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DYDDIO HEN DAI CYMREIG | DATING OLD WELSH HOUSES

PROSIECT DENDROCRONOLEG GOGLEDD ORLLEWIN CYMRU | NORTH WEST WALES DENDROCHRONOLOGY PROJECT

Oxford Dendrochronology Laboratory
Report 2010/57

THE TREE-RING DATING OF 10 CASTLE STREET, (Olde Bull's Head) BEAUMARIS, ANGLESEY (NGR SH 604 759)

Summary

Five *ex situ* timbers from a demolished section of the Townhouse, now part of the Olde Bull's Head were analysed. Four of the samples were dated, though the long series obtained did not match each other well, and they were dated independently. All appear to have been felled at around the same time. One timber retained complete sapwood, but degradation of the sapwood meant that not all its rings could be measured – and its felling date range was derived as **1614-16**. One other timber had a last measured ring date of 1615 with what appeared to be complete sapwood, meaning that felling could be no earlier than 1616. Two other timbers, one with sapwood, produced felling date ranges that are consistent with this date. It seems likely therefore that construction of this range took place in or shortly after 1616.

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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 1997a).

10 CASTLE STREET (notes by David Longley)

No. 10 Castle Street, Beaumaris, comprises two important town houses which have retained sufficient historic character to enable an interpretation of the development of the site from the later sixteenth century to the present day. The principal areas of interest in these houses focus on the sixteenth and seventeenth centuries. The property comprised several component parts, extending over 340 sq m of residential and commercial buildings and, in addition, an area of yard space and single storey outbuildings. The infilling of passageways, entries and roofed staircases have masked the distinction between what was two free standing houses.

The main building, House 1, with a long frontage on Castle Street, and a gable end on Rating Row, rises on two storeys and an attic, extending 18m west to east and 7m north to south.

House 2 is parallel with House 1, 5.8m to the north. It is 15m long, west-east, and 6.9m wide, north-south. It too, has two storeys and an attic rising to its roof ridge at 8.2m, 1.8m lower than the 10m of House 1.

House 1 roof trusses

There are four collar-beam trusses in the attic space which support the roof. These trusses span a width of 5.8m. The collars are pegged to the principals at 2.1m above the floor boards. Two raking struts rise from the collar to the principals, single pegged. The base of the principals sit on the wall-plates of the attic walls, 1m above the attic beams. The apex of each truss is at 4.4m above the boards. Carpenters marks are visible on each of the four trusses. It is possible, but not certain, that the attic walls and the roof were raised at around 1600.

House 2 trusses

There are four trusses in the attic space. The first three attic collar-beam trusses stand directly on transverse beams (used as tie beams in contrast to the trusses in House 1) with the exception of the fourth (easternmost) truss which is, or was, fixed against the eastern gable. These trusses employ a later style of collar-beam in which the collars are set against the faces of the principal rafters in half dove-tail rebates. These particular trusses have the collars set very high which maximises the available roof space in the attic.

SAMPLING

Five *ex situ* timbers were supplied by David Longley (Gwynedd Archaeological Trust) in October 2010. No plans were available for their original location within the building, which was thought to consist of two detached ranges, one behind the other, of different ages. One of the ranges was assessed in January 2010 and at least one truss was still *in situ* from which samples with good dating potential could be taken, should it not be possible to reconcile these results. All the samples were of oak (*Quercus* spp.). They were numbered using the prefix **angg.** The samples were removed for further preparation and analysis. Radial sections were cut from the timbers and then these were polished using progressively finer grits down to 1000 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).

Fig 1a: Timber **angg01** showing location of sample slice with II chiselled carpenters' mark

Fig 1b: Timber **angg02** showing location of sample slice with III chiselled carpenters' mark

Fig 1c: Timber **angg03** showing location of sample slice

Fig 1d: Timber **angg04** showing location of sample slice

Fig 1e: Timber **angg05** showing location of sample slice with IIII chiselled carpenters' mark

RESULTS AND DISCUSSION

Details of the samples are given in Table 1, with the timbers themselves being illustrated in Figs 1 a-e. All the samples were oak (*Quercus* spp.). The series were generally longer than usually experienced, although they each contained some quite narrow rings, needing additional sanding to distinguish clearly individual rings in some parts of the sequence. Surprisingly, with the exception of samples **01** and **04**, the series did not match each other well (Table 2). They were therefore dated individually against dated reference material, with the strongest matches being shown in Tables 3 a-d. No satisfactory cross-matching was found for series **angg05**. Given the closeness in age, it was decided to create a single site chronology from the four dated timbers, though the lack of internal cross-matching would normally preclude this. The relative positions of overlap of the timbers and their felling dates/date ranges are illustrated in Figure 2. The resulting 246-year long chronology did however give stronger matches against the reference material than the individual series (Table 3e) and is likely to be a useful chronology for dating other sites in the region. A map of the distribution of *t*-values in excess of *t*=4.0 is shown in Fig 3.

One timber (**03**) retained complete sapwood, but the outer part was significantly degraded and the complete series could not be measured with certainty. It was possible to determine that an additional unmeasured 18-20 rings were present, allowing a felling date range of 1614–16 to be determined. It was not certain that the sapwood on sample **01** was complete, although this appeared to be complete on the timber. Given the similar felling date ranges for the timbers, it seems likely that the construction date of the now demolished range was in 1616 or within a few years afterwards.

ACKNOWLEDGEMENTS

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We would also thank our fellow dendrochronologists for permission to use their data.

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Table 1: Details of samples taken from 10 Castle Street, Beaumaris, Anglesey.

Sample number	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens	Felling seasons and dates/date ranges (AD)
* **angg01**	*ex situ timber*	1386-1615	1594	21C?	230	0.77	0.42	0.24	*c.* 1616
* **angg02**	*ex situ timber*	1418-1548	-	-	131	1.07	0.32	0.21	after 1559
* **angg03**	*ex situ timber*	1427-1596	1576	20 (+18-20NM)	170	1.20	0.40	0.17	1614–16
* **angg04**	*ex situ timber*	1370-1598	1598	H/S	229	0.73	0.30	0.19	1609–1639
angg05	*ex situ timber*	undated	-	H/S?	85	1.32	0.57	0.23	unknown
* = included in Site Master **ANGG**		**1370-1615**			**246**	**0.94**	**0.28**	**0.16**	

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

Table 2: Cross-matching between the dated series from 10 Castle Street, Beaumaris

	***t*-values**		
Sample	**angg02**	**angg03**	**angg04**
angg01	2.6	1.6	6.3
angg02		2.1	1.8
angg03			1.6

Table 3a. Dating evidence for series **angg01,** AD 1386–1615 against regional (**bold**) individual site chronologies

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Ireland	Dublin Medieval Chronology	(Baillie 1977)	**DUBLIN2**	1357-1556	171	7.2
Cornwall	St Martin's Church, East Looe	(Arnold *et al* 2006)	LOOASQ01	1363-1518	133	6.0
Wales	Gwernfyda Llanllugan	(Miles and Haddon-Reece 1996)	GWRNFYDA	1410-1551	142	6.0
Dorset	Forde Abbey	(Miles 1998)	FRDABBY2	1386-1485	100	5.5
Shropshire	Wolverton Manor	(Miles and Haddon-Reece 1993)	WOLVERTN	1325-1580	195	5.3
Anglesey	Hafoty Llansadwen	(Hillam and Groves 1991)	HAFOTY1	1372-1499	114	5.3

Table 3b. Dating evidence for series **angg02,** AD 1418–1548 against regional (**bold**) individual site chronologies

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales	Lower Cill, Berriew, Mons.	(Miles *et al* 2006)	BERRIEW	1428-1583	121	6.1
Manchester	Stayley Hall	(Nayling 2000a)	STAY20	1387-1565	131	5.9
Hampshire	Wheelers, Odiham	(Miles and Worthington 2002)	WHEELERS	1384-1492	75	5.6
Wales	Welsh Master Chronology	(Miles 1997)	**WALES97**	404-1981	131	5.5
Wales	48 Castle Street, Beaumaris	(Miles and Bridge 2010)	ANGLSY4	1468-1618	81	5.4
Wales	St Idloes Church, Llanidloes	(Miles et al 2003)	LNYDLOS2	1384-1593	131	5.3

Table 3c. Dating evidence for series **angg03,** AD 1427–1596 against regional (**bold**) individual site chronologies

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Devon	Exeter Master Chronology	(Mills 1988)	**EXMED**	1367-1616	170	5.2
Shropshire	Stokesay Castle	(Miles and Worthington 1997)	STOKE4	1449-1640	148	5.1
Herefordshire	Pikes Farm, Michaelchurch, Escley	(Miles *et al* 2006)	MLCHRCH2	1342-1590	164	5.0
Wales	Vaynol Old Hall	(Miles and Bridge 2010)	GWYNEDD2	1448-1628	149	5.0
Wales	Parc Llanfrothen	(Miles *et al* 2006)	BDGLRT22	1386-1669	170	4.9
Wales	Gronant Llanfachraeth, Holyhead	(Miles and Bridge 2010)	ANGLSY2	1405-1589	163	4.8

Table 3d. Dating evidence for series **angg04,** AD 1370–1598 against regional (**bold**) individual site chronologies

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Shropshire	Coats Farm	(Miles and Haddon-Reece 1996)	COATSFM	1346-1485	116	6.1
Herefordshire	Pound Farm, Kington	(Nayling 2002)	POUNDT7	1316-1441	72	5.9
Shropshire	Upper Millichope	(Miles and Haddon-Reece 1995)	FORESTR1	1352-1450	81	5.7
Wales	Old Burfa, Evenjobb, Radnorshire	(Miles and Worthington 1998)	OLDBRFA1	1347-1500	118	5.6
Devon	Hole Farm, Hockworthy	(Miles *et al* 2004)	HOLEFARM	1306-1468	99	5.6
Wales	Old Impton Norton	(Miles and Worthington 1998)	OLDIMTN1	1391-1471	81	5.5

Table 3e. Dating evidence for site master **ANGG,** AD 1370–1615 against regional (**bold**) individual site chronologies

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Ireland	Dublin Medieval Chronology	(Baillie 1977)	**DUBLIN2**	1357-1556	187	9.0
Wales	Gwernfyda Llanllugan	(Miles and Haddon-Reece 1996)	GWRNFYDA	1410-1551	142	7.9
Wales	Royal House, Machynlleth	(Miles *et al* 2004)	ROYALHS1	1363-1560	191	7.4
Wales	Old Burfa, Evenjobb, Radnorshire	(Miles and Worthington 1998)	OLDBRFA1	1347-1500	118	6.8
Herefordshire	White House, Vowchurch	(Nayling 2000b)	WVT9	1364-1602	233	6.6
Shropshire	Lower Spoad Farm, Clun	(Miles and Bridge 2011)	LWRSPDFM	1349-1495	126	6.5
Shropshire	Wolverton Manor	(Miles and Haddon-Reece 1993)	WOLVERTN	1325-1580	211	6.4
Wales	White Hall, Presteigne	(Miles and Worthington 1999)	WHITEHLL	1352-1462	93	6.5
Shropshire	Rowton Grange, Clungunford	(Miles and Worthington 2002)	CGFE	1407-1597	191	6.4
Wales	St Idloes Church, Llanidloes	(Miles et al 2003)	LNYDLOS2	1384-1593	210	6.4

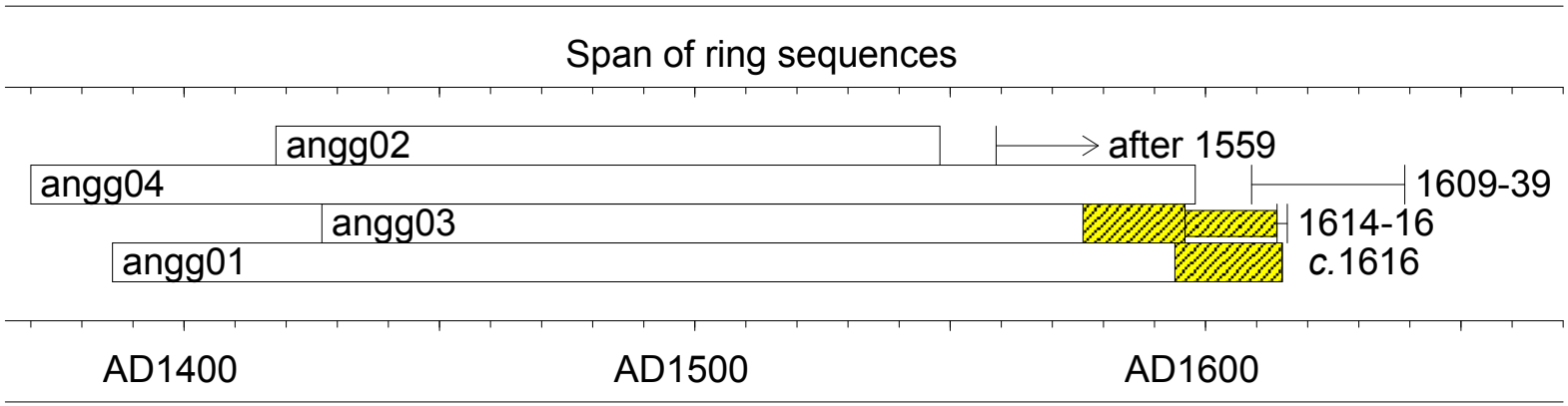

Figure 2: Bar diagram showing the relative positions of overlap of the dated timbers from 10 Castle Street, Beaumaris, along with their interpreted felling dates/date ranges. Yellow hatched sections represent sapwood rings.

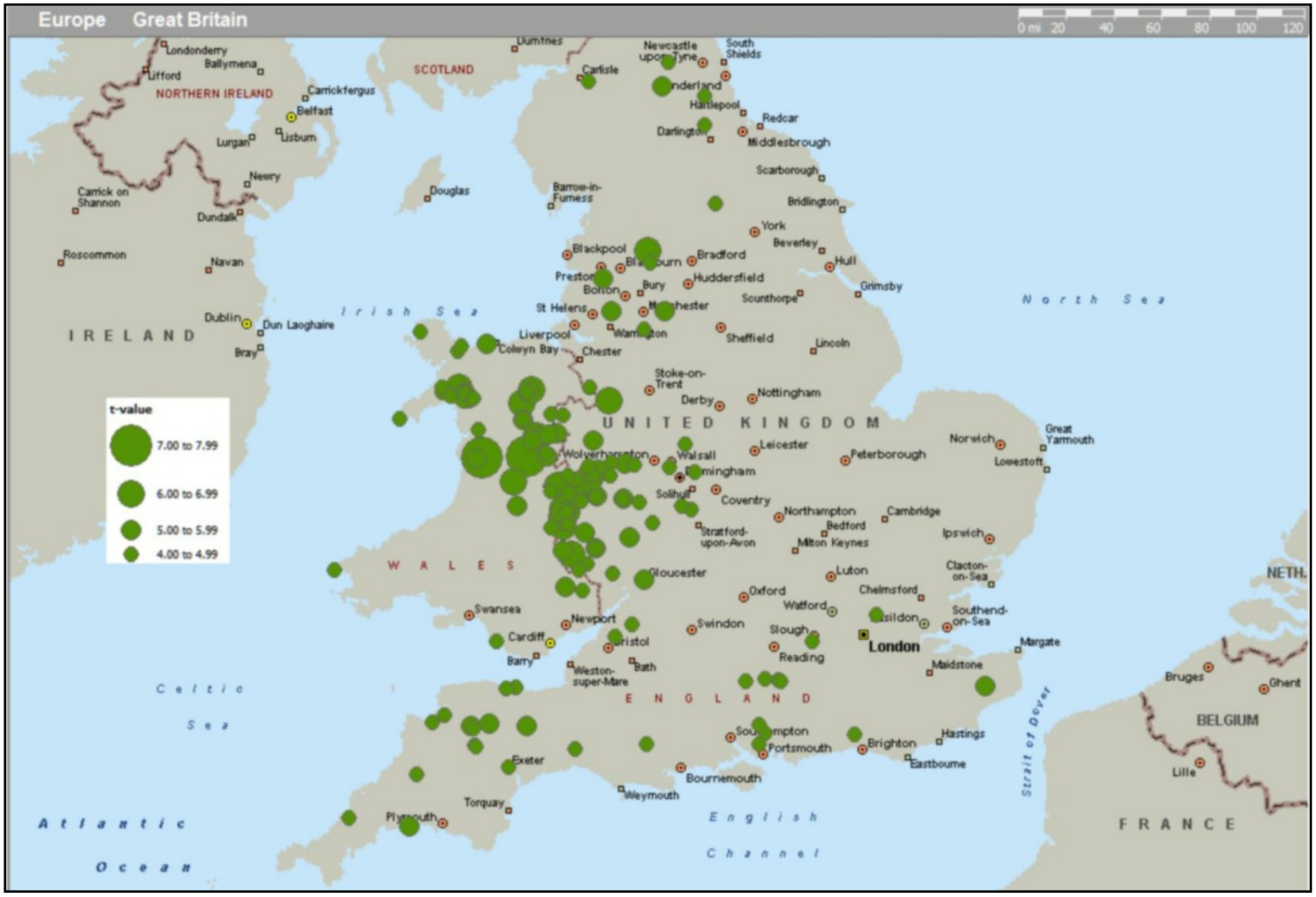

Fig 3: Map of the distribution of *t*-values for the site chronology **ANGG** against independent dated reference sites

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