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Oxford Dendrochronology Laboratory
Report 2016/15

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM RHYD YR EIRIN, HARLECH, MERIONETH (NGR SH 616 313)

photo Margaret Dunn

Summary

Seven timbers were sampled from this house, including a large transverse beam and joists in the ground-floor ceiling, a principal rafter and three purlins. The timbers were found to contain some extremely narrow rings, indistinguishable in some parts of the growth curve. The inner part of the large transverse beam was dated, but the outer part could not be dated, although the approximate number of rings found would give a felling date somewhere in the mid-C17th. A purlin, thought to be original, similarly had the innermost rings dated, and adding on the approximate number of unresolved rings gave a likely heartwood-sapwood boundary date in the early-C17th, again suggesting felling in the mid-C17th. Overall therefore, a mid-C17th century date is suggested, but far from proven, for this building.

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The Dendrochronological Dating of Timbers from Rhyd yr Eirin, Harlech, Merioneth (SH 616 313)

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.

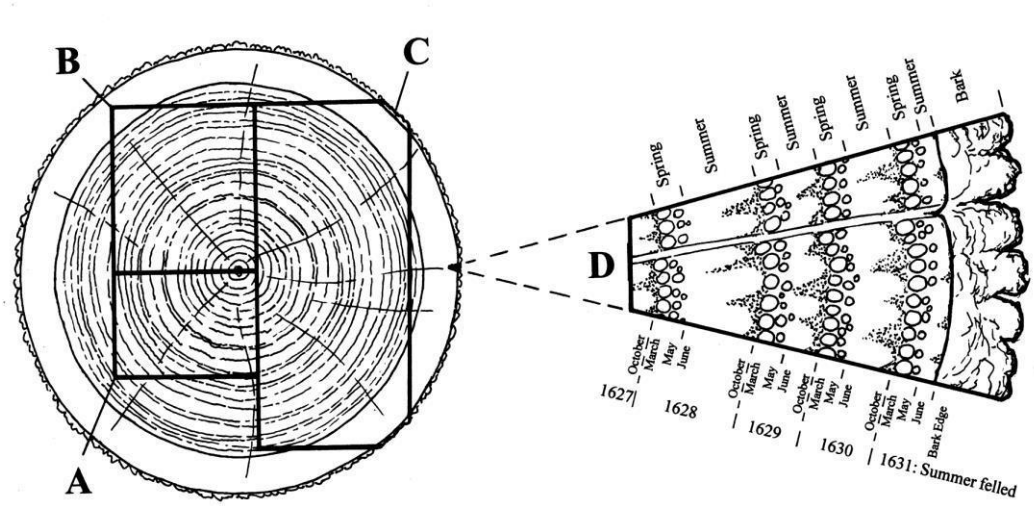
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

RHYD YR EIRIN (Notes by Richard Suggett)

This is a two-unit one and a half storey Snowdonian cottage-farmhouse with a fireplace stair to the roof-space chambers. The lap-jointed collar-beam trusses and arched fireplace beam suggest a possible C18th century date. There are associated outbuildings. (NPRN 28720).

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 **yre**) 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 ring width series all showed patches of very narrow rings where it became almost impossible, and in some cases actually impossible, to distinguish individual rings. These did not seem to be synchronised between the samples, so there was no reliable cross-matching between the individual samples. Some series were edited in the hope that part of the sequence would date. In the case of the long core from sample **yre01**, the inner 50 rings, ending at the start of a band of very narrow rings could be dated (Table 2a), but the outer – approximately 131 rings, including around 44 sapwood rings, could not be resolved. Fig 2 shows a plot of the attempted measurement of the sequence, and shows not only the very narrow nature of the rings overall, but abrupt growth rate changes within the sequence. Similarly, sample **yre05** was measured up to the start of a band of very narrow rings, and again the inner rings were subsequently dated (Table 2b), but the outer rings are approximate in number and could not be cross-matched for verification. The remaining samples all had a similar nature. They were in fact re-sanded and remeasured, but none of the sequences could be satisfactorily resolved, and all remain undated.

The two sequences (parts of the overall series) that could be dated (Fig 1) do at least suggest similar likely felling dates, though these are necessarily vague. The dated section of **yre01** ends in 1508, but there are around 131 additional rings, after the very narrow band where individual rings could not be resolved. These included approximately 44 sapwood rings to the bark edge. At best therefore, one can suggest a mid-C17th felling date. For **yre05**, part of the sequence could be dated, ending in 1567, but there were at least an additional 38 rings to the heartwood/sapwood boundary, and again these could not be fully resolved of cross-matched. This again suggests a likely felling date in the mid-C17th.

Although rather unsatisfactory, the two pieces of evidence suggest that the building is earlier than had been previously proposed. The short (50-year) sequence matched well against very local sites, again showing the value of having local data. The matches for the longer (137-year) sequence also match local sites, but interestingly also match against sites from the SW English peninsular (Devon and Cornwall).

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Table 1: Details of samples taken from Rhyd Yr Eirin, Harlech, Merioneth

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
yre01i	Inner rings, ground floor transverse beam	1459-1508	-	-	50	1.65	0.74	0.21	-
yre01ii	Outer rings, *ditto*	-	-	*c*44C	*c*131	*0.79*	*0.32*	*0.19*	mid-C17th
yre02	2nd joist from rear wall	-	-	34C	123	0.87	0.60	0.28	-
yre03	1st joist from rear wall	-	-	34C	47	0.89	0.80	0.30	-
yre04	Front right-hand principal rafter	-	-	H/S?	71	1.61	0.79	0.32	-
yre05	Upper right-hand purlin (original?)	1431-1567	*c*1605	-	137 (+38NM)	1.11	0.57	0.31	mid-C17th
yre06	Lower left-hand rear purlin (reset?)	-	-	25C	80	1.11	0.79	0.27	-
yre07	Upper left-hand rear purlin (reset?)	-	-	18 (+2NM)	55	1.24	0.76	0.34	-

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 2a: Dating evidence for the site sequence **yre01i AD 1459–1508** against dated reference chronologies

County or region	*Chronology name*	*Reference*	*File name*	*Spanning*	*Overlap (yrs)*	*t-value*
Site Chronologies						
Merioneth	Pengwern Old Hall	(Miles *et al* 2003)	PENGWERN	1353–1521	50	8.2
Caernarvonshire	Cae'nycoed-uchaf, Maentwrog	(Miles *et al* 2007)	BDGLRT17	1407–1592	50	7.8
Caernarvonshire	Plas ym Mhenrhos, Penrhos	(Miles *et al* 2012)	PLASMNRS	1413–1607	50	7.7
Merioneth	Cwm Farm, Cwm Cynfal	(Miles *et al* 2012)	CWMFM1	1364–1567	50	7.6
Merioneth	Plas y Dduallt, Maentwrog	(Miles *et al* 2011)	GWYNEDD5	1355–1604	50	7.2
Merionethshire	Nant-Pasgan-Mawr, Llandecwyn	(Miles *et al* 2008)	HOH	1400–1564	50	7.1
Caernarvonshire	Clenennau, Dolbenmaen	(Miles *et al* 2007)	BDGLRT10	1406–1570	50	7.0
Caernarvonshire	Derwyn-bach, Dolbenmaen	(Miles *et al* 2007)	BDGLRT15	1385–1548	50	6.9
Caernarvonshire	Y Gesail Gyfarch, Dolbenmaen	(Miles *et al* 2006)	BDGLRT6	1384–1609	50	6.4

Table 2b: Dating evidence for the site sequence **yre05 AD 1459–1508** against dated reference chronologies

County or region	*Chronology name*	*Reference*	*File name*	*Spanning*	*Overlap (yrs)*	*t-value*
Site Chronologies						
Cornwall	St Ildierna's Church, Lansallos	(Arnold and Howard 2006)	LANASQ03	1355–1514	84	7.2
Merioneth	Cwrt Plas yn Dre	(Bridge *et al* 2013)	CWRTPLAS	1397–1508	78	6.7
Devon	Wareleigh House, Tamerton Foliot	(Howard *et al* 2006)	TMFASQ01	1367–1539	109	6.1
Merioneth	Egryn Abbey	(Miles *et al* 2004)	LLANABR1	1433–1509	77	6.0
Merioneth	Cefn Caer Pennal	(Miles and Worthington 1999)	CEFNCAR1	1404–1525	95	5.9
Caernarvonshire	Ty Mawr, Llandrog	(Miles *et al* 2010)	GWYNEDD1	1428–1535	105	5.6
Lancashire	Turton Tower, Blackburn	(Arnold and Howard 2008)	TRTASQ03	1398–1522	92	5.6
Merioneth	Hafodysybyty, Ffestiniog	(Miles *et al* 2012)	HDYSBYTY	1374–1497	67	5.3
Gr Manchester	Lightshaw Hall, Golborne	(Groves 1998)	LGHTSHW2	1414–1552	122	5.3

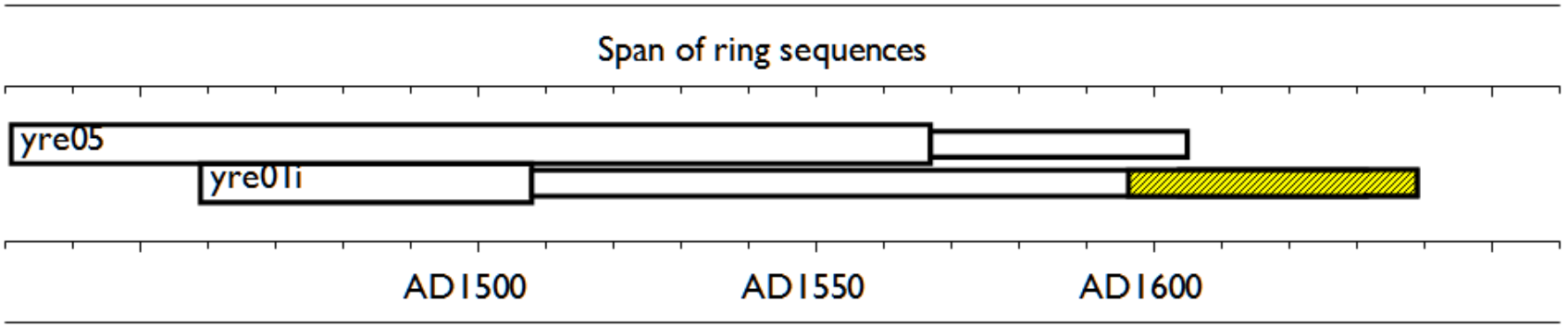

Figure 1: Bar diagram showing the relative positions of overlap of the dated timbers. White bars represent heartwood rings, yellow hatched sections represent sapwood, narrow sections represent additional unmeasured/undated rings.

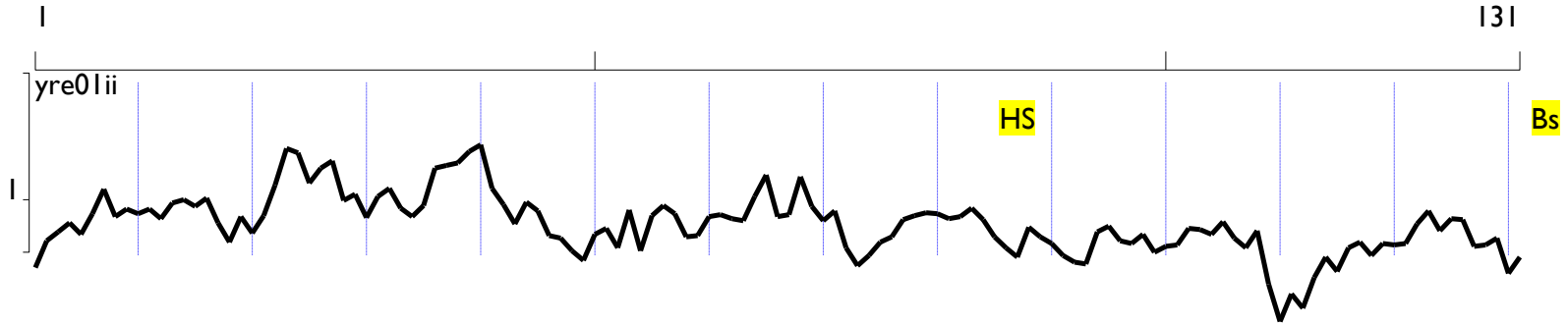

Figure 2: Ring-width plot of the outer rings of sample **yre01**, showing the very narrow rings and abrupt growth changes – *y* axis is ring width (mm) on a logarithmic scale.