Oxford Dendrochronology Laboratory
Report 2014/29

THE TREE-RING DATING OF TY CERRIG, LLANGOWER, MERIONETH (NGR SH 906 318)

Summary

Six timbers were dated from this site, four from the primary phase were found to have timbers from trees felled in winter 1500/01 and spring 1501, making construction most likely in **1501**, or within a year of two after this date. One timber from the second phase was from a tree felled in spring **1634**, with a second timber giving broad agreement to this felling date, making it the likely construction date, within a year or two, of this second phase. All the timbers matched each other, and probably grew in the same source area, even though the phases are over a century apart.

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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.

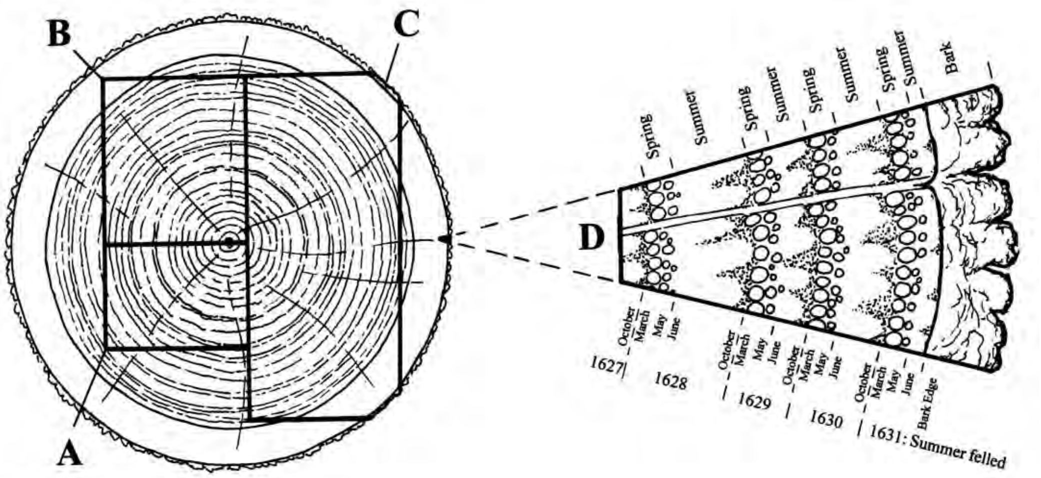
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

<u>TY CERRIG</u> (notes by Richard Suggett)

Tycerrig survives as an outbuilding to a farmhouse built *c*.1800. The older house is of end-chimney Snowdonian plan-type but incorporates two cruck-trusses from a hall-house predecessor. Both cruck-trusses have rather diminutive archbraces, but their original location within the hall-house is not certain. A reasonable interpretation, reinforced by the siting, is that the surviving trusses define the upper of the hall-house with the dais-end truss and central hall truss surviving. The probable central hall truss is the more refined truss with (formerly cusped?) struts above the shaped and chamfered collar. Two windbraces survive showing that the hall formerly had two tiers of plain windbraces.

In the second phase an end fireplace was probably built against the passage-end truss, which was removed and the outer bay lost. The adapted house was divided into hall and outer room reflecting the baying of the hall and inner room of the hall-house. The hall retains an inserted spine beam with convex stop. The outer room (parlour) has an ovolo-moulded beam consistent with the seventeenth-century dendro date for Phase II. A secondary doorway alongside the fireplace may have replaced a fireplace stair. An external stair now provides access to the first floor.

Coflein (RCAHMW's on-line database) entry: NPRN 28775. R.F. Suggett/RCAHMW/November 2014.

SAMPLING

Sampling took place in June 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 **tcrg**. Locations of samples 1 – 6 are shown in Fig. 1. 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. There were some complications in the measuring of these samples – in the case of **tcrg01**, a band of very narrow rings could not be satisfactorily resolved, even in comparison with the other series, though it was clear that the sequence was only a couple of years out in the latter stages, and therefore the sequence was edited to that part which could be resolved and cross-matched, and a close estimation of the remainder of the core in terms of rings and sapwood was made. In the case of **tcrg05**, a knot interrupted the sequence, but the outer rings and sapwood could again be approximately derived. Cross-matching was found between all the samples (Table 2) once these complications were taken into account. Although there were clearly two phases, the samples matched each other well enough to combine all the sequences into a single 261-year site chronology **TYCERRIG**, which was dated to the period 1373–1633, the strongest matches being shown in Table 3.

Figure 1 shows the relative positions of overlap of all the samples and the additional unmeasured ring, along with the actual or derived felling dates. The primary phase has timbers felled in winter 1500/01 and spring 1501, making construction most likely in **1501**, or within a year or two after this date. A single felling date represents the secondary phase, with the tree used being felled in **Spring 1634**, although the evidence from the other beam supports this dating.

ACKNOWLEDGEMENTS

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Table 1: Details of samples taken from Ty Cerrig, Llangower.

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
Primary phase									
§ **tcrg1**	Rear south-west cruck	1373-1476	1464	13 (+23C NM)	104	1.22	0.65	0.20	1499–1501
§ **tcrg2**	Front north-west cruck	1382-1465	1465	H/S	84	1.71	0.73	0.24	1476–1506
§ **tcrg3**	Lower purlin, bay 2 south	1436-1500	1476	24C	65	2.05	0.86	0.28	Winter 1500/01
§ **tcrg4**	Purlin on S side of east truss (re-used rail)	1411-1500	1486	14¼C	90	1.48	0.61	0.33	Spring 1501
Secondary phase									
§ **tcrg5**	Axial beam, east bay	1439-1555	-	~36C	117 (+65NM)	1.13	0.54	0.25	1620–40
§ **tcrg6**	Axial ovolo beam, west bay	1395-1633	1559	74 ¼ C	239	1.23	0.80	0.21	Spring 1634
§ = included in site master **TYCERRIG**		**1373-1633**			**261**	**1.16**	**0.65**	**0.19**	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; C = complete sapwood, felled the following winter; ¼C = complete sapwood, felled the following spring; ½ C = complete sapwood, felled the following summer; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured;

Table 2: Cross-matching between the samples (values over 3.5 are significant)

t-values					
Sample	**tcrg2**	**tcrg3**	**tcrg4**	**tcrg5**	**tcrg6**
tcrg1	3.5	5.9	5.0	*	6.0
tcrg2		*	2.0	*	6.0
tcrg3			5.3	5.3	5.3
tcrg4				3.2	6.3
tcrg5					6.9

* = overlap too short for meaningful calculation

Table 3: Dating evidence for the site master **TYCERRIG AD 1373–1633** against dated reference chronologies, regional chronologies in **bold**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Regional chronologies						
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	261	7.4
Individual site chronologies						
Montgomeryshire	St Idloes Church, Llanidloes	(Miles *et al* 2003)	LNYDLOS2	1384–1593	210	8.2
Denbighshire	Tyddyn Cynnar Llansilin	(Miles *et al* 2003)	TYDDYNC1	1348–1471	99	7.6
Radnorshire	Old Impton Norton	(Miles and Worthington 1998)	OLDIMTN1	1391–1471	81	7.6
Merioneth	Rhydywernen, Llanfor	(new ODL data, unpublished)	RHYDYWRN	1403-1530	128	7.4
Denbighshire	Branas-Uchaf, Llandrillo	(Miles *et al* 2010)	DENBY6	1388–1763	246	7.1
Caernarvonshire	Dylasau Isaf	(Miles *et al* 2011)	DYLASAU1	1412–1592	181	7.1
Radnorshire	Old Burfa, Evenjobb	(Miles and Worthington 1998)	OLDBRFA1	1347–1500	115	7.1
Montgomeryshire	Trefrechan barn	(Miles *et al* 2004)	TREFECHN	1423–1606	184	7.1
Shropshire	St Swithin's Church, Clunby	(Tyers 2000)	CLUNBY	1239–1494	122	6.9
Montgomeryshire	Blaen-y-cwm, Pennant Melangell	(Miles *et al* 2005)	BLNYCWM4	1406–1503	98	6.8
Denbighshire	Rose and Crown, Gwyddewern	(Miles and Worthington 2000)	GWYDWN	1411–1571	161	6.8
Cardiganshire	St Padarn's Church, Llanbadarn Fawr	(Miles *et al* 2011)	STPADRNS	1416–1489	74	6.8
Monmouthshire	St Woolos Cathedral, Newport	(Miles *et al* 2011)	WOOLOS2	1318–1482	110	6.7

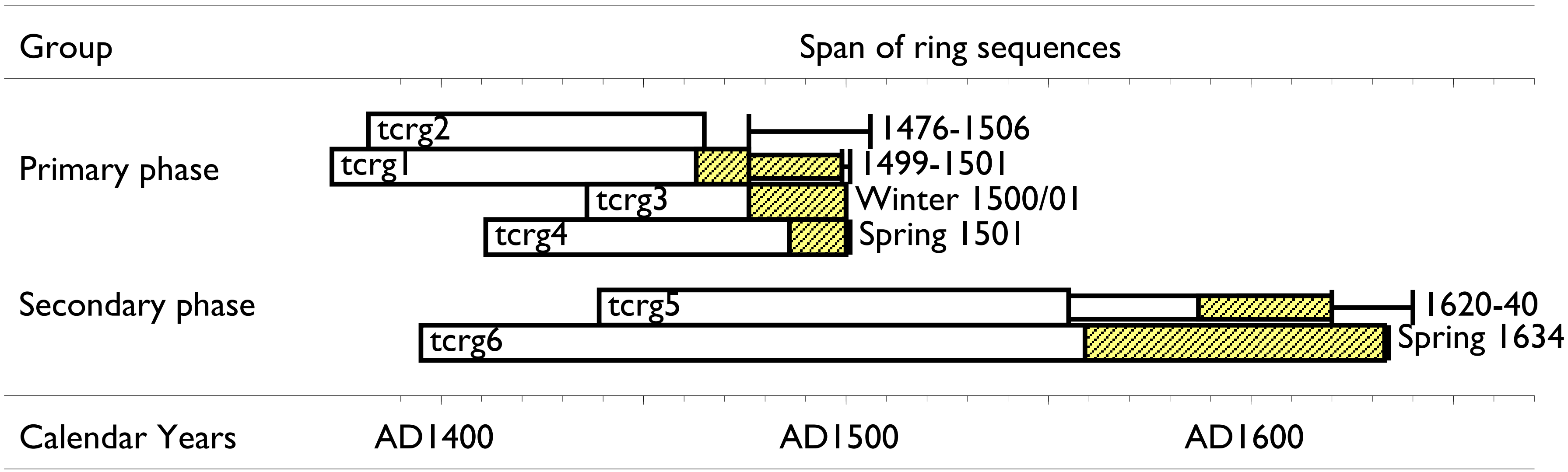

Figure 1: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely, or actual, felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings

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