Oxford Dendrochronology Laboratory
Report 2011/14

THE DENDROCHRONOLOGICAL INVESTIGATION OF PANT GLAS, PADOG, BETWS-Y-COED (NGR SH 845 514)

Summary

Seven samples were taken from various elements of the trusses in the eastern part of this long building. None of the samples could be dated.

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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.

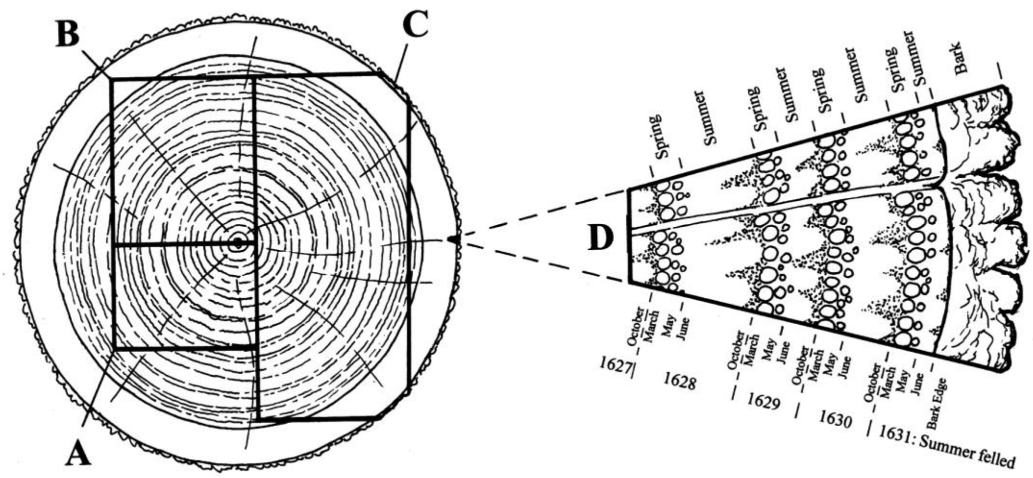
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student’s *t*-test. The *t*-test compares the actual difference between two means in relation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

PANT GLAS (Notes from Richard Suggett)

A C19th farmstead with house and stable in range set apart from a courtyard group of farm buildings with barn flanked by cowhouses. Earthworks behind the farmhouse mark the site of Pant-glas mansion taken down in the first half of the C19th when the present house was built. The stable range incorporates reused timber which may have come from the mansion house.

SAMPLING

Sampling took place in March 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 **pang**. 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 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, and their locations, are given in Table 1, and some are illustrated in Fig 1. Cross-matching between samples failed to yield any strong acceptable matches, so no site master chronology could be built. Individual series were then compared to the dated reference material, and again, no acceptable replicated matches were found, leaving the timbers all undated. Some series (e.g. **pang07**) did show unusual growth characteristics, in this case a regular decline in ring-width and slow recovery, perhaps resulting from management of the tree. The lack of cross-matching between the samples perhaps suggests that they came from scattered sources. It would be expected however that other long series may have given dates. The chiselled truss numbers (II on the east truss) suggest a post-medieval origin.

Figure 1: View of the east truss (looking west) showing the approximate positions of the samples **01 -03** from the two principal rafters and the lower collar.

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Table 1: Details of samples taken from Pant Glas

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Sample number	Timber and position	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens
pang01	North principal rafter, east truss	11+6NM	99	1.40	0.64	0.18
pang02	South principal rafter, east truss	7¼C	68	2.25	0.99	0.21
pang03	Lower collar, east truss	32+7NM	103	103	0.80	0.28
0.19pang04	South middle purlin, middle bay	27+11NM	101	101	0.97	0.95
0.23pang05	South lower collar, middle bay	25C	100	1.01	0.74	0.31
pang06	Lower collar, west truss	H/S	57	1.11	0.68	0.27
pang07	South principal rafter, west truss	24C	80	1.06	0.69	0.32

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; C = complete sapwood, winter felled; ½C = complete sapwood, felled the following summer; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured;

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