Darganfod Hen Dai Cymreig
Discovering Old Welsh Houses

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Oxford Dendrochronology Laboratory
Report 2016/06

THE DENDROCHRONOLOGICAL DATING OF A BEAM AT CAEN Y COED, LLANDECWYN, MERIONETH

(SH 658 387)

Summary

A transverse beam to the left of the entrance, in what is currently a kitchen area, carries an interesting amount of graffiti, not generally seen. It retains complete sapwood, and was found to have been converted from a tree felled in **spring 1585**, making its conversion most likely in this year, or within a year or two after this date. With no other timbers in the building being dated one cannot say whether this represents the date of the building of the house itself, but further analysis of the fabric may reveal whether this is thought to be a primary timber to this building or not.

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The Dendrochronological Dating of a Beam at Caen y Coed, Llandecwyn, Merioneth (SH 658 382)

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.

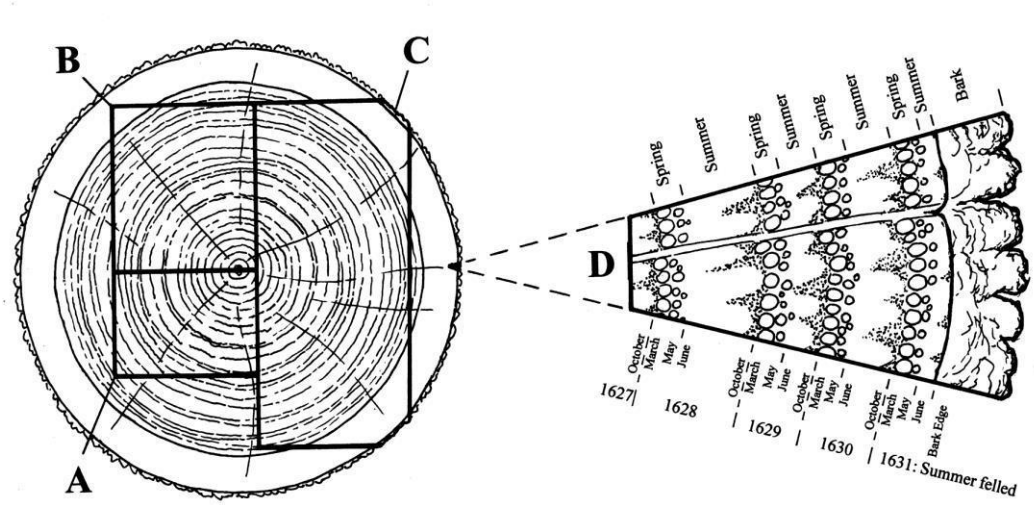
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

CAEN Y COED

Little information could be found on the house itself, although it is likely to be the subject of a report by the Discovering Old Welsh Houses Group in the near future.

SAMPLING

Samples were taken in January 2016. The locations of the samples are described in Table 1, the 'graffiti beam' is illustrated in Fig 1. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **cyc**) 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. Two cores were taken from the transverse beam to the left of the main entrance (the one with large numbers of symbols on it) to maximise the information that could be obtained from it. Another core was taken from a similar transverse beam to the right of the entrance, over the doorway through to the next room. This second beam yielded a short sequence with only 43 rings which did not match anything.

The two sequences from the first beam matched each other and were combined into a single 122-year long sequence which retained the complete sapwood, and was from a tree felled in spring. The sequence was compared with the database of reference chronologies which dated it to the period 1463–1584, the strongest matches being shown in Table 2. Most matches are with very local sequences, showing the value of having a local database. As a single tree, without this local material to compare it with, it is unlikely that the timber could have been dated.

The tree converted for this beam was felled in Spring 1585. Although it looks likely to be a primary timber to the building, this was not investigated to any great extent at the time of sampling, so with no other timbers in the house being dated, it cannot at this stage be established whether or not this represents the construction of the property.

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Figure 1: Photo of the ‘graffiti beam’ sampled for dendrochronology.

Table 1: Details of samples taken from Caen Y Coed, Llandecwyn

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
cyc01a	Transverse beam in kitchen	*1465-1584*	*1568*	*16¼C*	*120*	*1.09*	*0.54*	*0.18*	
cyc01b	*ditto*	*1463-1568*	*1568*	*H/S*	*106*	*0.98*	*0.39*	*0.21*	
cyc01	Mean of 01a and 01b	1463-1584	1568	16¼C	122	1.02	0.44	0.19	Spring 1585
cyc02	Transverse beam over doorway	-	-	-	43	1.55	0.55	0.25	

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

Table 2: Dating evidence for the site sequence **CYC01** **AD 1463–1584** 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	122	5.4
Site Chronologies						
Caernarvonshire	Cae'nycoed-uchaf, Maentwrog	(Miles *et al* 2007)	BDGLRT17	1407–1592	122	6.9
Caernarvonshire	Clenennau, Dolbenmaen	(Miles *et al* 2007)	BDGLRT10	1406–1570	108	6.7
Merioneth	Plas y Dduallt, Maentwrog	(Miles *et al* 2011)	GWYNEDD5	1355–1604	122	6.5
Caernarvonshire	Plas ym Mhenrhos, Penrhos	(Miles *et al* 2012)	PLASMNRS	1413–1607	122	6.2
Caernarvonshire	Gelli, Llanfrothen	(Miles *et al* 2007)	BDGLRT8	1391–1662	122	6.1
Lancashire	Tonge Hall, Middleton	(Arnold and Howard 2014)	TNGBSQ01	1449–1687	122	6.0
West Yorkshire	Upper Headley Farmhouse, Thornton	(Tyers 2006)	HEADLEY	1507–1587	78	5.9
Merioneth	Bryn yr Odyn, Gwynedd	(Miles and Bridge 2010)	BRYNRDYN	1388–1586	122	5.8
Caernarvonshire	Rhos, Minfordd, Penrhyndeudraeth	(Miles *et al* 2007)	BDGLRT13	1434–1571	109	5.6