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Tree Ring Dating

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Oxford Dendrochronology Laboratory  
Report 2018/5

**THE DENDROCHRONOLOGICAL  
INVESTIGATION OF  
TIMBERS FROM  
LLANERCH BARN,  
CYNWYD,  
MERIONETH**

**(SJ 04377 38609)**



**Summary**

A cruck blade yielding a sequence of 157 rings had been taken previously from this building, although it did not date. A further nine timbers were sampled, many exhibiting long ring width sequences, and several retaining complete sapwood. However, the sequences showed high sensitivity (great year-to-year variation in ring width) and the samples could not be dated.

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## **The Dendrochronological Investigation of Timbers from Llanerch Barn, Cynwyd, Merioneth (SJ 04377 38609)**

### **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.

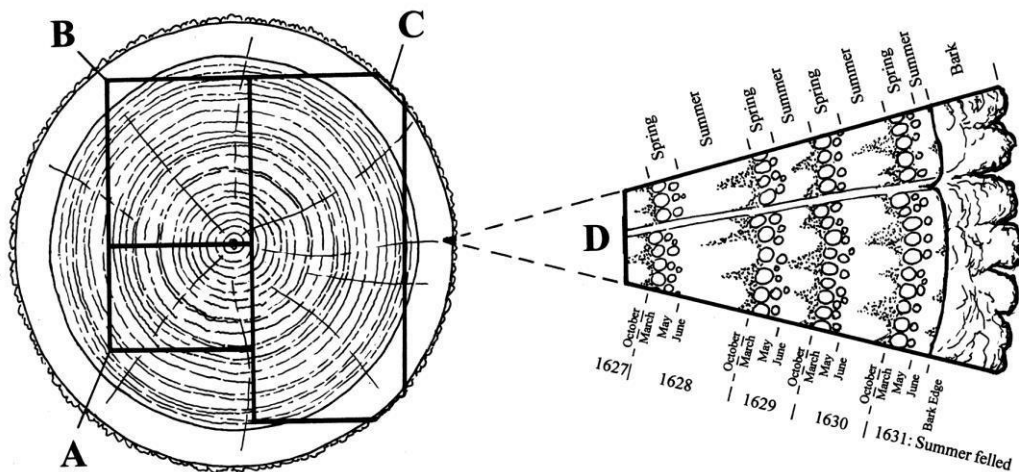
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

### **Llanerch Barn** (Coflein entry by Richard Suggett)

A cruck-framed barn of four bays associated with a cruck-framed house (NPRN 421847). Five trusses survive in the stone-walled range, and a wallpost embedded in the stone wall shows that the range was originally timber walled. The original plan seems to have been a three-bay barn partitioned from the N end bay. RFS/RCAHMW/Dec. 2016.A

### **SAMPLING**

One sample (III11) had previously been taken from a cruck whilst working on the adjacent house back in December 2016. Nine new samples were taken in November 2017. Core samples were extracted using a

15mm diameter borer attached to an electric drill. They were labelled with the prefix **III**, the numbering following on from previous work on the house at this site. The samples were polished with progressively finer grits down to 800 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 written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker, as well as DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

## **RESULTS AND DISCUSSION**

The locations and details of the samples are described in Table 1. Significant matches were found between samples **11** and **12** ( $t = 6.3$  with 138 years overlap), two crucks from the same truss, and these were combined into a single sequence for subsequent analysis. It is possible these two cruck blades are made from the same tree, but distortions in the growth patterns (Fig 1) reduces the usual level of matching found between two samples from the same tree. It is interesting that whilst sample **11** matches the ring sequence from a purlin (**16**) ( $t = 4.7$  with 113 years overlap), sample **12** does not give significant matching at the equivalent position ( $t = 1.3$  with 113 years overlap), which may indicate that **11** has the more typical growth pattern, and **12** is the distorted curve.

No other acceptable matches were found between the individual curves. Each individual sequence, along with combined series **11** and **12**, and **11** and **16**, were then compared with the dated reference material, but whilst some low level matches were found, no consistent replicated matches were deemed acceptable as dating these timbers which have very sensitive ring sequences (i.e. high year-to-year variation in ring width). This has been found at other sites in the neighbourhood (e.g. Garneddwen Fawr and Maes y Groes).

## **ACKNOWLEDGEMENTS**

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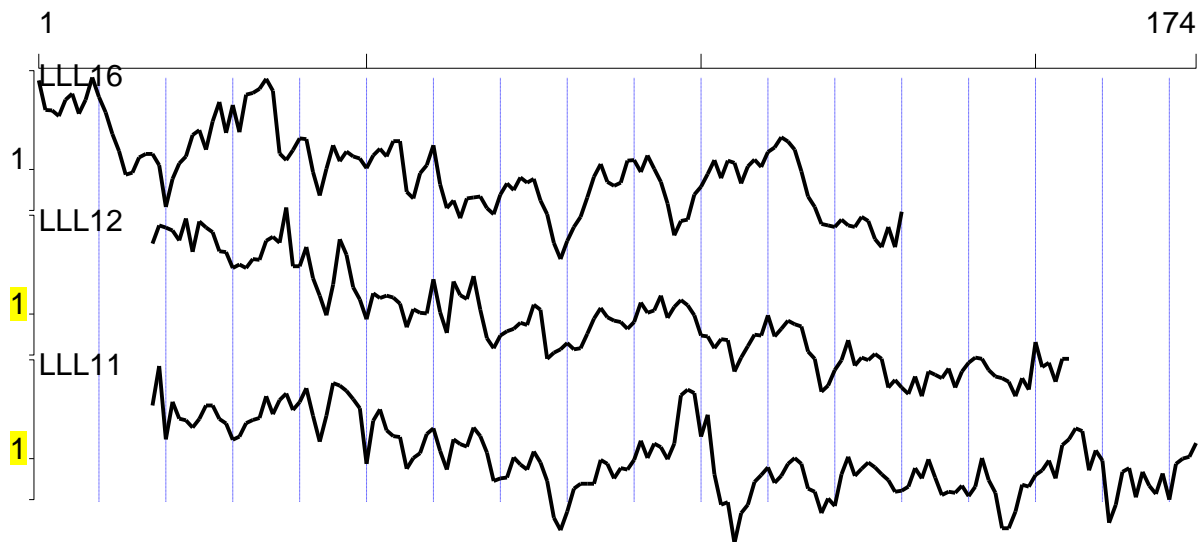
We thank the many members of DOWHG who made arrangements for our visits, and assisted during the fieldwork, especially at this site Martin Cherry and Margaret Dunn, and the owners, Lee and Rebecca Mollinson-White for allowing the work to be carried out. We also thank our fellow dendrochronologists for permission to use their data.

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**Table 1:** Details of samples taken from Llanerch Barn, Cynwyd.

Sample number	Timber and position	Sapwood complement	No of rings	Mean width (mm)	Std devn (mm)	Mean sens
III11	West cruck, truss D	26	157	1.20	0.73	0.25
III12	East cruck, truss D	4	138	1.22	1.06	0.22
III1112	Mean of 11 and 12	24	157	1.19	0.82	0.23
III13	Tiebeam, truss D	43¼C	144	0.76	0.60	0.27
III14	Collar, truss D	H/S	66	2.46	0.63	0.18
III15	West lower purlin, bay C - D	3	113	1.39	0.84	0.29
III16	West lower purlin, bay B - C	29C	130	1.25	0.90	0.23
III17	2 <sup>nd</sup> rafter south of truss B, west side	H/S	96	0.98	0.57	0.29
III18	Tiebeam, truss C	H/S	136	1.12	0.99	0.23
II19	West cruck, truss A	44C	160	1.48	1.61	0.24
III20a	Collar, truss A	-	60	2.04	1.13	0.22
III20b	<i>ditto</i>	H/S	65	1.58	0.58	0.22



**Figure 1:** Plots of samples 11, 12 and 16 at possible matching sites. Whilst 11 and 12 match ( $t = 6.3$ ) and 11 and 16 match ( $t = 4.7$ ), no significant match is found between 12 and 16 ( $t = 1.3$ ). y – axis represents ring width (mm) on a logarithmic scale.