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Oxford Dendrochronology Laboratory
Report 2011/3

THE TREE-RING DATING OF DYFFRYN MYMBYR, CAPEL CURIG, LLANDEGAI, CONWY (NGR SH 695 573)

Summary
Seven of the ten timbers sampled were dated. Two timbers retained complete sapwood, but this became detached on coring, with the possible result of losing some rings. The felling date ranges for these two timbers are therefore given as 1553–55, and the other timbers have likely felling date ranges that would seem to be in agreement with these, making the most likely date of construction of this house **1553–55**.

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February 2011

The Tree-Ring Dating of Dyfryn Mymbyr, Capel Curig, Llandegai.
(NGR SH 695 573)

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 endrochronologists use series longer than at least fifty years.

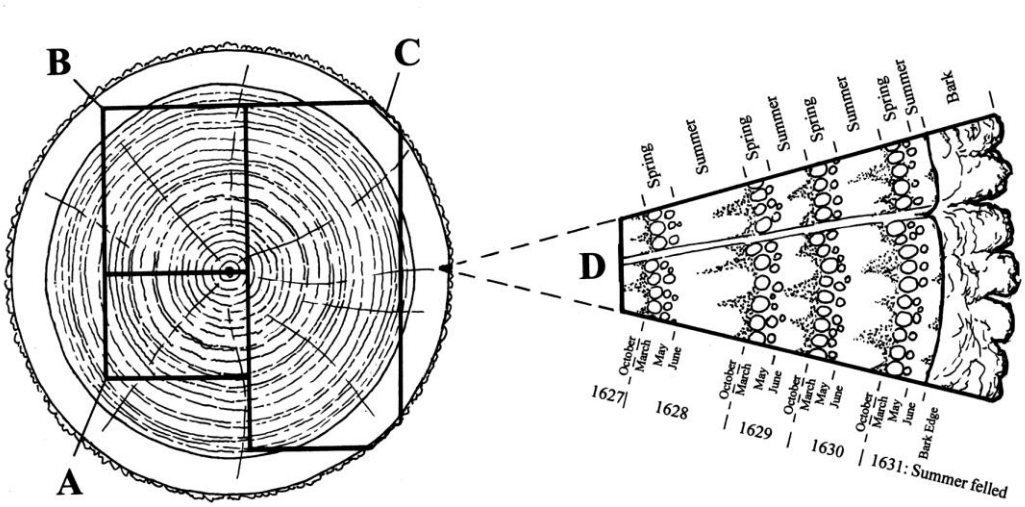
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

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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 **bcdm**. 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. Approximate locations of the samples are shown in Figure 1. Two samples, **04** and **05**, from the principal rafters to the west truss, did not contain enough rings for further analysis. A sample was taken from the screen forming the west wall to the east bedroom (Fig 2). This screen is thought to have been moved from the ground floor. This sample did not match the others, and was not dated conclusively. The cross-matching between the remaining samples is shown in Table 2. Some sequences matched well with each other, but many gave rather poor matches, perhaps indicating that the timbers came from several sources.

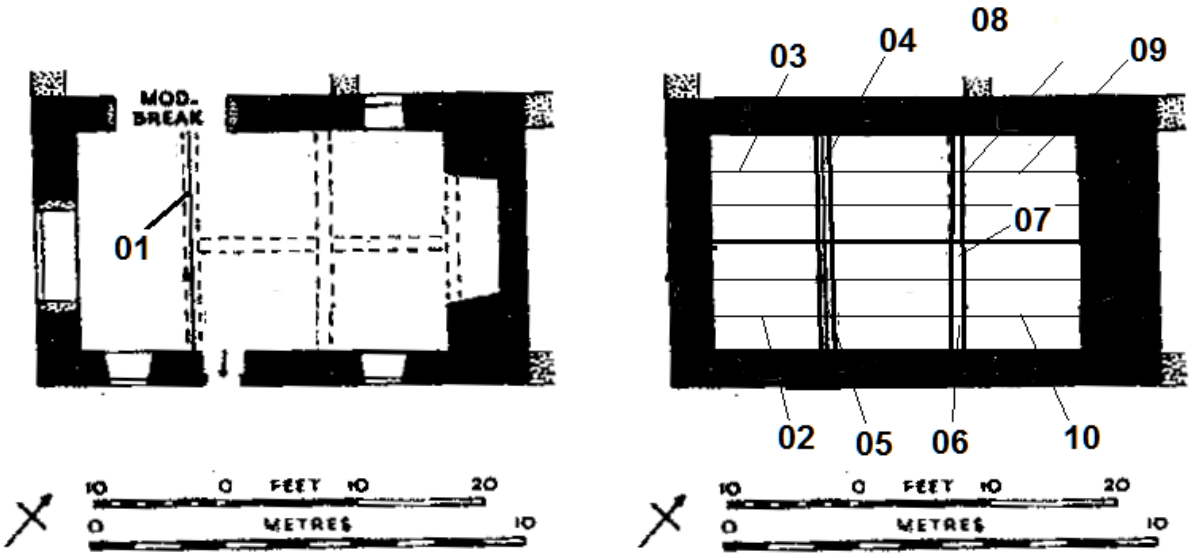

Figure 1: Locations of the samples taken for dendrochronology (ground floor left, first floor right) based on a plan in the RCAHMW Caernafonshire Inventory Vol I (1957).

The seven dated sequences were combined into a 149-year site chronology (**DYFMYM**), which was subsequently dated to the period 1383–1531, the strongest matches being shown in Table 3. All the samples retained at least the heartwood-sapwood boundary, but the sapwood partially disintegrated, or become detached on several samples. Samples **01** and **07**, a ceiling beam and a collar, had complete sapwood on the timbers, but in both cases this became detached, and it is possible that one or two rings were lost. This enables an estimate of the felling date to be made to within a few years, at 1553–55. The other samples have likely felling date ranges that show that they are likely to have all been felled at the same time. The most likely date of construction of this property is therefore **1553–55**.

Figure 2: Plank and muntin panel on the first floor, thought to have been moved from the ground floor, with an inserted ogee doorhead.

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Table 1: Details of samples taken from Dyfryn Mymbyr, Llandegai .

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
* **bcdm01**	Ground floor, west ceiling beam	1436-1526	1511	15+26NM	91	1.54	1.10	0.22	*c*1553-55
bcdm02a	West bedroom, lower S purlin	*1427-1516*	*1516*	*H/S+25NM*	*90*	*1.06*	*1.01*	*0.26*	
bcdm02b	*ditto*	*1460-1525*	*1518*	*7+19NM*	*66*	*0.67*	*0.23*	*0.24*	
* **bcdm02**	Mean of **bcdm02a** and **bcdm02b**	1427-1525	1517	8+19NM	99	1.04	0.96	0.22	1544–58
* **bcdm03**	West bedroom, lower N purlin	1422-1523	1520	3+18NM	102	1.20	0.78	0.25	1541–61
bcdm04	West truss, N principal rafter	undated	-	-	<40	NM	-	-	unknown
bcdm05	West truss, S principal rafter	undated	-	-	<40	NM	-	-	unknown
bcdm06	East truss, S principal rafter	1383-1521	1521	H/S	139	1.58	0.74	0.22	1532–62
* **bcdm07**	East truss, collar	1461-1522	1522	H/S+31NM	62	2.06	0.72	0.20	*c*1553-55
bcdm08	Plank in first floor screen	undated	-	14	60	1.56	0.62	0.25	unknown
* **bcdm09**	East bay, N lower purlin	1448-1513	*c*1518	-	66+5NM	1.05	0.57	0.20	*c*1529–62
* **bcdm10**	East bay, S lower purlin	1438-1531	1524	7+2NM	94	1.06	0.41	0.23	1535–65
* = included in site master **DYFMYM**		**1383-1531**			**149**	**1.62**	**0.81**	**0.17**	

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

	***t*-values**					
Sample	**bcdm02**	**bcdm03**	**bcdm06**	**bcdm07**	**bcdm09**	**bcdm10**
bcdm01	3.3	2.7	6.0	2.8	0.9	3.4
bcdm02		3.3	3.3	2.2	4.3	7.5
bcdm03			2.9	2.7	2.3	5.0
bcdm06				5.2	1.4	5.9
bcdm07					0.9	2.4
bcdm09						5.6

Table 3: Dating evidence for the site master BCDM **AD 1383–1531** against dated reference chronologies, regional chronologies in **bold**

County or region:	***Chronology name:***	***Short publication reference:***	***File name:***	***Spanning:***	***Overlap (yrs):***	***t-value:***
Wales	Cae'nycoed-uchaf, Maentwrog	(Miles *et al* 2006)	BDGLRT17	1407-1592	125	6.6
Lancashire	Stubley Hall	(Bridge 2003)	STUBLEY	1382-1490	108	6.1
Shropshire	Shootrough Farm, Cardington	(Miles and Haddon-Reece 1996)	shu6	1433-1538	99	6.0
Wales	Pengwern Old Hall	(Miles *et al* 2003)	PENGWERN	1353-1521	139	5.9
Wales	Plas Mawr House	(Miles 1997b)	PLASMAWR	1360-1578	149	5.8
Wales	Bodwrda, Aberdaron	(Miles *et al* 2010)	LYNA	1384-1527	144	5.3
Lancashire	Turton Tower, Blackburn	(Arnold and Howard 2008)	TRTASQ01	1483-1665	49	5.2
Cumbria	Dacre Hall	(Arnold *et al* 2004)	LCPASQ01	1350-1504	122	5.2
Lancashire	Sawley	(Tyers 2000)	SAWLEY	1433-1506	74	5.1
Wales	Royal House, Machynlleth	(Miles *et al* 2004)	ROYALHS1	1363-1560	149	5.1
Durham	Middridge Grange	(Arnold *et al* 2006)	MRGASQ02	1427-1516	90	5.0
Shropshire	Church Farm, Ditton Priors	(Miles *et al* 2004)	DITTON5	1437-1578	95	5.0
Wales	Hafodruffydd-uchaf, Beddglert	(Miles *et al* 2006)	BDGLRT20	1416-1523	108	5.0

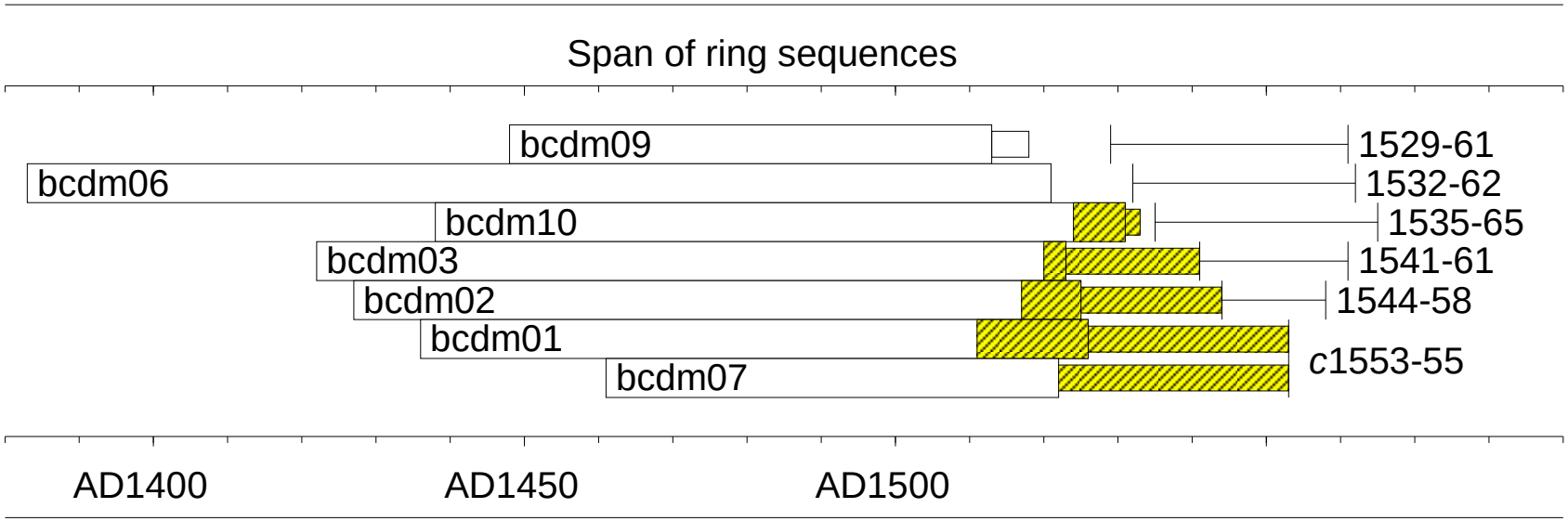

Figure 1: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings.