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DYDDIO HEN DAI CYMREIG | DATING OLD WELSH HOUSES

PROSIECT DENDROCRONOLEG GOGLEDD ORLLEWIN CYMRU | NORTH WEST WALES DENDROCHRONOLOGY PROJECT

Oxford Dendrochronology Laboratory
Report 2011/35

THE TREE-RING DATING OF CYNFAL FAWR, CEUNANT CYNFAL, MAENTWROG, GWYNEDD (NGR SH 703 407)

Summary
Although a house is recorded on the site in 1480, the surviving cruck truss roof was found to have been constructed in **1515** or within a year or two after. Samples from the inserted floor in the cruck range, and from the western range failed to date.

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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 Cynfal Fawr, Ceunant Cynfal, Maentwrog, Gwynedd.
(NGR SH 703 407)

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.

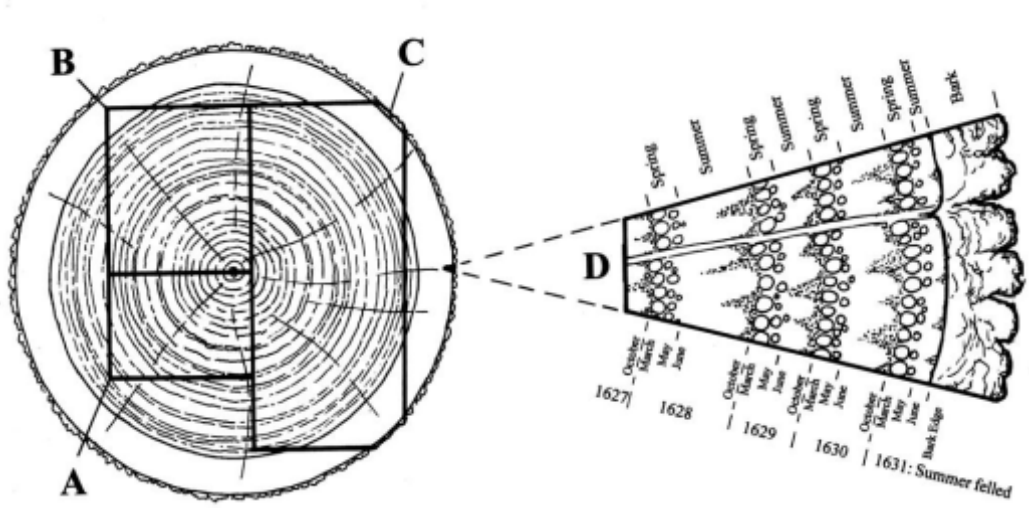
One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence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

CYNFAL FAWR

The site is first recorded as a residence in 1480, owned by Rhys ap Ifan, and it is thought one of his grandsons probably built the 'new' part of the house in the sixteenth century. All that remains of the old house is the cruck and a stone arch. The house is recorded as being the birthplace of Morgan Llwyd o Wynnedd, a famous puritan minister and writer of the Commonwealth period. The house was licensed in 1669 as an Independent meeting house. The main part of the house is the 'new' part, refaced *c*1800. It is of two storeys with an attic, a three-window range with distinctive 3-light casements with transoms

and gothic heads to the lower lights. The older part of the house forms a single-storeyed gabled range at the left (east) end with a medieval cruck surviving. The crucks (Fig 1) are well made and have an arch-braced collar joining them with mortices for two struts (now gone), and a small high-set collar.

Figure 1: Cruck-truss at Cynfal Fawr.

There is an inserted Elizabethan ceiling within this wing. There are later parts of the building to the west.

SAMPLING

Sampling took place in August 2011. 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 **cyf**. 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.

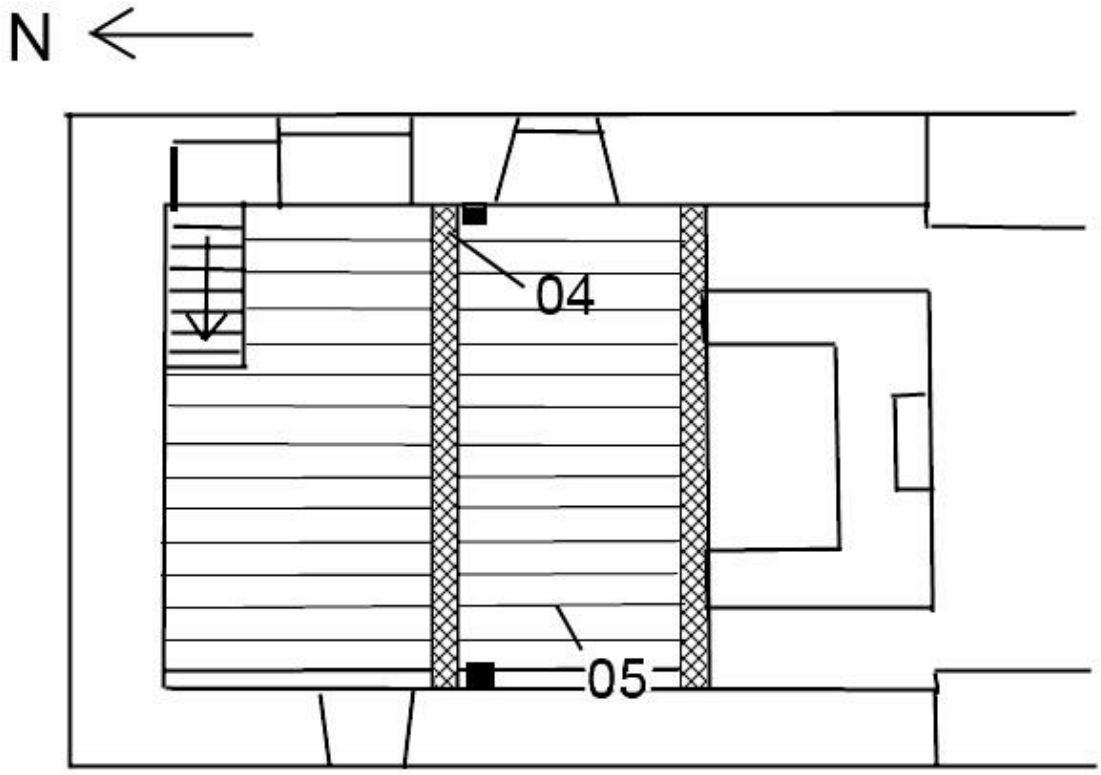


Figure 2: Ground floor of the cruck wing, showing timbers sampled in the inserted 'Elizabethan' floor

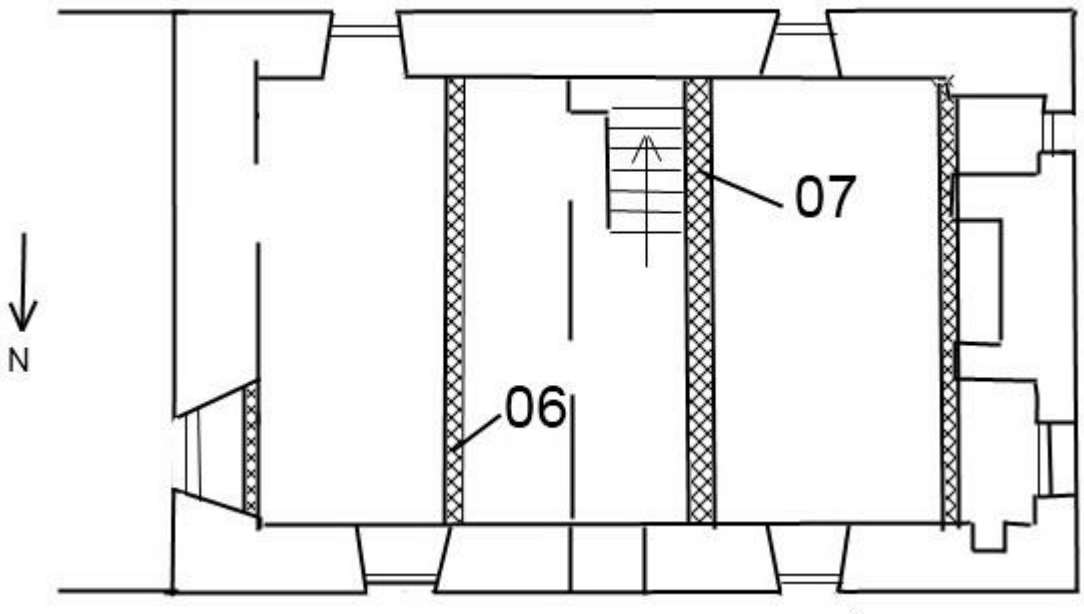


Figure 3: Ground floor of the west wing, showing timbers sampled

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1, and illustrated in Figures 2 and 3. The cross-matching between the three samples from the cruck roof is shown in Table 2. Whilst there is good matching between two of these samples, series **cyf02** has a short overlap and did not match well. It was therefore dated independently as a check, with the best matches being shown in Table 3a.

The three cruck roof series were combined to make a 131-year site master, **CYNFALFR**, the dating evidence for which is shown in Table 3b. The relative positions of overlap of the samples is shown in Fig 4. One cruck retained complete sapwood, and was from a tree felled in winter 1514/15, the other had complete sapwood detached from the main core. Allowing for some loss of rings at the beginning of the sapwood, the estimate of the felling date for this tree is 1511–1514. It seems likely therefore that the construction of this cruck roof was in **1515**, or within a year or two after this date. This means that this section of the house is not the remains of the building recorded on the site in 1480.

Two samples were taken from the inserted 'Elizabethan' floor – so-called because of the mouldings on the main floor beam. The two series did not match each other. Attempts to date the series independently did give some matches with local chronologies that would be consistent with the expected age of the floor, but none of these were robust enough to date the series with any level of certainty. Similarly, the two samples from the west wing, thought to be of late-seventeenth century date, did not match each other, but also gave some weak matches with local material at possible positions at around the expected age. These were also too weak and insufficiently replicated to be able to date the series conclusively.

Table 1: Details of samples taken from Cynfal Fawr, Maentwrog.

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
Cruck Roof									
* **cyf01**	East cruck	1407-1514	1480	34C	108	1.40	0.53	0.24	Winter 1514/15
* **cyf02**	East purlin	1384-1458	-	-	75	1.91	0.84	0.21	after 1469
* **cyf03**	West cruck	1405-1473	1473	38NM	69	1.89	0.72	0.26	*c*1511–14
Inserted 'Elizabethan' floor									
cyf04	North floor beam	-	-	H/S	133	0.93	0.59	0.21	-
cyf05	3rd Joist from west side	-	-	35	94	1.20	0.74	0.29	-
West Wing									
cyf06	East beam in eastern room	-	-	17C	69	1.95	1.03	0.32	-
cyf07	West beam in western room	-	-	H/S	83	1.70	0.90	0.28	-
* = constituent of Site Master **CYNFALFR**		**1384-1514**			**131**	**1.65**	**0.69**	**0.21**	

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 the dated samples

	***t*-values**	
Sample	**cyf02**	**cyf03**
cyf01	3.4	7.3
cyf02		2.6

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Table 3a: Dating evidence for sample **cyf02 AD 1384–1458**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales	Pengwern Old Hall	(Miles *et al* 2003)	PENGWERN	1353-1521	75	7.1
Wales	Parc Llanfrothen	(Miles *et al* 2006)	BDGLRT22	1386-1669	73	6.7
Wales	Derwyn-bach, Dolbenmaen	(Miles *et al* 2006)	BDGLRT15	1385-1548	74	6.5
Wales	Abbey Farmhouse, Cymmer	(Miles and Haddon-Reece 1996)	CYMMER	1306-1440	57	6.4
Wales	Cwm Farm, Cwm Cynfal	(Miles *et al* 2012)	CWMFM1	1364-1567	75	6.3
Wales	Beddgelert	(Nayling pers comm)	BEDD_T6	1302-1529	75	6.0
Wales	Plas y Dduallt, Maentwrog	(Miles *et al* 2011)	GWYNEDD5	1355-1604	75	5.7
Wales	Gelli, Llanfrothen	(Miles *et al* 2006)	BDGLRT8	1391-1662	68	5.5

Table 3b: Dating evidence for the site master **CYNFALFR AD 1348–1514** against dated reference chronologies

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales	Bryn yr Odyn, Gwynedd	(Miles *et al* 2010)	BRYNRDYN	1388-1586	127	7.9
Wales	Plas y Dduallt, Maentwrog	(Miles *et al* 2011)	GWYNEDD5	1355-1604	131	7.6
Wales	Cwm Farm, Cwm Cynfal	(Miles *et al* 2012)	CWMFM1	1364-1567	131	7.5
Wales	Plas ym Mhenrhos, Penrhos	(Miles *et al* 2012)	PLASMNRS	1413-1607	102	7.1
Wales	Beddgelert	(Nayling pers comm)	BEDD_T6	1302-1529	131	6.9
Wales	Parc Llanfrothen	(Miles *et al* 2006)	BDGLRT22	1386-1669	129	6.9
Wales	Derwyn-bach, Dolbenmaen	(Miles *et al* 2006)	BDGLRT15	1385-1548	130	6.6
Wales	Y Gesail Gyfarch, Dolbenmaen	(Miles *et al* 2006)	BDGLRT6	1384-1609	131	6.4
Wales	Bodwrda, Aberdaron	(Miles *et al* 2010)	LYNA	1384-1527	131	6.4
Wales	Hafodysybyty, Ffestiniog	(Miles *et al* 2012)	HDYSBYTY	1374-1497	114	6.3
Wales	Pengwern Old Hall	(Miles *et al* 2003)	PENGWERN	1353-1521	131	6.2
Wales	Bodloesygad, Ffestiniog	(Miles *et al* 2012)	BODLSYGD	1368-1560	131	6.0
Shropshire	Whittington Castle	(Miles *et al* 2004)	WHITNGTN	1351-1628	131	5.4

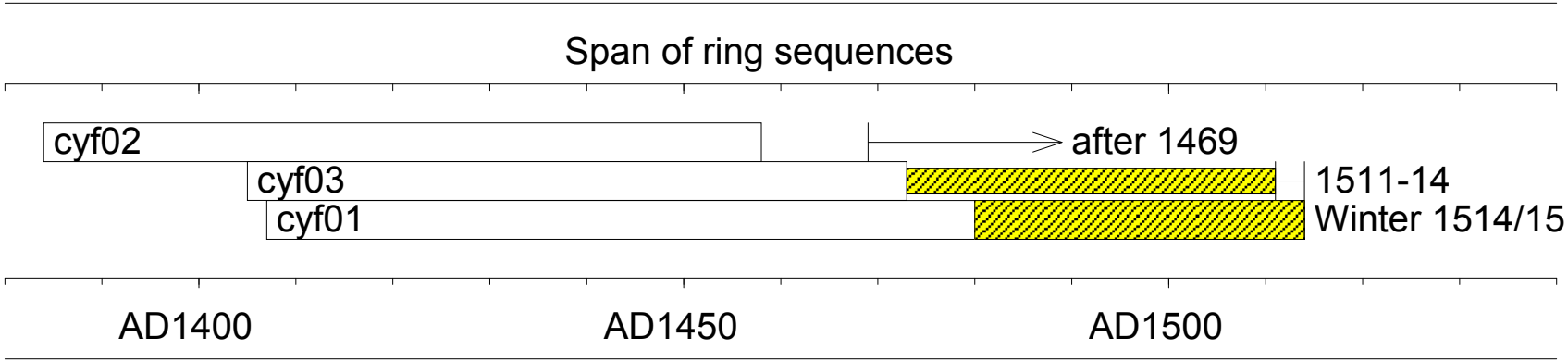

Figure 4: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely, or actual, felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings

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