Darganfod Hen Dai Cymreig
Discovering Old Welsh Houses

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Oxford Dendrochronology Laboratory
Report 2018/32

THE DENDROCHRONOLOGICAL DATING OF PEN Y CEFN, CILCAIN, FLINTSHIRE

(SJ 1888 6678)

Summary

Most of the timbers investigated were assessed as having too few rings to be useful for dendrochronology, however some of the roof timbers warranted further investigation, along with a single ground-floor ceiling timber. Only a single timber, an upper purlin in the south-west corner of the building, yielded a sequence that was datable. The outermost measured ring, the second sapwood ring, was formed in 1568. The rest of the sapwood, at least 25 rings, was detached, but complete, giving a likely felling date for this single timber of **1593–98.** This suggests a date for the roof in the last decade of the sixteenth-century, but it needs to be established that the purlin is original, and caution always needs to be employed when dating a whole phase on the basis of a single timber.

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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 Pen Y Cefn, Cilcain, Flintshire
(SJ 1888 6678)

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.

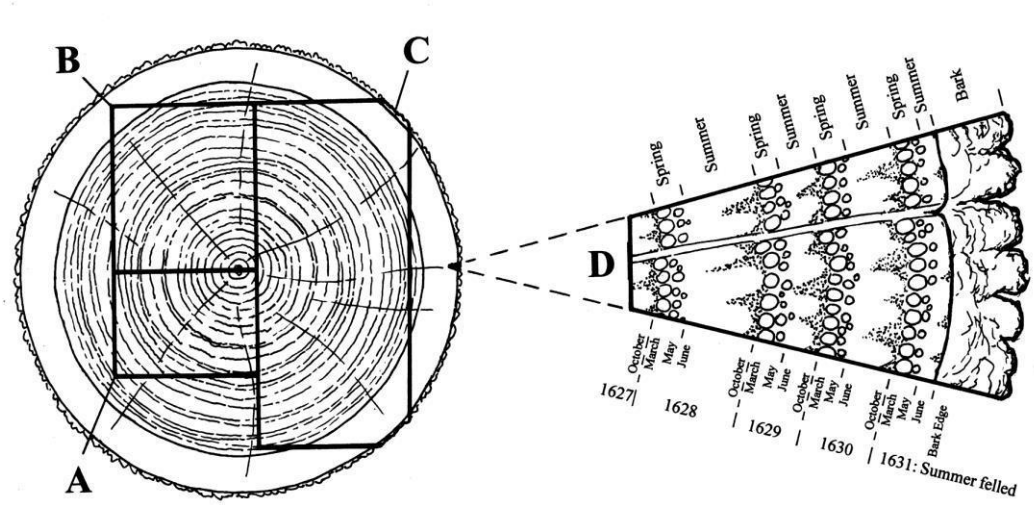
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

Pen y Cefn (Source:- Cadw listed buildings, NJR 08/06/2010, with additional observations)

Pen-y-Cefn is a two-storey, rubble stone built farmhouse which is colour washed at the front and roughcast to the sides. It has a slate roof, stone chimneys to the rear and one side, brick chimneys to the other side and a later rear extension. It was probably originally a sixteenth century minor gentry house and the form with lateral stack to the rear suggests a three-unit plan with cross passage which may have had an open hall. The stone stack at one end suggests a heated parlour and this pattern conforms with nearby hall houses of a sixteenth century date. The reported stair position could represent an insertion into the cross passage as in other Cheshire examples of the period. The rear wing, a later extension was refenestrated in the nineteenth century. The interior includes a cambered bressummer over hall fireplace, timber-framed walls, plank doors with strap hinges and stairs leading up from the entrance lobby.

The two outer roof trusses were closed, and have collars supported by queen struts, whilst the central open truss has a larger collar, set lower than the other two trusses. The purlins are scarfed together over the trusses.

SAMPLING

An assessment of many timbers on the ground and first floors rejected most timbers as having too few rings to be useful for dendrochronological analysis, although one ceiling beam from the central ground floor room was sampled. Six other samples were taken from timbers in the roof. Sampling was carried out in August 2018 during extensive renovation work. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled with the prefix **pycc**, and taken away for subsequent analysis, where they were glued to laths.

The samples 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 programs by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

The locations and details of the samples are described in Table 1. Most samples had far fewer rings than are usually useful for dendrochronological analysis, although those with more than 40 rings were looked at further, and tested against the available database. One sample (**05**) had a very distorted growth sequence, and was not measured. No matching was found between any of the timbers from this site.

One timber, the upper purlin from the south-west corner of the four-bay roof, yielded a sequence of 100 years (including 2 sapwood rings) – with additional degraded sapwood rings to the bark edge having broken off. This sequence dated very well (Table 2), and allowing for the possibility of missing rings at the break in the core, has a felling date range of **1593–98**. Clearly it would be wrong to date the whole roof on the basis of a single timber, which may itself have been a stock-piled timber or a later replacement, but it does suggest that the roof is of very late sixteenth-century origin.

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Table 1: Details of samples taken from the roof at Pen y Cefn, Cilcain.

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
pycc01	Upper purlin, NW corner	-	-	H/S	35	2.89	1.11	0.21	-
pycc02	Upper purlin, SW corner	1469–1568	1566	2 +25C NM	100	1.59	0.63	0.17	1593–98
pycc03	S principal rafter to West truss	-	-	H/S	51	1.89	0.79	0.25	-
pycc04	Collar, W truss	-	-	H/S	35	4.00	1.79	0.18	-
pycc05	S upper purlin, bay 2-3	-	-	C	NM*	-	-	-	-
pycc06	S principal rafter, E truss	-	-	H/S	46	1.86	1.17	0.27	-
pycc07	N-S ceiling beam, grd flr central room	-	-	3	33	3.40	0.75	0.16	-

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

Table 2: Dating evidence for the site sequence **pycc02 AD 1469–1568** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Site Chronologies						
Montgomeryshire	Peniarth-Uchaf, Meifod	(Miles and Haddon-Reece 1996)	PENIARTH	1385–1550	82	8.9
Shropshire	Alkington Hall	(Miles and Haddon-Reece 1996)	ALKINGTON	1421–1591	100	7.6
Shropshire	Old Hall Farm, All Stretton	(Miles and Haddon-Reece 1996)	OLDHLLFM	1379–1630	100	7.6
Montgomeryshire	Llwyn Llandrinio	(Miles *et al* 2003)	LLWYN	1413–1551	83	7.3
Denbighshire	Ty Mawr, Druid, Corwen	(Miles *et al* 2010)	DENBY1	1440–1583	100	7.2
Worcestershire	Upwich salt making site	(Groves and Hillam 1997)	UPWICH3	1454–1651	100	7.2
Caernarvonshire	Pant-glas-uchaf, Clynnog	(Miles *et al* 2007)	BDGLRT14	1413–1573	100	7.0
Herefordshire	Church House, Allensmore	(Miles *et al* 2006)	CHAM	1357–1551	83	7.0
Montgomeryshire	Blaen-y-cwm, Pennant Melangell	(Miles *et al* 2005)	BLNYCWM3	1457–1646	100	6.9
Denbighshire	Plas Uchaf, Glan Conwy	(Bridge *et al* 2017)	PLASUCGC	1415–1569	100	6.8
Montgomeryshire	Rhos-fawr-isaf, Meifod	(Miles *et al* 2005)	RHOSFAWR	1430–1576	100	6.8
Warwickshire	Middleton Hall	(Arnold *et al* 2006)	MIDHSQ02	1390–1646	100	6.8