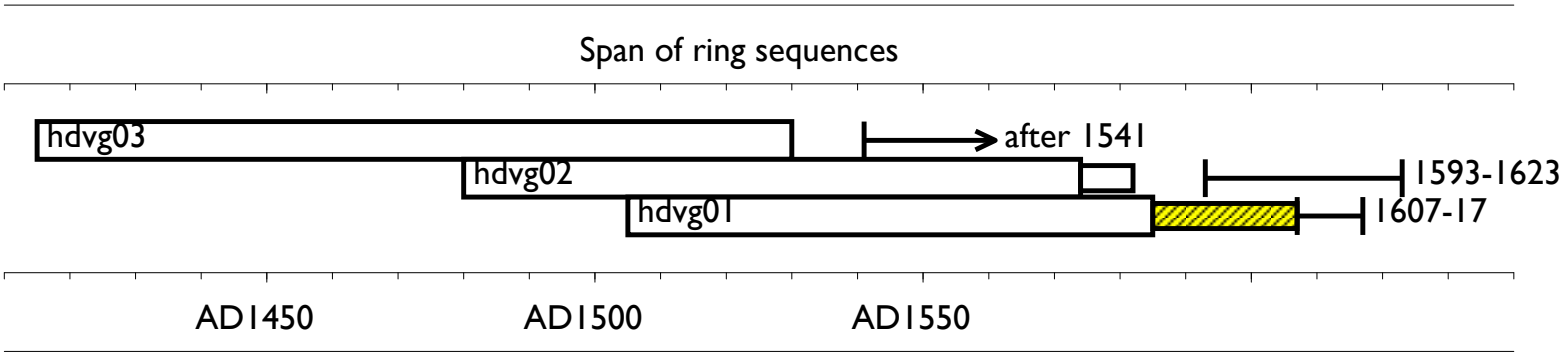

Figure 1: Bar diagram showing the relative positions of overlap of the dated timbers. White bars represent heartwood rings, yellow hatched sections represent sapwood, narrow sections represent additional unmeasured/undated rings