Tree Ring Dating

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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/**

THE DENDROCHRONOLOGICAL INVESTIGATION OF DOLMELYNLLYN HALL, GANLLWYD, DOLGELLAU, GWYNEDD (NGR SH 725 240)

Draft as at 17/10/11

Summary
The opportunity was taken to sample timbers from a single truss and its associated infill planks during renovation work. A second pair of trusses from a different phase of the building was also investigated. Unfortunately none of the timbers were dated on this occasion.

Author: Dr M. C. Bridge FSA
Oxford Dendrochronology Laboratory
Mill Farm
Mapledurham
Oxfordshire
RG4 7TX

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The Dendrochronological Investigation of Dolmelynllyn Hall, Ganllwyd, Dolgellau, Gwynedd (NGR SH 725 240)

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.

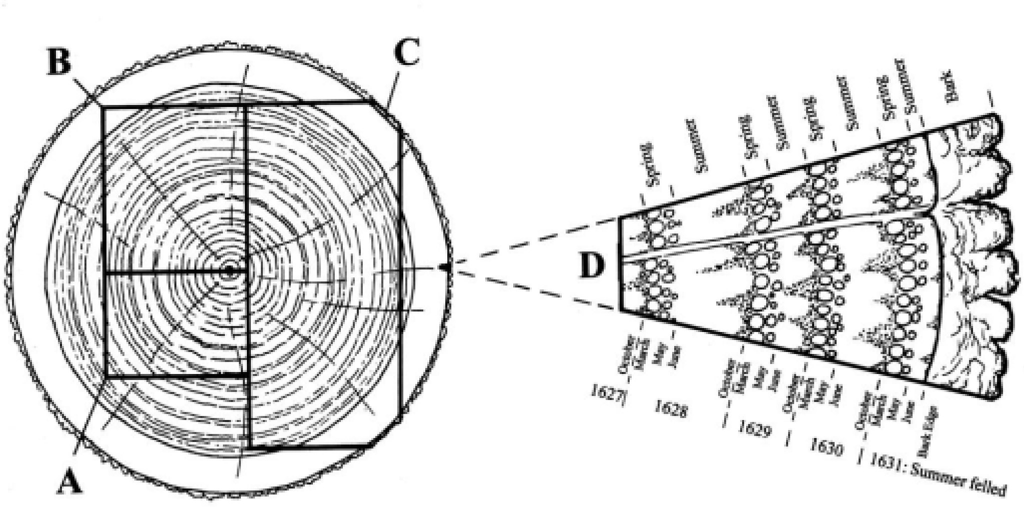
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

DOLMELYNLLYN HALL

To be inserted

SAMPLING

Sampling took place in July 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 **dmh**. Five samples were taken from the structural timbers of the truss in the 'Artro' room, and six planks that had formed infill panels, but which had been removed during renovation work, had thin cross-sections removed. Samples were also taken from the west principal rafters of two trusses in the 'Glaslyn' room, one of these being a cranked timber with a groove for plank infill. The samples were removed for further preparation and analysis. Cores were mounted on wooden laths and then these and the cross-sections 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.

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1, and illustrated in Figure 1.

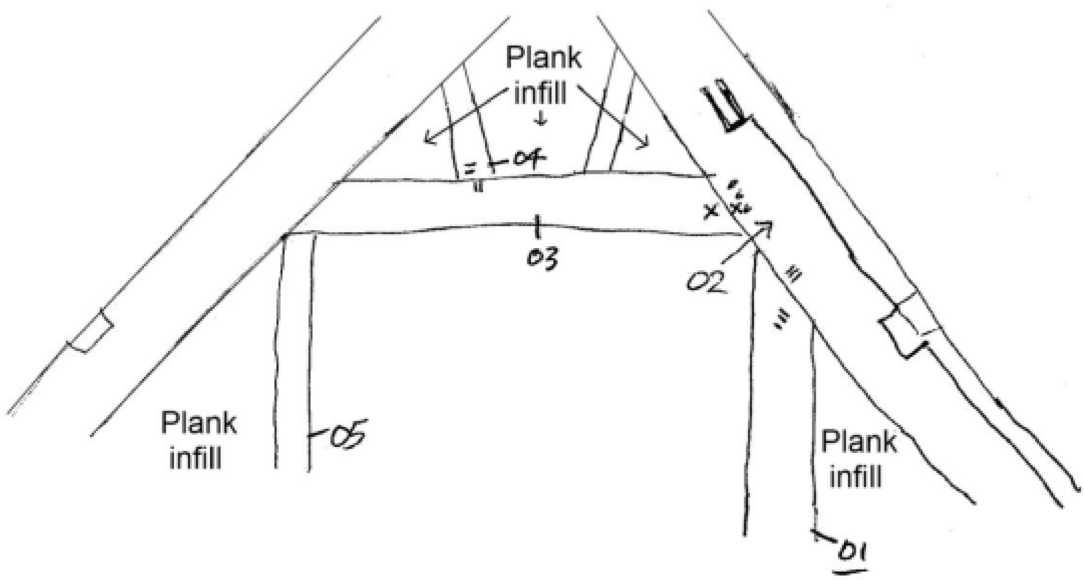


Figure 1: Sketch of the south face of the truss in room 'Artro' – showing the timbers sampled

Cross-matching was attempted between all the sample series. One possible match was detected between two of the *ex situ* planks, and a new series was derived from the two. Neither this nor any of the remaining individual series could be dated when compared with the dated material from the independent database. All the timbers therefore remain undated, but will be kept on file and may be dated in the future when more sites are available in the vicinity.

Table 1: Details of samples taken from Dolmelynllyn Hall, Ganllwyd.

Sample number	Timber and position	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens
Truss in room 'Artro'						
dmh01	East main stud	-	77	2.21	1.22	0.31
dmh02	East principal rafter	-	78	1.63	0.67	0.24
dmh03	Collar	-	<40	NM		
dmh04	West raking strut	-	61	1.61	1.03	0.21
dmh05	Main stud on west side	H/S	53	2.40	0.95	0.27
dmhs1	Slice from *ex situ* plank	-	65	1.26	0.29	0.16
dmhs2	Slice from *ex situ* plank	-	121	0.97	0.76	0.29
dmhs3	Slice from *ex situ* plank	-	52	1.31	0.28	0.15
dmhs4	Slice from *ex situ* plank	H/S	119	0.67	0.26	0.27
dmhs5	Slice from *ex situ* plank	-	89	1.37	0.98	0.21
dmhs6	Slice from *ex situ* plank	-	52	1.76	0.72	0.28
dmhs24m	Mean of **s2** and **s4**	H/S	152	0.89	0.69	0.26
Trusses in room 'Glaslyn'						
dmh20	West principal rafter, middle truss	H/S	60	1.07	0.32	0.21
dmh21	West principal rafter, north truss	-	82	2.58	1.71	0.32

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured;

dmhs2 *vs* **dmhs4,** $t = 4.1$ with 88 years overlap, this is a relatively poor match, but a possible one

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