Oxford Dendrochronology Laboratory
Report 2015/2

THE TREE-RING DATING OF A FLOOR TIMBER AT PENRHYN OLD HALL, LLANDUDNO

(NGR SH 815 815)

Photo: Margaret Dunn

Summary

Few timbers in this building displayed enough rings to be dendrochronologically dated, however, two ground floor ceiling beams and a timber in the apex of a roof truss were sampled. One of the ground floor ceiling beams dated to the period 1463–1534, giving a likely felling date range for the tree used as 1545–76.

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A report commissioned by Dating Old Welsh Houses Project in partnership with
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The Tree-Ring Dating of a Floor Timber at Penrhyn Old Hall, Llandudno (NGR SH 815 815)

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.

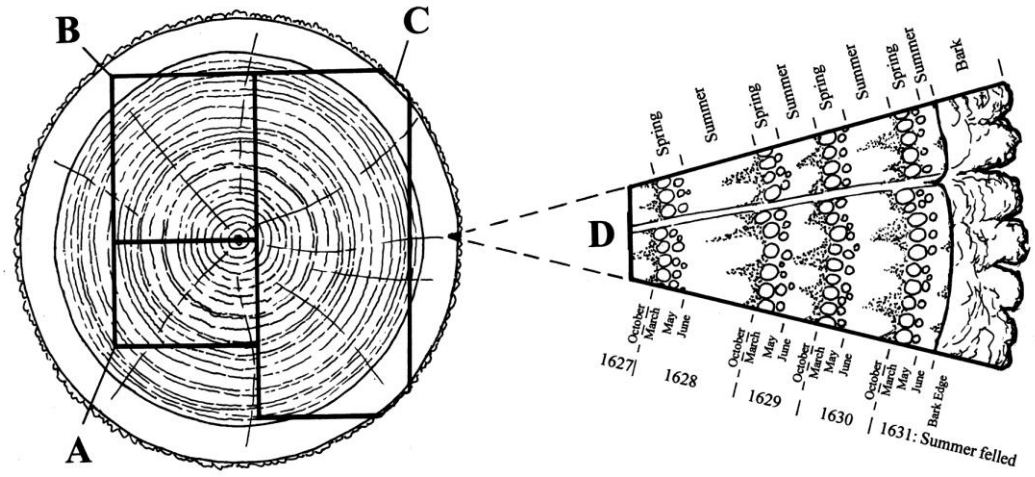
One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence 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)

<u>PENRHYN OLD HALL</u> (source Coflein)

A largely sixteenth century mansion that is thought to incorporate some fabric of a medieval house. An 'auncient stone house' is mentioned by Leland (1536-9). From the mid eighteenth century the house declined into a farmhouse, until restored as a gentleman's residence at the start of the twentieth century. It is now a club or public house.

The house has an irregular H-plan. It is a two storey building and its stone walls are mostly rendered. It has slate gabled roofs and tall chimney stacks. The north-east range has a crow-stepped gable.

The earliest part is the south-west wing. This was built in the middle years of the sixteenth century, incorporating some earlier features. The south-western part of the central range was then added. Both parts incorporate late medieval architectural salvage. The north-east wing was built as a separate block in the late sixteenth century and at about the same time the south-west wall of the south-west wing was rebuilt. The two parts of the house were then joined by a continuation of the central range. The house has been much altered, extended and otherwise modified, particularly in about 1900. A long service range is attached on the north-east (NPRN 31423).

A ruinous sixteenth century chapel stands to the north-east (NPRN 43681). The house's early decline and late revival have limited the recorded grounds and gardens (NPRN 86443). Two lodges were built on the north drive (NPRN 16855, 16604) and there is a further estate cottage in Penrhyn-Side (NPRN 16719). There are well preserved farmbuildings to the east of the house (NPRN 31422) with a modern farmhouse (NPRN 16690).

Source: RCAHMW Caernarvonshire Inventory I (1956), 179-81 No. 650

SAMPLING

Sampling took place in November 2014. 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 **proh**. 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. The ring-width series were compared on an IBM compatible computer for statistical cross-matching using a variant of the Belfast CROS program (Baillie and Pilcher 1973). A version of this and other programmes were written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker. Subsequent analyses were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1. Few of the timbers seen contained enough rings to be dated by dendrochronology, however two of the larger beams from the ground floor ceiling of the oldest part of the building and a strut in the apex of a roof truss were sampled.

Only one timber dated, this being the main longitudinal beam to the ground floor ceiling. This was dated 1463–1534, the dating evidence being presented in Table 2. There are several references to this 16th century building, and this date accords well with evidence for a mid-16th century date, the likely felling date range being 1545–76.

ACKNOWLEDGEMENTS

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Table 1: Details of samples taken from Penrhyn Old Hall, Llandudno.

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
Ground Floor									
proh01	Main north-south ceiling beam	1463–1534	1534	h/s	72	1.79	1.06	0.27	1545–76
proh02	Beam at south end of ceiling	-	-	28C	83	1.85	1.77	0.24	-
First Floor									
proh03	Strut in apex of south truss	-	-	h/s	46	1.33	0.63	0.34	-

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

Table 2: Dating evidence for the site sequence **proh01** **AD 1463–1534** against dated reference chronologies

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Shropshire	Upper Lake, Westbury	(Miles and Worthington 2000)	UPRLAKE	1418–1546	72	6.4
Shropshire	Habberley Hall	(Miles and Haddon-Reece 1995)	HABBERLY	1386–1554	72	6.4
Shropshire	28 Watergate, Whitchurch	(Miles and Worthington 2001)	WHGHWHIT	1416–1596	72	5.6
Worcestershire	Badge Court, Elmbridge	(Bridge 2002)	BADGECT	1418–1578	72	5.4
Shropshire	Buildwas Abbey	(Miles 2002)	BUILDWS2	1374–1547	72	5.3
Denbighshire	Bryngwylan, Abergele, Conwy	(Bridge *et al* 2013)	BRYNGWYL	1430–1586	72	5.2
Shropshire	Lion Tap, Shrewsbury	(Miles and Haddon-Reece 1994)	lt1	1432–1570	72	5.1
Caernarvonshire	Plas Tirion, Llanrwst	(Oxford Dendro Lab unpublished)	TIRION1	1418–1545	72	5.0
Worcestershire	Church House, Areley Kings	(Miles *et al* 2003)	ARELEY	1365–1535	72	4.9
Montgomeryshire	St Idloes Church, Llanidloes	(Miles *et al* 2003)	LNYDLOS2	1384–1593	72	4.8