Darganfod Hen Dai Cymreig
Discovering Old Welsh Houses

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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 2012/15

THE DENDROCHRONOLOGICAL INVESTIGATION OF CAE'RBERLLAN, LLANRWST, CONWY (NGR SH 806 602)

Summary
Three large beams were sampled from this site, the principal parlour beam, a (dais) beam between the sitting and dining rooms, and a north-south beam across the stairs. All three ring series were long, but each contained bands of narrow rings and unusual, almost regular, changes in growth rate, suggesting the trees may have been managed in some way, or grew in an unusual environment. All three series failed to date.

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The Dendrochronological Investigation of Cae'rberllan, Llanwrst, Conwy (NGR SH 806 602)

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.

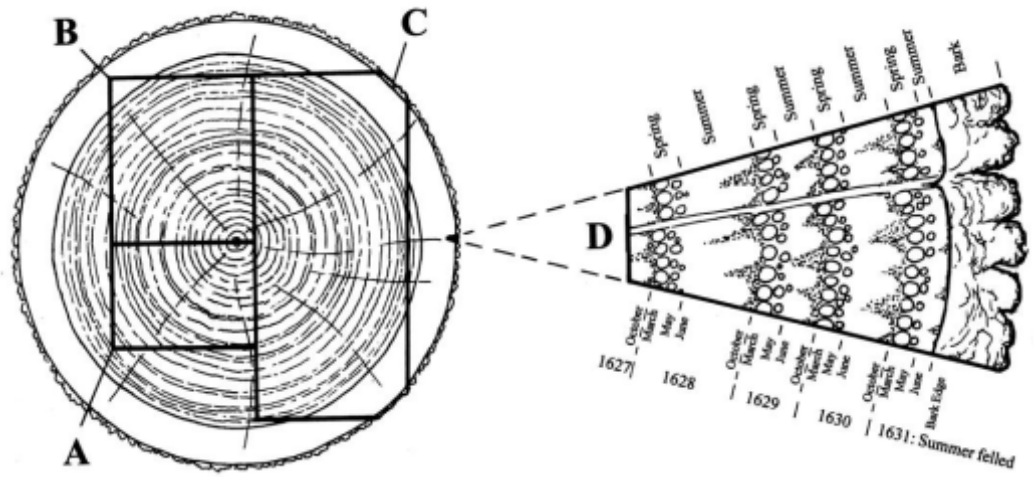
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

CAE'RBERLLAN

Cae'rberllan is a substantial three-unit stone-built fully storeyed house. The plan is unusual but best understood as a developed form of the Snowdonian plan-type which has a large parlour at the entry displacing the service-room to beyond the hall. A storeyed porch gives access to the large parlour and hall. Timber detail internally includes the hall screen and fine ceilings. The stop chamfers are distinctive angle-cut ogees. The windows have substantial timber lintels internally and drip moulds externally. The stair has been re-made but may retain some original work. The detail suggests a mid-C17th date. NPRN 26911.

Cae'rberllan barn adjacent to the house retains a full cruck-truss which was considered too fast grown for successful sampling.

SAMPLING

Sampling took place in January 2012. 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 **cbl**. 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.

RESULTS AND DISCUSSION

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

Table 1: Details of samples taken from Cae'rberllan, Conwy.

Sample number	Timber and position	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens
cbl01i	N-S beam over stairs in GFlr ceiling	-	56	2.98	2.24	0.30
cbl01ii	*ditto*	42¼C	125	0.87	0.48	0.30
cbl02	Ceiling beam between dining room and parlour	42¼C	117	0.71	0.30	0.26
cbl03i	Principal parlour beam	-	92	1.29	1.13	0.34
cbl03ii	*ditto*	41¼C	82	0.78	0.49	0.30

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; ¼C = complete sapwood, felled the following spring; std devn = standard deviation; mean sens = mean sensitivity.

All three timbers retained complete sapwood, showing all three trees to have been felled in spring. Both the beam in the hallway over the stairs, and the principal parlour beam had breaks in the samples and each was treated as two individual series. The series from the dais beam (**cbl02**) had a band of very narrow rings in the inner part, and only the outer 117 years were measured. None of the series cross-matched with each other, and neither did they give acceptable replicated matches against the dated reference material. The very high values of mean sensitivity (a measure of year-to-year variation in ring width) reflect the erratic nature of the series – illustrated in Figure 1.

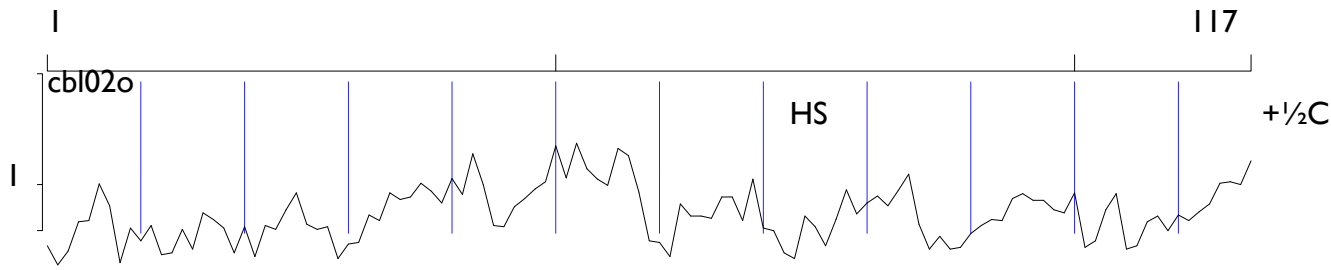


Figure 1: Plot of the ring-width series from the outer part of sample cbl02, (plotted on a semi-logarithmic scale), showing the number of sudden growth declines experienced by all the samples at this site.

The numerous sudden declines in growth rate seen in all three series suggest some form of management of the trees, or growth in a very unusual environment (perhaps a flood plain that was often flooded) and render the series undatable by dendrochronology.

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