Oxford Dendrochronology Laboratory
Report 2011/15

THE TREE-RING DATING OF DYLASAU UCHAF, BETWS-Y-COED CAERNARFONSHIRE (NGR SH 831 516)

Summary
The building appears to consist of two different phases, the north wing and the south wing. Only three timbers were sampled in the south wing, and one of these dated with an outer ring formed in 1551. This was thought likely to be the heartwood-sapwood boundary, making the likely felling date range 1562–92, but this is the only dated timber from the range, so any interpretation of this date has to be made with great caution. Five samples were taken from the north range. None of the series matched each other, nor did they date independently, a fact that is of no great surprise, given that most sequences showed bands of narrow rings that are atypical.

Author: Dr M. C. Bridge FSA
Oxford Dendrochronology Laboratory
Mill Farm
Mapledurham
Oxfordshire
RG4 7TX

May 2011

A report commissioned by The North West Wales Dendrochronology Project in partnership with The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

The Tree-Ring Dating of Dylasau Uchaf, Betws-y-Coed, Caernarfonshire (NGR SH 831 516)

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.

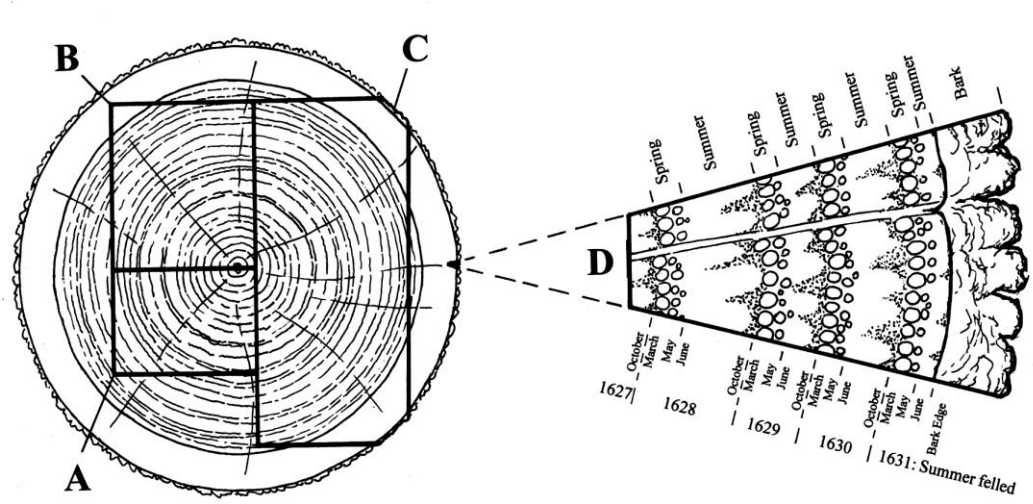
One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence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

DYLASAU UCHAF

Dulasau-uchaf is a multi-period farmhouse incorporating an early storeyed house as the south wing. This early house was of end-chimney two-unit (?Snowdonian) type with evidence for a post-and-panel partition under the (?re-set) beam between hall and outer bay. Latterly the wing may have had an end-chimney lobby-entry plan and possibly functioned in a unit-system arrangement. Plan in RCAHMW, *Caernarvonshire Inventory, Volume I: East* (1956), p. 175, fig. 172 (Mon. 624).

SAMPLING

Sampling took place in March 2011. 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 **dluc**. 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. Measurements and subsequent analysis were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

Details of the samples, and their locations, are given in Table 1. Three samples were taken from the south wing, but sample **03** broke up on coring and did not yield a sequence long enough to justify further analysis. The ring–width sequences from samples **01** and **02** did not match each other, but **dluc02** did date independently against dated reference material at a position where the outside ring was found to have been formed in 1551 (Table 2). This outer ring was noted at the time of sampling as probably representing the heartwood-sapwood boundary, though this was not certain. If so, this would make the likely felling date range for this timber 1562–92. Little can be deduced from a single timber, which may be a replacement, a re-used timber, or one that had been stockpiled prior to use.

The five samples from the north wing did not match each other. Sample **07** contained too few rings for further analysis. The others were compared individually with reference material, but failed to date. The ring width sequence from sample **dluc06** showed two unusual growth depressions in its early years, and so the file was edited to leave the outer 62 rings only, to see if this would date. Samples **dluc05** and **dluc08** also had bands of narrow rings, and these probably explain why none of the north wing sequences dated.

Table 1: Details of samples taken from Dylasau Uchaf, Betws-y-Coed.

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
South Wing									
dluc01	East principle rafter	undated	-	H/S	68	1.80	0.50	0.21	-
dluc02	West principle rafter	1450-1551	?1551	?H/S	102	2.56	0.68	0.21	?1562–92
dluc03	Purlin in SE corner	undated	-	-	<40	NM	-	-	-
North Wing									
dluc04	Low collar on middle truss	undated	-	3	52	1.75	0.76	0.31	-
dluc05	East principal rafter on south truss	undated	-	5	70	1.38	0.75	0.28	-
dluc06	West principal rafter on south truss	undated	-	19½C	112	1.33	0.55	0.17	-
dluc07	East purlin	undated	-	H/S	<40	NM	-	-	-
dluc08	East principle rafter on middle truss	undated	-	16C	70	1.45	0.81	0.23	-

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

Table 2: Dating evidence for the site sequence **dluc02** **AD 1450–1551** against dated reference chronologies, regional chronologies in **bold**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales	Rose and Crown, Gwydwn	(Miles and Worthington 2000)	GWYDWN	1411-1571	102	7.7
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404-1981	102	7.3
Shropshire	Porch House, Bishops Castle	(Miles and Worthington 2000)	PORCHBC	1416-1564	102	7.3
Wales	Ty Mawr, Druid, Corwen	(Miles *et al* 2010)	DENBY1	1440-1583	102	7.2
Lancashire	Worden Old Hall, Chorley	(Bridge 2003)	OLDWORD2	1415-1531	82	6.9
Northern England	Northern England Master	(Hillam and Groves 1994)	**NORTH**	440-1742	102	6.8
Warwickshire	Baddesley Clinton	(Miles and Worthington 2002)	BADESLY3	1423-1577	102	6.8
Wales	Branas-Uchaf, Llandrillo	(Miles *et al* 2010)	DENBY6	1388-1763	102	6.6
Wales	Ucheldref Rhug, Corwen	(Miles *et al* 2010)	DENBY4	1373-1597	102	6.6
Herefordshire	Broad Street, Leominster	(Miles 2001)	LEOMSTR2	1349-1499	50	6.3
Shropshire	Boscobel House, nr Brewood	(Tyers 2010)	BOSCOBL2	1367-1595	102	6.3
Wales	Plas y Dduallt, Maentwrog	(Miles *et al* 2011)	GWYNEDD5	1355-1604	102	6.2

ACKNOWLEDGEMENTS

We would like to thank the owners – Mr and Mrs G Roberts – for allowing sampling to take place.

This study was part of the North-West Wales Dendrochronology Project, co-ordinated by Margaret Dunn, with support by the Royal Commission on Ancient and Historic Monuments of Wales – with thanks to Richard Suggett.

REFERENCES

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. (2003) *Tree-ring analysis of timbers from Worden Old Hall, Euxton Lane, Chorley, Lancashire*, **Centre for Archaeology Rep**, 47/2003.

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

Hillam, J. and Groves, C. (1994) Compilation of master chronologies from the North, unpublished computer file NORTH, Sheffield Dendrochronology Laboratory.

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

Miles, D. H. (1997b) Working compilation of 58 reference chronologies centred around Wales by various researchers, unpublished computer file WALES97, Oxford Dendrochronology Laboratory.

Miles, D. W. H. (2001) *The Tree-Ring Dating of the Galleried Building and 'Dairy', 40 Broad Street, Leominster, Herefordshire*, **Centre for Archaeology Rep**, 38/2001.

Miles, D. H. and Worthington, M. J. (2000) Tree-ring dates, **Vernacular Architecture**, 31, 90-113.

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

Miles, D. H., Worthington, M. J., Bridge, M. C., Suggett, R. and Dunn, M. (2010) Tree-ring dates, **Vernacular Architecture**, 41, 110-118.

Miles, D. H., Bridge, M. C., Suggett, R. and Dunn, M. (2011) Tree-ring dates, **Vernacular Architecture**, 42, (in prep).

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

Tyers, I. (2010) *Boscobel House, near Brewood, Shropshire, Dendrochronological analysis of oak timbers*, **EH Research Dept Rep Ser,** 12-2010.