Oxford Dendrochronology Laboratory
Report 2017/04

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM CRAIG Y CASTELL DYSERTH, DENBIGHSHIRE (SJ 059 800)

Summary

Two large transverse beams were sampled at ground floor level. These both retained complete sapwood, And were found to have come from trees felled in spring 1614 and spring 1615.

Authors: Dr M. C. Bridge FSA and Dr D. Miles FSA
Oxford Dendrochronology Laboratory
Mill Farm
Mapledurham
Oxfordshire
RG4 7TX

January 2017

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 Craig Y Castell, Dyserth, Denbighshire (SJ 059 800)

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.

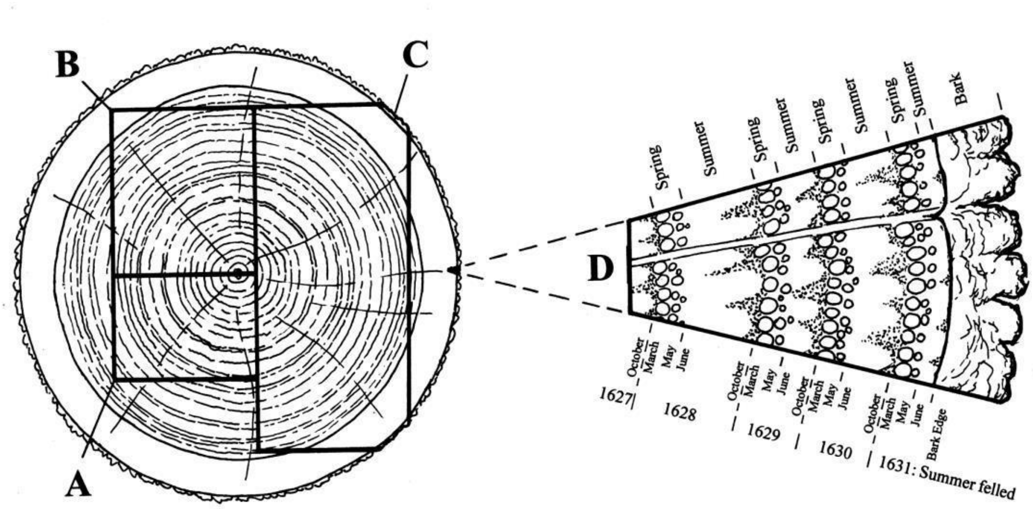
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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



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>Craig y Castell</u>

Early C16th century work in stone modern residence. 13th century arms in gable front adj former castle, carved heads. Interior beams.
(Coflein Jan 2017)

SAMPLING

Samples were taken in November 2016. The locations of the samples are described in Table 1, and shown in Fig 1. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **cycd**) and 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 DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

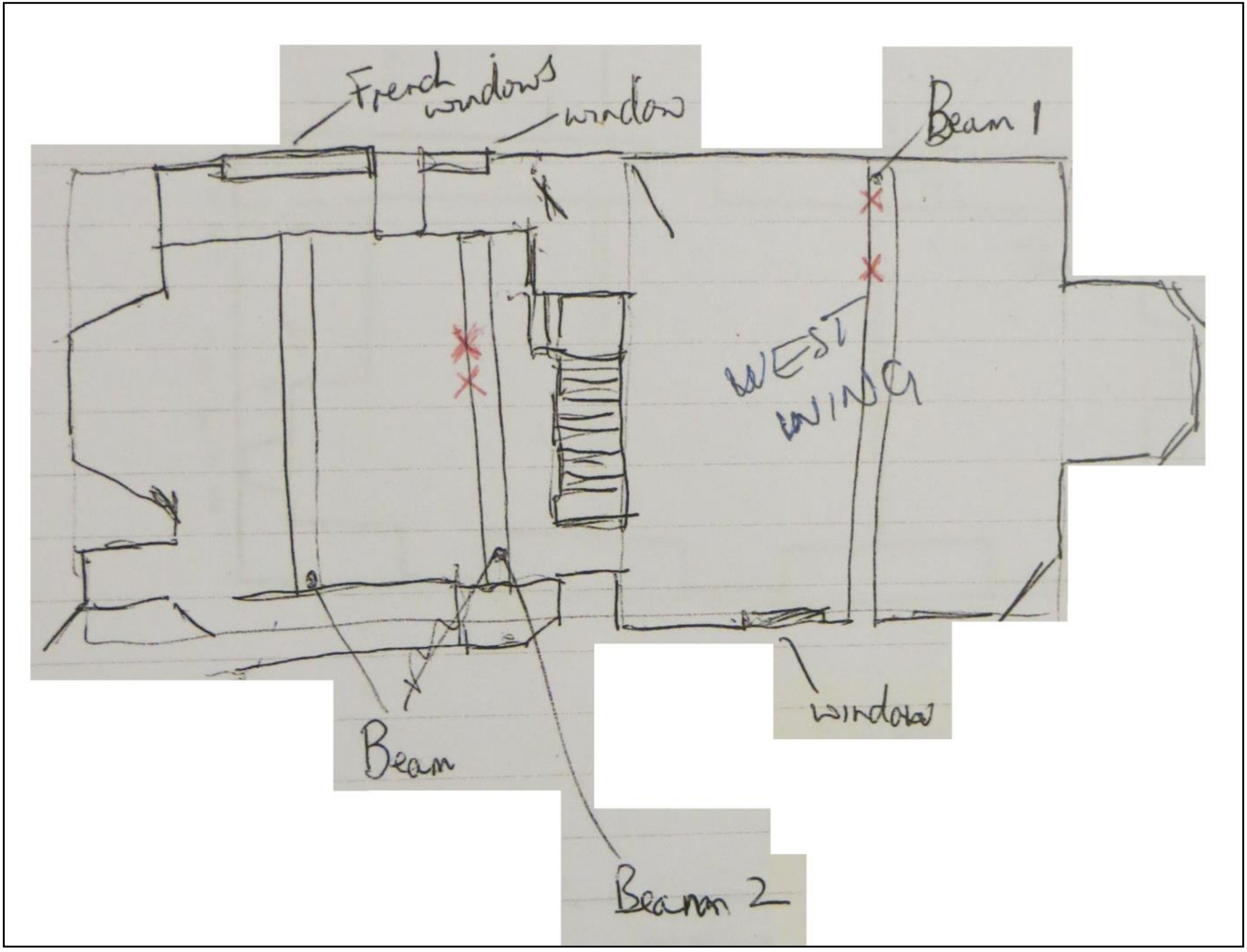


Figure 1: Sketch plan showing approximate positions of sampling

RESULTS AND DISCUSSION

Details of the samples are given in Table 1. The two samples from beam 1 matched each other well (t = 15.2 with 79 years overlap) as did those from beam 2 (t = 10.2 with 102 years overlap). Both pairs were therefore meaned to give two new series, **cycd01** and **cycd02**. These matched each other (t = 5.3 with 103 years overlap) and were combined to produce a 105-year long site chronology CRAIGYC, which was subsequently dated to the period 1510–1614, the strongest matches being shown in Table 2. The relative positions of overlap are shown in Fig 2. Both timbers retained complete sapwood, and were found to have come from trees felled in spring 1614 and spring 1615.

ACKNOWLEDGEMENTS

The Discovering Old Welsh Houses - North East Wales Project - acknowledges that this project would not have been possible without the grants gratefully received from the Woodtiger Fund, the Marc Fitch Fund, the Vernacular Architecture Group and the Clwydian Range & Dee Valley Area of Outstanding Natural Beauty Fund

We thank the many members of DOWHG who made arrangements for our visits, and assisted during the fieldwork, and to the owner, Mr David Wilkinson for allowing the work to be carried out. We also thank our fellow dendrochronologists for permission to use their data.

REFERENCES

Arnold, A. J., Howard, R. and Litton, C. D. (2006) *Tree-ring analysis of timbers from Middleton Hall, Warwickshire*, **EH Research Dept Rep**, 13/2006.

Baillie, M.G.L. and Pilcher, J.R. (1973) *A simple cross-dating program for tree-ring research*. **Tree Ring Bulletin**, 33, 7-14.

Bridge, M. C. (1988) *The dendrochronological dating of buildings in southern England*, **Medieval Archaeology**, 32, 166-174.

Bridge, M. C. (1993) List 52 **-** Tree-ring dates, **Vernacular Architecture**, 24, 48-50.

English Heritage (1998) *Guidelines on producing and interpreting dendrochronological dates,* **English Heritage, London.**

Haddon-Reece, D., Miles, D. H. and Munby, J. T. (1989) List 32 **-** Tree-ring dates, **Vernacular Architecture**, 20, 46-49.

Haddon-Reece, D., Miles, D. H., Munby, J. T., and the late Fletcher, J. M. (1993) Oxfordshire Mean Curve **-** a compilation of master chronologies from Oxfordshire, unpublished computer file OXON93, Oxford Dendrochronology Laboratory.

Miles, D. H. (1995) Working compilation of 71 reference chronologies centred around Shropshire by various researchers, unpublished computer file SALOP95, Oxford Dendrochronology Laboratory.

Miles, D. (1997) *The interpretation, presentation, and use of tree-ring dates*, **Vernacular Architecture**, 28, 40-56.

Miles, D. (2007) *The Tree-Ring dating of the White Tower, HM Tower of London (TOL99 and TOL100), London Borough of Tower Hamlets*, **EH Research Dept Rep Ser**, 35/2007.

Miles, D. H. and Worthington, M. J. (1999) Tree-ring dates, **Vernacular Architecture**, 30, 98-113.

Miles, D. H. and Worthington, M. J. (2002) Tree-ring dates, **Vernacular Architecture**, 33, 81-102.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2004) Tree-ring dates, **Vernacular Architecture**, 35, 95-113.

Miles, D. H., Worthington, M. J. and Bridge, M. C. (2008) Tree-ring dates, **Vernacular Architecture**, 39, 135-146.

Miles, D. H. and Bridge, M. C. (2010) Tree-ring dates, **Vernacular Architecture**, 41, 102-105.

Miles, D. H., Bridge, M. C., and Marshall, G. (2014) Tree Ring Dating Lists, **Vernacular Architecture**, 45, 119-120.

Nayling, N. (2000) *Tree-ring analysis of timbers from The White House, Vowchurch, Herefordshire,* **Anc Mon Lab Rep**, 73/99.

Tyers, I. (2004) *Dendro for Windows Program Guide 3rd edn*, **ARCUS Report,** 500b**.**

Wilson, R., Miles, D., Loader, N. J., Melvin, T., Cunningham, L., Cooper, R. and Briffa, K. (2012) *A millennial long March-July precipitation reconstruction for southern-central England*, **Climate Dynamics**, 40, 997-1017.

Table 1: Details of samples taken from Craig y Castell, Dyserth.

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
cycd01a	Transverse beam	*1511-1589*		*H/S*	*79*	*1.54*	*0.61*	*0.18*	
cycd01b	*ditto*	*1510-1614*		*25¼C*	*105*	*1.35*	*0.59*	*0.19*	
*** cycd01**	Mean of **01a** and **01b**	1510-1614	1589	25¼C	105	1.35	0.60	0.17	Spring 1615
cycd02a	Transverse beam by stairs	*1511-1612*		*33*	*102*	*1.84*	*1.31*	*0.19*	
cycd02b	*ditto*	*1511-1613*		*36¼C*	*103*	*1.67*	*1.33*	*0.19*	
*** cycd02**	Mean of **02a** and **02b**	1511-1613	1577	36¼C	*103*	*1.74*	*1.31*	*0.18*	Spring 1614
***** = included in site master **CRAIGYC**		**1510-1614**			**105**	**1.54**	**0.88**	**0.15**	

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

Table 2: Dating evidence for the site chronology **CRAIGYC AD 1510–1614** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Regional Chronologies						
Oxfordshire	Oxfordshire Master Chronology	(Haddon-Reece *et al* 1993)	**OXON93**	632–1987	105	8.5
England	Southern Central England	(Wilson *et al* 2012)	**SCENG**	663–2009	105	7.9
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881–1745	105	7.8
Site Chronologies						
Oxfordshire	Chazey Court	(Miles *et al* 2004)	CHAZEY1	1507–1614	105	8.4
Buckinghamshire	Boarstall Tower	(Miles and Worthington 1999)	BOARSTL2	1450–1614	105	7.7
Warwickshire	Middleton Hall	(Arnold *et al* 2006)	MIDHSQ02	1390–1646	105	7.6
Oxfordshire	Lower Hernes, Rotherfield Greys	(Miles *et al* 2008)	LHERNES1	1470–1566	57	7.4
Buckinghamshire	Chantry, Fenny Stratford	(Bridge 1993)	FENNY	1468–1591	82	7.2
Herefordshire	White House, Vowchurch	(Nayling 2000)	VOWCH	1364–1602	93	7.1
London	White Tower, Tower of London	(Miles 2007)	WHTOWR7	1463–1616	105	7.0
Radnorshire	Llansantfraidd	(Miles and Worthington 2002)	TUHWNT	1400–1647	105	7.0
Oxfordshire	Upper House Farm, Nuffield	(Haddon-Reece et al 1989)	NUFF	1404–1627	105	6.7
Oxfordshire	Wadham College	(Miles and Bridge 2010)	WADHAM	1426–1610	101	6.6
Buckinghamshire	24 Crown Court, West Wycombe	(Miles *et al* 2014)	WWJ	1373–1656	105	6.6

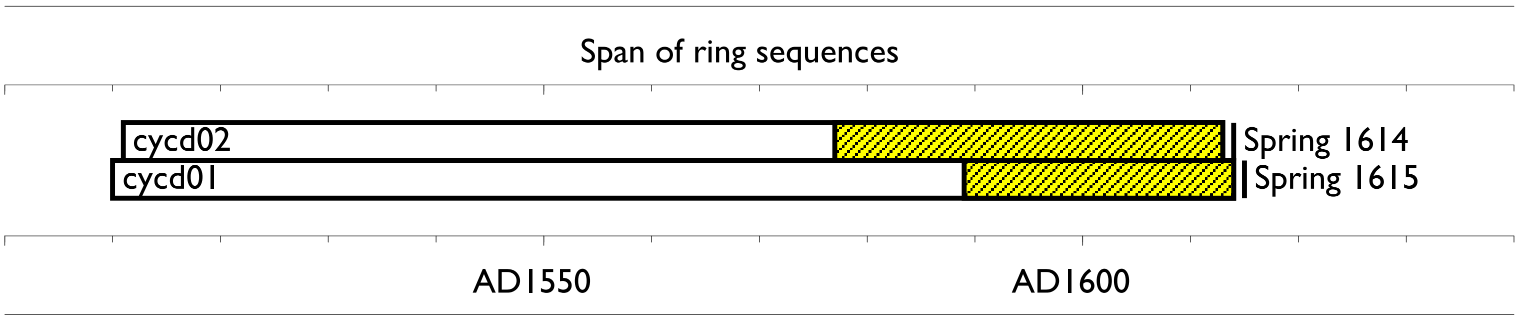


Figure 2: Bar diagram showing the relative positions of overlap of the dated samples, with their actual or likely felling dates / date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood, narrow bars represent additional unmeasured rings.