# Darganfod Hen Dai Cymreig
# Discovering Old Welsh Houses

Reports: Welcome to the many Discovering Old Welsh Houses Reports which are available here on our website. All the reports - House Histories, Building Reports and Tree-ring Dating reports - can be accessed - *here*

Discovering Old Welsh Houses studies and celebrates the traditional houses of North Wales and the lives of the people who lived in them.



If you find the content useful, please consider becoming a *Member* to access the many benefits available.

Please note that these reports are being updated as part of an ongoing programme of revision. Older reports sometimes refer to the old names of the Group. Between 2005 and 2012 also known as The Snowdonia Dendrochronology Project, then the N W Wales Dendrochronology Project and then the Dating Old Welsh Houses Group.

New reports will be added from time to time. Keep an eye on our website for updates.

DYDDIO HEN DAI CYMREIG | DATING OLD WELSH HOUSES

PROSIECT DENDROCRONOLEG GOGLEDD ORLLEWIN CYMRU | NORTH WEST WALES DENDROCHRONOLOGY PROJECT

Oxford Dendrochronology Laboratory
Report 2011/01

# THE TREE-RING DATING OF TY CERRIG, LLANFWROG, DENBIGHSHIRE (NGR SJ 114 576)


## Summary

Three purlins and four crucks were sampled. Two of the purlins were considered to have come from the same parent tree. The new series formed from these two purlins cross-matched the third purlin and two crucks, forming a 97-year site chronology dated to the years 1404–1500. The earliest part of this sequence was represented by a single tree with a narrow band of rings, and editing out the first 16 rings to form an 81-year site chronology greatly improved the level of cross-matching with the reference material. Three of the dated timbers retained complete sapwood. One cruck was found to have been felled in the spring of 1500, whilst a front lower purlin was felled in the spring of the following year, 1501. The front upper purlin dated to the winter of 1500/01, and as the rear upper purlin from the same bay was found to have originated from the same parent tree, then it has been possible to ascribe the same felling date to this timber as well. Another cruck had no sapwood surviving, but a felling date range of 1483-1513, which is entirely consistent with the 1500 and 1501 felling dates. This clustering of dated would suggest that Ty Cerrig was most likely constructed during **1501**.



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


February 2011

**The Tree-Ring Dating of Ty Cerrig, Llanfwrog, Denbighshire**
**(NGR SJ 114 576)**

## 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.

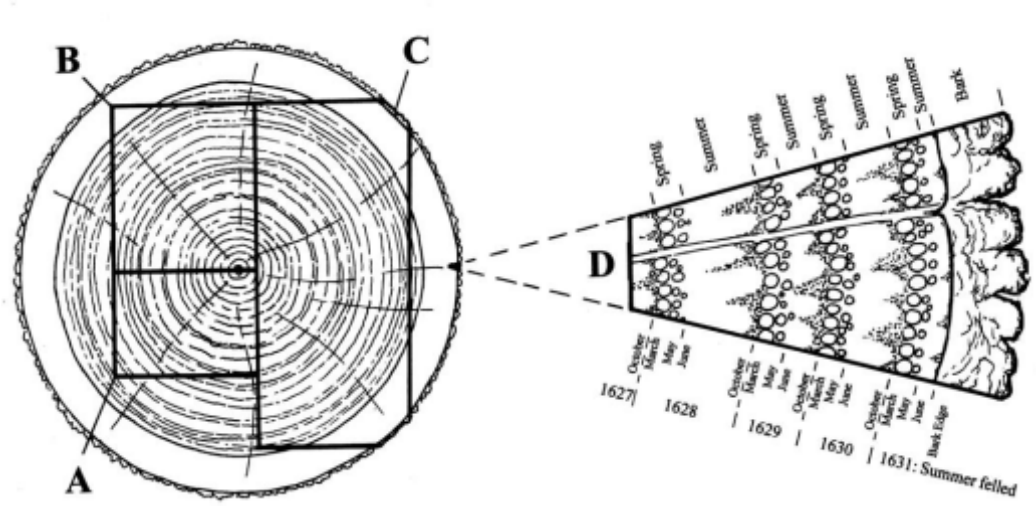
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

## TY CERRIG, LLANFWROG

**********

## SAMPLING

Sampling took place in January 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 **denh**. 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

Basic information about the samples and their origins are shown in Table 1.

Seven timbers were sampled which included three purlins and four crucks. Two of the purlins, **denh1** and **denh2**, were found to match together sufficiently well ($t$=10.7 with 73 ring overlap) to be considered to have originated from the same tree, and were therefore combined to form the same-tree mean **denh12**. Other matches are shown in Table 2.

This mean was then compared with the other samples from the site and was found to match another purlin (**denh3**), and two crucks (**denh4** and **denh5**). These were then combined to form the 97-ring site master **DENBY7x**. This was then compared with the reference chronologies and was found to match, spanning the years 1404–1500. The early years of this chronology were represented by a single tree with a narrow band of rings at the start of the sequence. Removing the first 16 rings, reducing the site master (**DENBY7**) to the years 1420–1500, significantly increases the cross-matching with reference material (Table 3b).

Three of the dated timbers retained complete sapwood. The rear cruck to Truss 1 (**denh4**) was found to have been felled in the spring of 1500, whilst the front lower purlin in bay 1 (**denh3**) was felled in the spring of the following year, 1501. The front upper purlin (**denh2**) dated to the winter of 1500/1501, and as the rear upper purlin (**denh1**) from the same bay was found to have originated from the same parent tree, then it has been possible to ascribe the same felling date to this timber as well. The front cruck to Truss 2 (**denh5**) did not have sapwood surviving, but a felling date range of 1483-1513 is entirely consistent with the 1500 and 1501 felling dates. This clustering of dated would suggest that Ty Cerrig was most likely constructed during 1501. The relative cross-matching and interpreted felling dates are shown in Figure 1.

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

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| **denh1** | Rear (west) upper purlin, bay 1-2 | 1427-1499 | 1479 | 20 | 73 | 1.21 | 0.75 | 0.19 | (winter 1500/01) |
| **denh2** | Front (east) upper purlin, bay 1-2 | 1427-1500 | 1485 | 15C | 74 | 1.76 | 1.00 | 0.21 | Winter 1500/01 |
| * **denh3** | Front (east) lower purlin, bay 1-2 | 1462-1500 | 1494 | 6¼C | 39 | 2.97 | 1.04 | 0.26 | Spring 1501 |
| * **denh4** | Rear (west) cruck T1 | 1426-1499 | 1475 | 24¼C | 74 | 2.31 | 1.09 | 0.24 | Spring 1500 |
| * **denh5** | Front (east) cruck T2 | 1404-1472 | 1472 | H/S | 69 | 2.13 | 1.09 | 0.28 | 1483–1513 |
| **denh6** | Front (east) cruck T2 | undated | - | 23C | 74 | 2.59 | 1.36 | 0.28 | unknown |
| **denh7** | Front (east) cruck T3 | undated | - | 16¼C | 41 | 2.30 | 0.97 | 0.29 | unknown |
| * **denh12** | Same tree mean **denh1** + **denh2** | 1427-1500 | 1482 | 18C | 74 | 1.49 | 0.85 | 0.20 | Winter 1500/01 |
| * = included in Site Master **DENBY7x** | | **1404–1500** | | | **97** | **2.08** | **0.96** | **0.24** | |

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

**Table 2:** Cross-matching between dated samples (**denh1** *v* **denh2**, *t* = 10.7 with 73 years overlap)

| | ***t*-values** | | |
|---|---|---|---|
| **Series** | **denh3** | **denh4** | **denh5** |
| **denh12** | 4.3 | 6.5 | 4.4 |
| **denh3** | | 3.4 | 1.9 |
| **denh4** | | | 7.0 |

**Table 3a:** Dating evidence for the site master **DENBY7x AD 1404–1500** against dated reference chronologies, regional chronologies in **bold**

| *County or region:* | *Chronology name:* | *Short publication reference:* | *File name:* | *Spanning:* | *Overlap (yrs):* | *t-value:* |
|---|---|---|---|---|---|---|
| Shropshire | Church Farm, Ditton Priors | (Miles *et al* 2004) | DITTON5 | 1437-1578 | 64 | 7.4 |
| Wales | Llwyn Llandrinio Montgomeryshire | (Miles *et al* 2003) | LLWYN | 1413-1551 | 88 | 6.8 |
| Wales | George and Dragon, Beaumaris | (Miles *et al* 2010) | ANGLSY1 | 1437-1540 | 64 | 6.4 |
| Wales | Neuadd Cynhinfa Pontrobert | (Miles and Haddon-Reece 1996) | neu1 | 1438-1506 | 63 | 6.3 |
| Wales | Lower Cill, Berriew, Montgomeryshire | (Miles *et al* 2006) | BERRIEW | 1428-1583 | 73 | 5.7 |
| Wales | Rose and Crown, Gwydwn | (Miles and Worthington 2000) | GWYDWN | 1411-1571 | 90 | 5.6 |
| Shropshire | Dutch Cottage, Clunbury | (Miles *et al* 2006) | DUTCHCOT | 1424-1549 | 77 | 5.6 |
| Shropshire | Abcott Manor, Clungunford | (Miles and Worthington 2002) | CGFA | 1422-1545 | 79 | 5.5 |
| Wales | Old Market Hall, Llanidloes | (Miles *et al* 2003) | LNYDLOS1 | 1424-1589 | 77 | 5.5 |
| Somerset | The Knapp, Tivington | (Miles *et al* 2004) | THEKNAPP | 1445-1508 | 56 | 5.4 |
| Wales | Nannerth-Ganol Rhayader | (Miles and Haddon-Reece 1996) | nan2 | 1454-1554 | 47 | 5.3 |
| Wales | Ffinnant, Llansantffraid-ym-Machain | (Miles *et al* 2010) | FFINNANT | 1437-1609 | 64 | 5.3 |
| Herefordshire | Forbury Chapel, Leominster | (Arnold, Laxton and Litton 2003) | HFCASQ01 | 1432-1520 | 69 | 5.1 |
| Wales | Trefrechan barn | (Miles *et al* 2004) | TREFECHN | 1423-1606 | 78 | 5.1 |

**Table 3b:** Dating evidence for the site master **DENBY7 AD 1420–1500** against dated reference chronologies, regional chronologies in **bold**

| *County or region:* | *Chronology name:* | *Short publication reference:* | *File name:* | *Spanning:* | *Overlap (yrs):* | *t-value:* |
|---|---|---|---|---|---|---|
| Shropshire | Church Farm, Ditton Priors | (Miles *et al* 2004) | DITTON5 | 1437-1578 | 64 | 7.7 |
| Wales | Llwyn Llandrinio Montgomeryshire | (Miles *et al* 2003) | LLWYN | 1413-1551 | 81 | 7.2 |
| Wales | Rose and Crown, Gwydwn | (Miles and Worthington 2000) | GWYDWN | 1411-1571 | 81 | 6.9 |
| Wales | Welsh Master Chronology | (Miles 1997) | **WALES97** | 404-1981 | 81 | 6.6 |
| Wales | George and Dragon, Beaumaris | (Miles *et al* 2010) | ANGLSY1 | 1437-1540 | 64 | 6.5 |
| Wales | Plas Mawr House | (Miles and Haddon-Reece 1996) | PLASMWR2 | 1360-1578 | 81 | 6.5 |
| Wales | Neuadd Cynhinfa Pontrobert | (Miles and Haddon-Reece 1996) | neu1 | 1438-1506 | 63 | 6.5 |
| Wales | Ucheldref Rhug, Corwen | (Miles *et al* 2010) | DENBY4 | 1373-1597 | 81 | 6.4 |
| Shropshire | Chapel Cottage, Ditton Priors | (Miles *et al* 2004) | DITTON2 | 1404-1544 | 81 | 6.3 |
| Wales | Branas-Uchaf, Llandrillo | (Miles *et al* 2010) | DENBY6 | 1388-1763 | 81 | 6.2 |

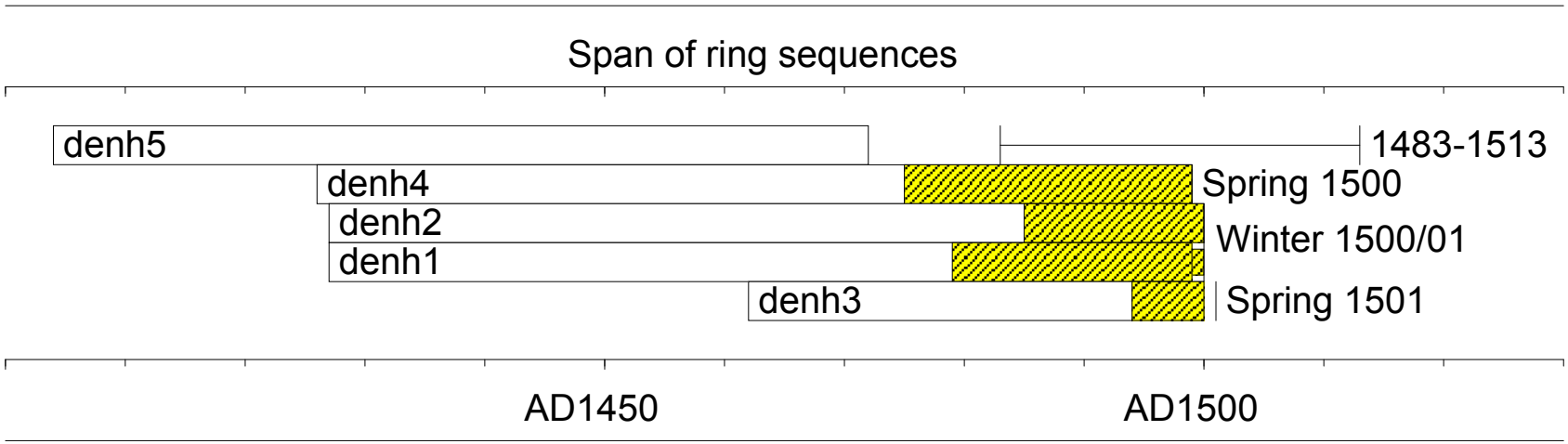



**Figure 1:** Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings

## ACKNOWLEDGEMENTS

The dating was commissioned by Margaret Dunn of the North-West Wales Dendrochronology Project. We are grateful to the owners Dr and Mrs Lyne for allowing access to their house, and to Richard Suggett from the Welsh Royal Commission who assisted in the interpretation on site and provided useful background material. Matt Hurford assisted on site during the sampling.

## REFERENCES

Arnold, A. J., Laxton, R. R., and Litton, C. D. (2003) *Tree-ring analysis of timbers from Forbury Chapel, Church Street, Leominster, Herefordshire*, **Centre for Archaeology Report**, 18/2003.

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.

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

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. H. and Haddon-Reece, D. (1996) List 72 - Tree-ring dates, **Vernacular Architecture**, 27, 97-102.

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. and Bridge, M. C. (2003) Tree-ring dates, **Vernacular Architecture**, 34, 109-113.

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. (2006) Tree-ring dates, **Vernacular Architecture**, 37, 118-132.

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

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