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Discovering Old Welsh Houses

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Oxford Dendrochronology Laboratory
Report 2018/34

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM 2 WATER STREET, CAERWYS DENBIGHSHIRE

(SJ 1288 7921)

Photo: Margaret Dunn

Summary

Three of the five samples were dated, though they did not match each other well. The resulting 100 year-long site chronology matched well against the dated reference material, though the strongest matches do not cover the whole sequence, possibly reflecting the lack of early dated sites in the area. The north cruck blade of the east truss was found to have come from a tree felled in **spring 1465**, making construction most likely in this year, or within a year or two after this date.

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A report commissioned by the Discovering Old Welsh Houses Group in collaboration with the Royal Commission on the Ancient and Historic Monuments Wales (RCAHMW)

The Dendrochronological Dating of Timbers from 2 Water Street, Caerwys, Denbighshire (SJ 1288 7921)

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.

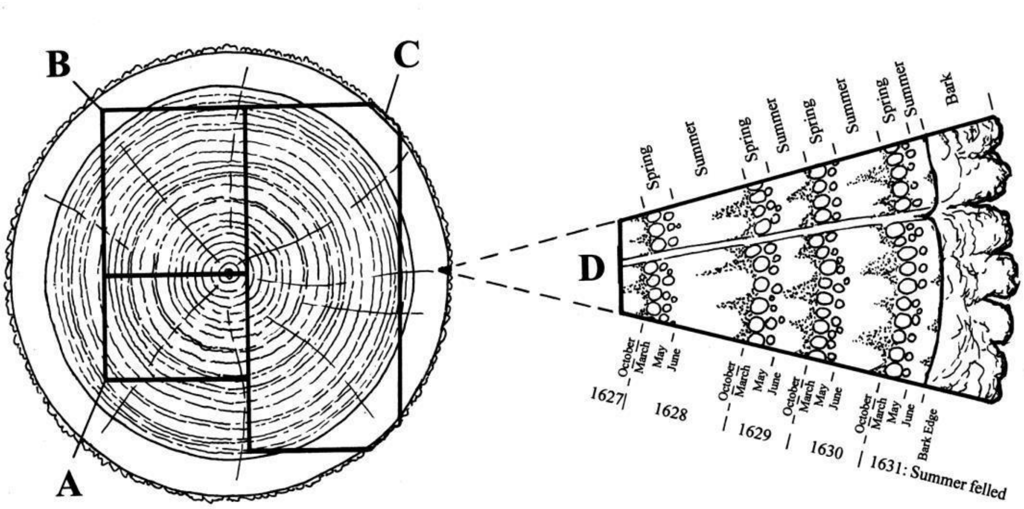
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

2 Water Street

From the outside, this property looks like a late C19th terraced house, but when recently sold, a DOWHG member noticed a photograph of a cruck in the sales brochure, which in turn led to an assessment in November 2017. Two large cruck trusses remain, and there may be another in the adjacent property to the west (not seen). Little is as yet known about the history of the property, but the trusses were assessed as useful for dendrochronology.

SAMPLING

Samples were taken from timbers in the roof structure during August 2018. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled with the prefix **cwws**, and taken away for subsequent analysis, where they were glued to laths.

The samples were polished with 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 programs by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

The locations and details of the samples are described in Table 1, and a field-sketch of the first floor layout is shown in Fig 1. The first sequence, from the north cruck of the east truss gave a 100-year chronology that dated well individually against reference material. No good matches were found between the samples, with those subsequently dating, not matching each other significantly (Table 2), and with relatively short sequences, there was some hesitation about making the site chronology, although the next longest sequence (**02**, 74 rings) also appeared to date reasonably well on its own against the reference material. Combining **01** and **02** gave a working site sequence against which **04** looked to match reasonably well when comparing the plots, and its incorporation boosted the level of matching of the new site master, **CAERWYS**, the strongest matches being shown in Table 3. The two other series did not date.

The result is that three series that do not match together strongly produce a site master that appears to date well, although the strongest matches only use part of the sequence for cross-matching. After much consideration however, the level of matching and replication was accepted as dating the site sequence, which reinforced the matches found for the longest sequence considered on its own. Only one timber retained complete sapwood, the north cruck of the east truss being found to have been converted from a tree felled in spring 1465. Sample **02** was noted as having heartwood-sapwood boundary on coring, and its outer ring has a similar date to the h/s boundary of **01**, but this was uncertain on the sample itself, and this has therefore been considered as not having h/s boundary for the rest of the analysis.

The relative positions of overlap of the dated sequences are shown in Fig 2.

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Table 1: Details of samples taken from 2 Water Street, Caerwys.

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
*** cwws01**	North cruck to east truss	1365–1464	1444	20¼C	100	1.89	0.85	0.22	Spring 1465
*** cwws02**	North cruck to west truss	1373–1446	?	?h/s	74	3.15	1.18	0.27	After 1457
cwws03	Collar to west truss	-	-	?h/s	64	2.07	0.77	0.22	-
*** cwws04**	Re-used timber as rafter, west truss	1389–1437	-	-	49	2.90	0.56	0.21	After 1448
cwws05	South cruck to west truss	-	-	-	61	2.27	2.24	0.29	-
*** =** included in site master **CAERWYS**		**1365–1464**			**100**	**2.48**	**0.86**	**0.19**	

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; NM = not measured. [1] based on mean H/S date for two timbers.

Table 2: Cross-matching between the dated samples in site master **CAERWYS**

Sample	cwws02	cwws04
cwws01	1.3	2.9
cwws02		1.1

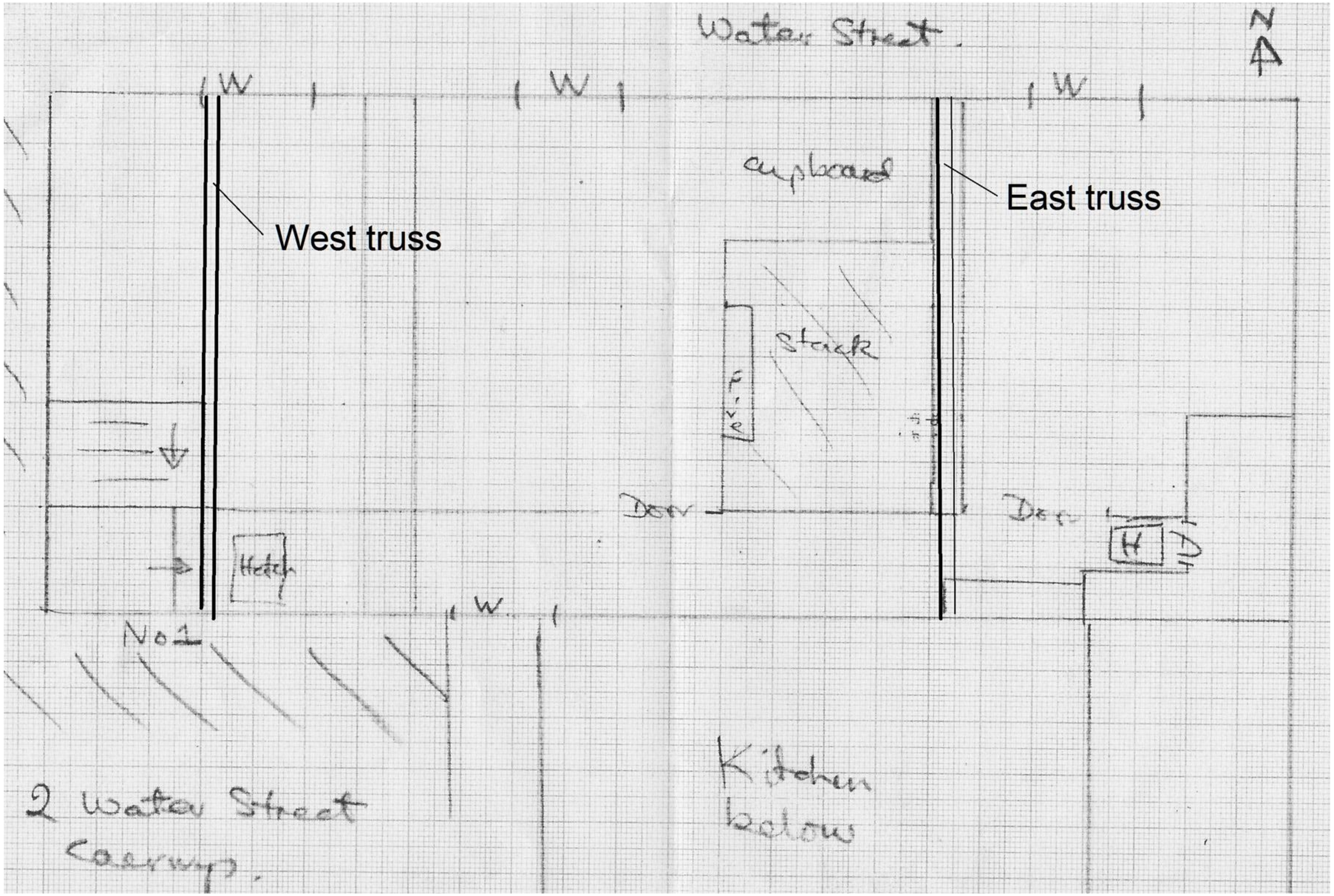

Figure 1. Field-sketch by Margaret Dunn, adapted to show the approximate position of the trusses sampled

Table 3: Dating evidence for the site chronology **CAERWYS AD 1365–1464** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Site Chronologies						
Denbighshire	Plas Uchaf, Glan Conwy	(Bridge *et al* 2017)	PLASUCGC	1415–1569	50	7.5
Gloucestershire	Owlpen Manor Barn	(Bridge and Miles 2017)	OWLPEN2	1337–1445	81	6.9
Shropshire	Ightfield Hall barn, Whitchurch	(Groves 1997)	IGHTFELD	1341–1566	100	6.8
Anglesey	34 Castle Street, Beaumaris	(Miles *et al* 2011)	ANGJ41m	1398–1482	67	6.5
Anglesey	Plas Coch, Anglesey	(Miles *et al* 2011)	PLASCOCH	1402–1591	63	6.4
Devon	West Hele, King's Nympton	(Tyers *et al* 1997)	WESTHELE	1384–1441	58	6.4
Denbighshire	Tyddyn Cynnar Llansilin	(Miles *et al* 2003)	TYDDYNC1	1348–1471	100	6.2
Shropshire	Brookgate Farm	(Miles and Haddon-Reece 1993)	BROOKGT	1362–1611	100	6.2
Yorkshire	Stank Hall Barn, Leeds	(Hillam and Groves 1992)	STANK	1384–1444	61	6.1
Oxfordshire	Pebble Court, Swinbrook	(Miles and Haddon-Reece 1992)	PEBBLE	1281–1436	72	6.1
Denbighshire	Llanelian-yn-Rhos church	(Miles *et al* 2011)	llnlnrs1	1410–1489	55	6.1

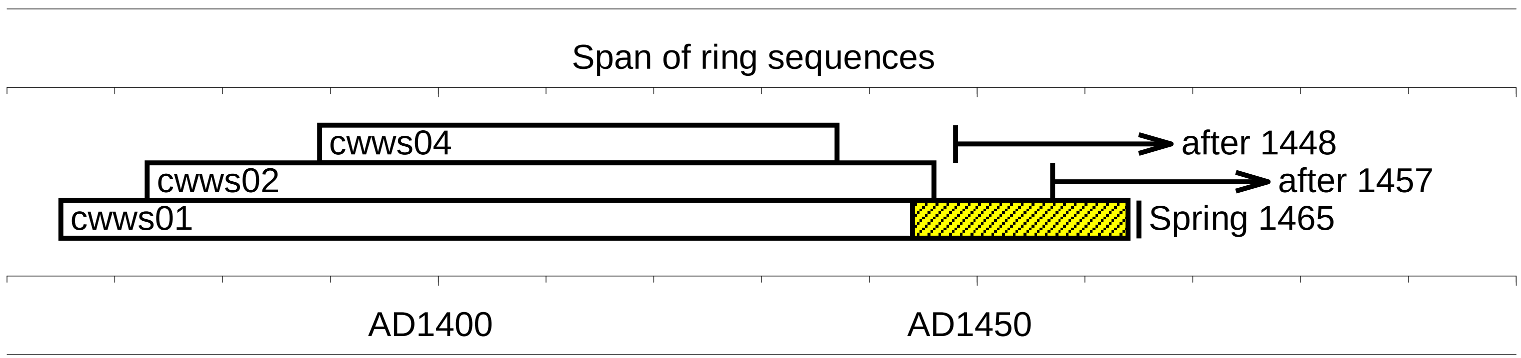

Figure 2: Bar diagram showing the relative positions of overlap of the dated samples, with their likely felling date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood, narrow bars represent additional unmeasured rings.