Darganfod Hen Dai Cymreig
Discovering Old Welsh Houses

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

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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.

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Appendix 2

Oxford Dendrochronology Laboratory
Report 2014/6

THE TREE-RING DATING OF
PRYS MAWR,
LLANUWYCHLYN
GWYNEDD
(NGR SH 869 302)

Summary
Two areas of the property were looked at – the roof of the kitchen wing, and the main house itself. Whilst the roof timbers looked superficially very good for dating, once prepared, the samples showed several bands of very narrow rings, probably resulting from management of the trees. This made them undatable. Three ceiling timbers from the main range did date however, giving a likely combined felling date range of **1540–70**.

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March 2014

The Tree-Ring Dating of Prys Mawr, Llanuwychlyn, Gwynedd
(NGR SH 869 302)

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.

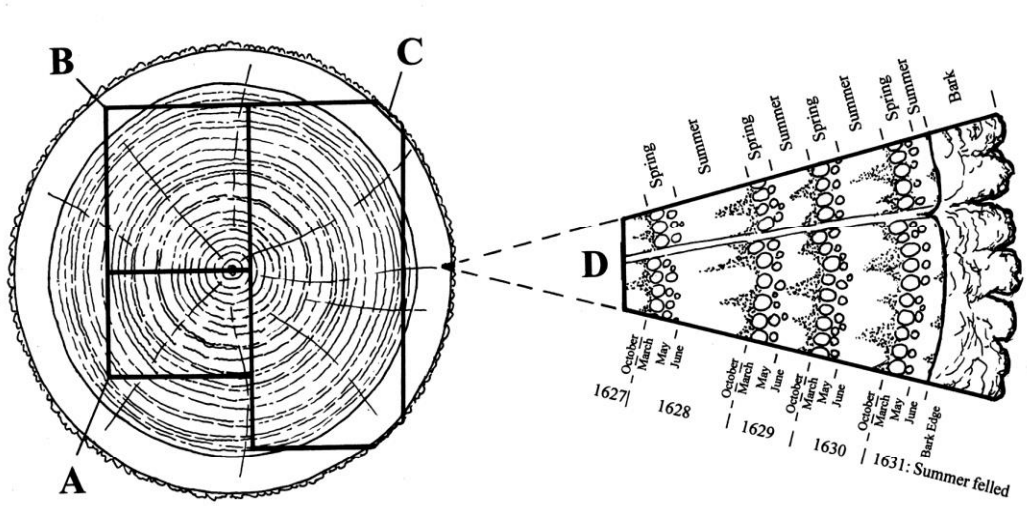
One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence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

PRYS MAWR (notes by Ian Brooks)

This is a sub-medieval lesser gentry house of end-chimney with cross-passage plan. There is a second wing set at right angle to the rear of the house which holds the kitchen. This has a 3-bay pegged collar-truss roof. The roof in the main range has been replace (probably in c 1890), however the hall and parlour have beamed ceilings with wide stopped-chamfered main and subsidiary beams and narrow chamfered joists. In the centre of the rear partition wall, between the main and rear ranges, is a large chamfered post on a stone plinth which supports the main lateral beam. This post and another recently

found in the front elevation suggest an early timber phase. There is a date stone of 1685 which reflects a later phase in the development of the house.

SAMPLING

Sampling took place in February 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 **prm**. 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, and illustrated in Figs 1-3. The samples from the Kitchen Wing roof exhibited bands of narrow rings (Fig 4) which were not apparent at the time of coring. Two series matched very well (Table 2), these being the samples from each principal rafter of truss 1 (Figure 1) – suggesting that they are two halves of the same tree. Unfortunately these bands of very narrow rings do not reflect natural weather-related variation, and are probably the result of human management of the trees, lopping or pollarding. None of these samples dated therefore.

Several of the samples from the main range also exhibited sudden growth changes, but not as severe as those found in the Kitchen Wing roof. Three of the samples had too few rings for further analysis. Sample pmr10 had a break in it which may have lost rings between the two sections, which were therefore treated as two separate parts (i and ii), which could not be matched with any other series, or dated independently. Series **pmr11**, whilst having 150 rings, also failed to match other series or date independently, probably as a result of these growth changes which are unlikely to have been caused by natural weather fluctuations, and similarly the 90-year long fireplace lintel ring series also failed to match. Three series gave relatively poor matches with each other (Table 2) but had their matching positions confirmed by dating each series independently against the reference material. These ceiling beam series were combined to form a 111-year site chronology, **PRYSMAWR**, which was dated to the period 1421-1531. The relative positions of overlap of the series are shown in Fig 5 along with their likely felling date ranges, the strongest matches being shown in Table 3.

Two dated series retained the heartwood-sapwood boundary, giving a mean H/S date of 1529, and a likely combined felling date range of **1540–70**, making this the likely date range of construction.

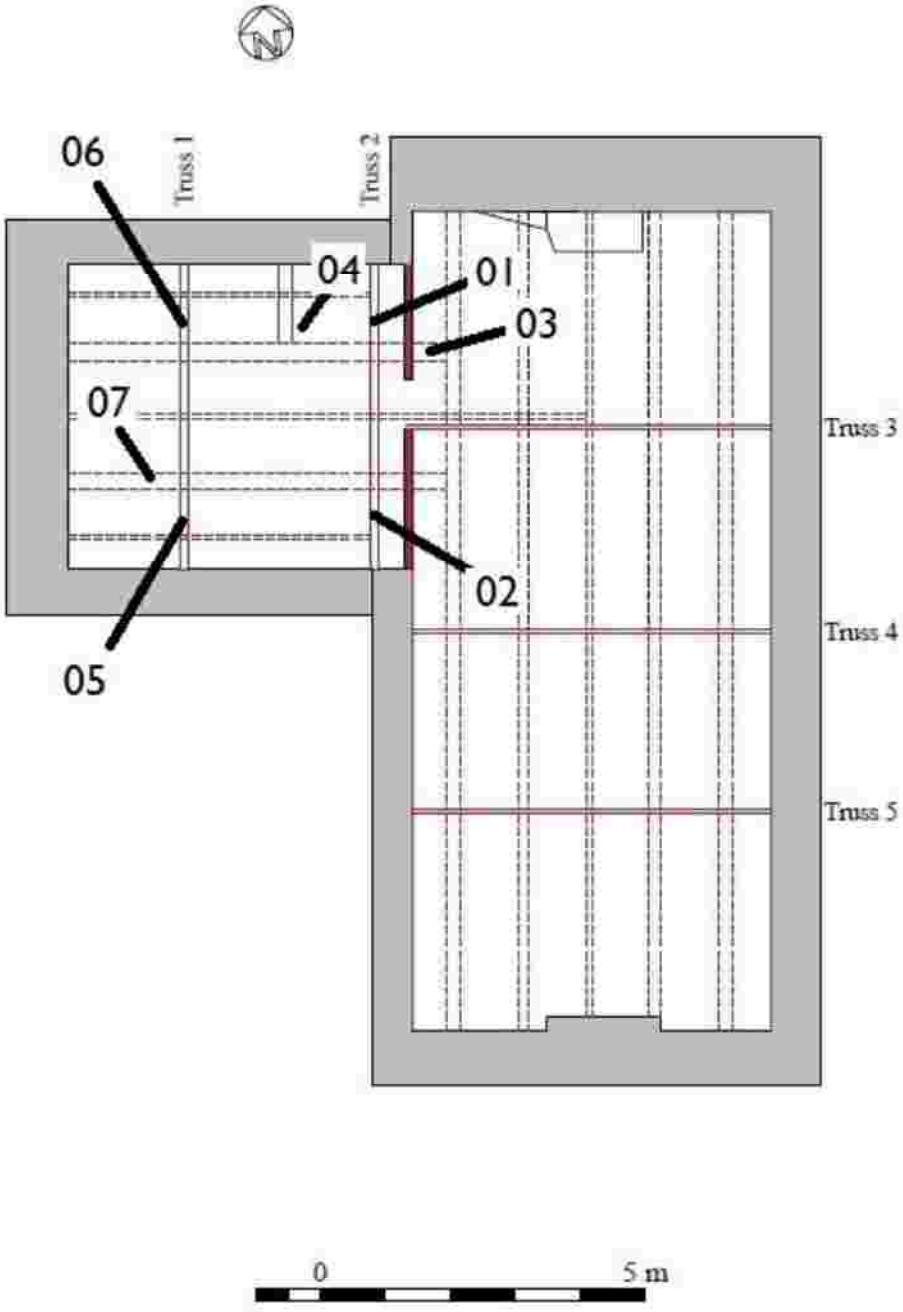


Figure 1: Roofs of Prys Mawr, showing the approximate positions of samples taken for dendrochronology, adapted from original drawings by Ian Brooks

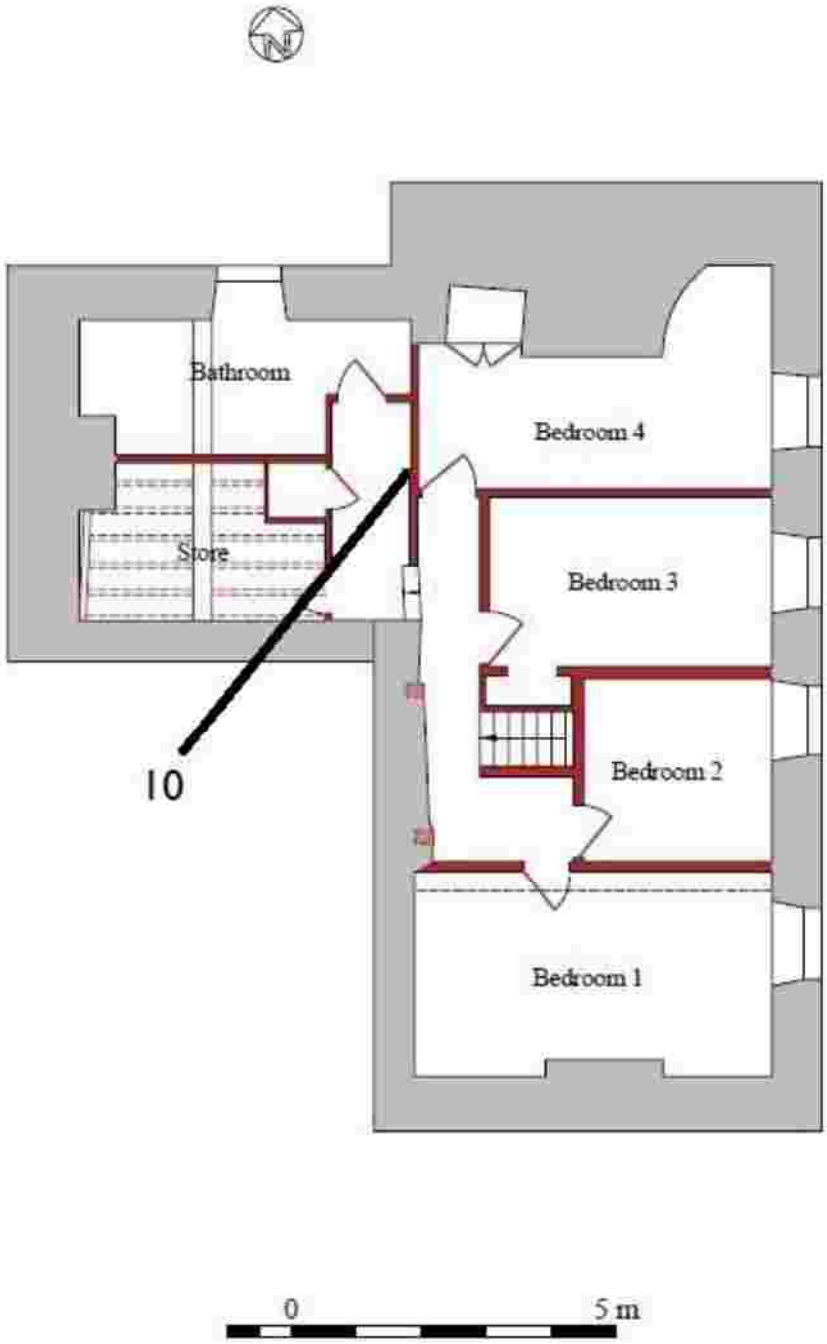


Figure 2: First Floor plan of Prys Mawr, showing the approximate positions of a sample taken for dendrochronology, adapted from original drawings by Ian Brooks

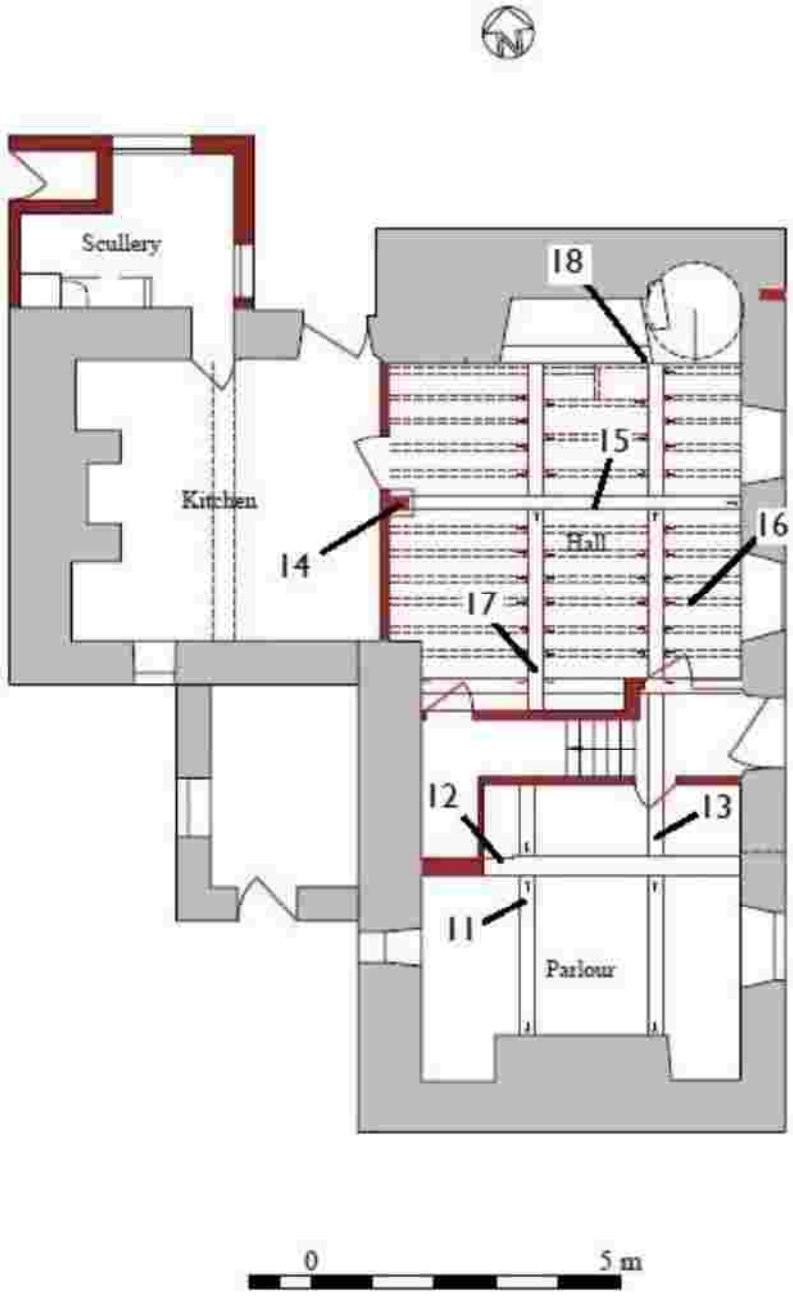


Figure 3: Ground Floor Plan of Prys Mawr, showing the approximate positions of samples taken for dendrochronology, adapted from original drawings by Ian Brooks

Table 1: Details of samples taken from Prys Mawr, Llanuwychlyn.

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
Kitchen Wing Roof									
pmr01	North principal rafter, truss 2	-	-	H/S	100	1.27	0.86	0.30	-
pmr02	South principal rafter, truss 2	-	-	H/S	77	1.47	1.18	0.30	-
pmr03	North upper purlin, east of truss 2	-	-	-	<40	NM	-	-	-
pmr04	North lower purlin, west of truss 2	-	-	+30NM	54	1.42	0.89	0.22	-
pmr05	South principal rafter, truss 1	-	-	H/S +24NM	43	0.92	0.63	0.29	-
pmr06	North principal rafter, truss 1	-	-	19	65	1.22	0.82	0.32	-
pmr07	South upper purlin, west of truss 1	-	-	17½C	90	0.96	0.56	0.25	-
Main House									
pmr10i	Post in rear wall at north end of house, inner part	-	-	-	40	1.74	0.90	0.24	-
pmr10ii	*ditto,* outer part of core	-	-	-	44	1.55	0.37	0.17	-
pmr11	West ceiling beam in south Grd Flr room	-	-	-	150	1.14	0.93	0.23	-
pmr12	Main E-W beam in south Grd Flr room	-	-	H/S	<40	NM	-	-	-
* **pmr13**	East ceiling beam in south Grd Flr room	1428-1483	-	-	56	1.26	0.35	0.24	after 1494
pmr14	Post in rear wall of parlour	-	-		<40	NM	-	-	-
* **pmr15**	Central W-E beam in hall	1421-1527	1527	H/S	107	1.23	0.41	0.25	1538–68
pmr16	Joist, 3rd from door	-	-		<40	NM	-	-	-
* **pmr17**	Ceiling beam in SW quadrant	1440-1531	1531	H/S	92	1.94	1.07	0.29	1542–72
pmr18	Fireplace lintel	-	-	H/S	90	1.67	0.80	0.27	-
* = included in site master **PRYSMAWR**		**1421-1531**	**1529**	**H/S**	**111**	**1.46**	**0.49**	**0.24**	**1540–70**

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

Table 2: Cross-matching between samples

	t-values		
Sample	**pmr06**	**pmr15**	**pmr17**
pmr05	7.7	-	-
pmr13		2.3	4.0
pmr15			3.6

Table 3: Dating evidence for the site master **PRYSMAWR AD 1421–1531** against dated reference chronologies, regional chronologies in **bold**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales	Royal House, Machynlleth	(Miles *et al* 2004)	ROYALHS1	1363–1560	111	7.2
Cumbria	Wetheral Priory	(Arnold *et al* 2004)	WPGASQ04	1410–1511	91	7.1
Wales	Cefn Caer Pennal	(Miles and Worthington 1999)	CEFNCAR1	1404–1525	105	6.6
Wales	Ty Cerrig, Llanfwrog	(Miles *et al* 2011)	DENBY7a	1420–1500	80	6.6
Wales	Ucheldref Rhug, Corwen	(Miles *et al* 2010)	DENBY4	1373–1597	111	6.4
Wales	Branas-Uchaf, Llandrillo	(Miles *et al* 2010)	DENBY6	1388–1763	111	6.3
Staffordshire	Biddulph Old Hall	(Miles *et al* 2005)	BIDDULPH	1404–1524	104	6.2
Wales	Trefrechan barn	(Miles *et al* 2004)	TREFECHN	1423–1606	109	5.9
Shropshire	St Swithin's Church, Clunby	(Tyers 2000)	CLUNBY	1239–1494	74	5.9
Wales	Plas Coch, Anglesey	(Miles *et al* 2011)	PLASCOCH	1402–1591	111	5.8
Wales	Llannerchyfelin, Rowen, Conwy	(Bridge *et al* 2013)	LLANNFEL	1419–1578	111	5.8
Wales	Plas Tan-y-Bwlch, Maentwrog	(Miles *et al* 2006)	BDGLRT23	1411–1535	111	5.7
Wales	Rose and Crown, Gwydwn	(Miles and Worthington 2000)	GWYDWN	1411–1571	111	5.7

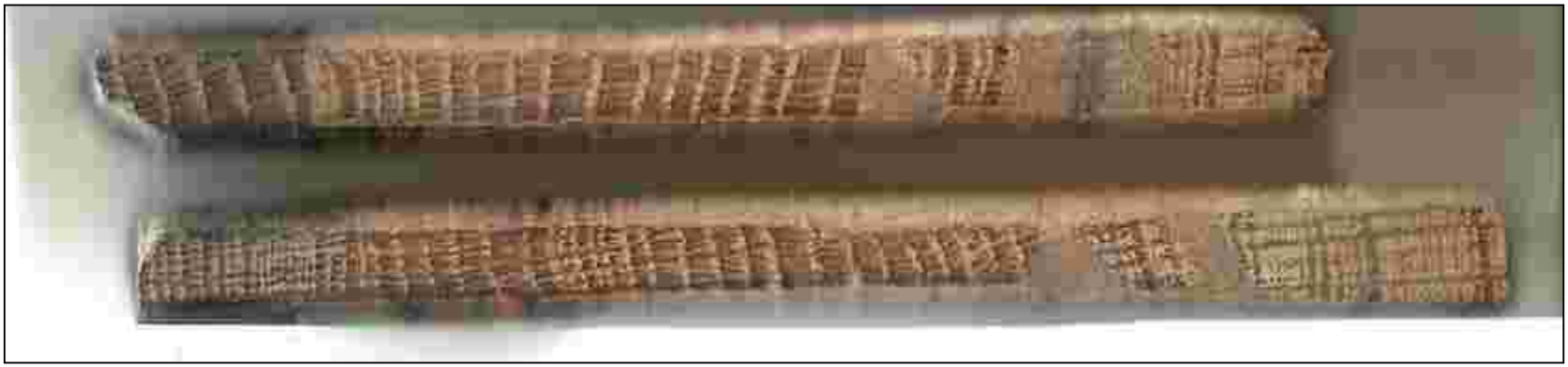


Figure 4: Scan of cores **pmr01** and **pmr02**, showing bands of narrow rings. Some areas have been cut with a scalpel after sanding to aid in distinguishing ring boundaries.

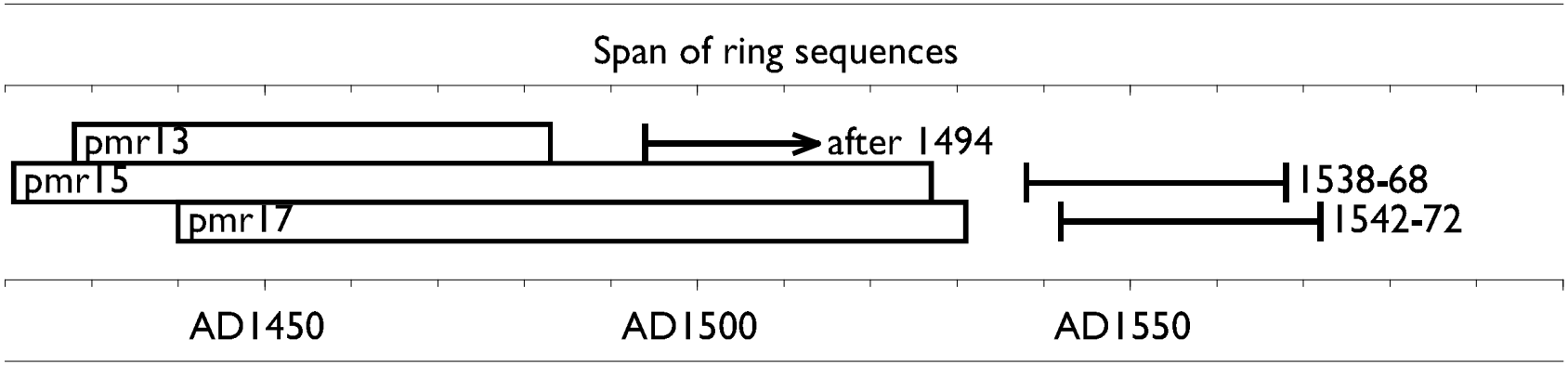


Figure 5: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely, or actual, felling date ranges. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings

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