Oxford Dendrochronology Laboratory
Report 2010/21a

THE TREE-RING DATING OF TIMBERS FROM BRYN YR ODYN, CWMCYNFAL, BLAENAU FFESTINIOG, GWYNEDD (NGR SH 7077 4085)

Summary

Samples were taken from the roof of the rear (north) wing and the main roof, the cross-passage screens, the ground floor ceilings of the main range and a fireplace lintel in the main ground floor room. The fireplace lintel was the earliest timber dated – it had 36 sapwood rings, possibly including the outermost ring, although this is uncertain, its felling date is therefore given as ***c*1503**. Eleven timbers, including roof timbers from the main range and some north wing roof timbers, two from the cross passage screens, two ceiling timbers from the main range, and a rear range mantel beam, were felled over a period from winter 1555/56 to summer 1557, and appear to represent a single phase of construction, most likely in **1557**. The north (rear) range roof appears to have been reconstructed using some original purlins and a principal rafter with an outer heartwood ring formed in 1586, giving a likely felling date after 1597**,** which may be of the same date as the axial beam felled in **summer 1640**.

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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 Timbers from Bryn yr Odyn, Cwmcynfal, Blaenau Ffestiniog, Gwynedd (NGR SH 7077 4085)

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.

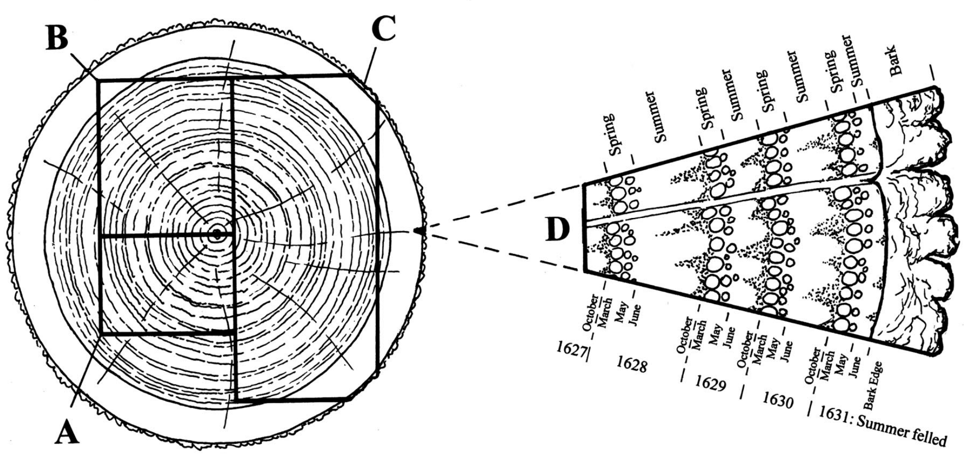
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation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

BRYN YR ODYN (Notes from Richard Suggett)

A substantial house of Snowdonian type with voussoir-headed doorways and a fully-screened cross-passage. The post-and-panel partitions originally had twin doorways into the outer rooms and a large central doorway into the hall. The house is fully storeyed with a habitable attic. Structural evidence suggests that the single-storey north-west kitchen wing has been added. However, tree-ring dating suggests that much of the timber of the trusses is contemporary or nearly so with the main house although a principal rafter gives a felling date of after 1597. The early felling date for the fireplace beam indicates further reuse. The collar-beam trusses of the main range were not sampled. Plan: *Houses of the Welsh Countryside* (2nd edn.), fig. 217 (h-l).

SAMPLING

Sampling took place in June 2010. 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 **byr**. They 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).

No sampling was carried out in the roof of the main range because of the presence of bats in June.

Update: At the end of the season, in November 2010, the site was re-visited and Dan Miles took five further samples, including roof timbers, to refine the dating obtained

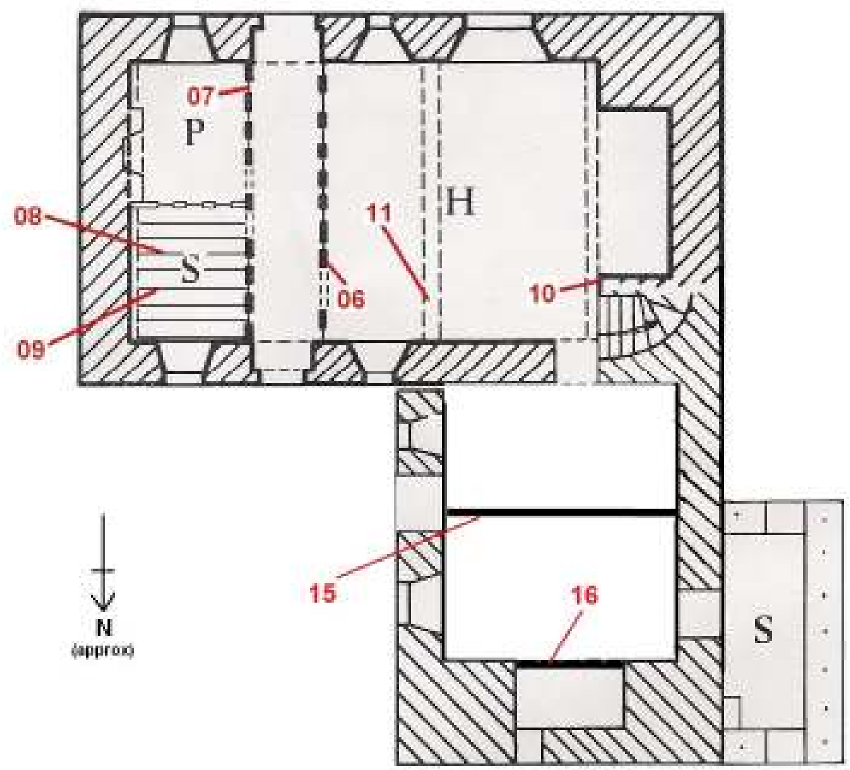


Figure 1a: Plan of the ground floor of the house showing the approximate positions of samples taken for dendrochronology

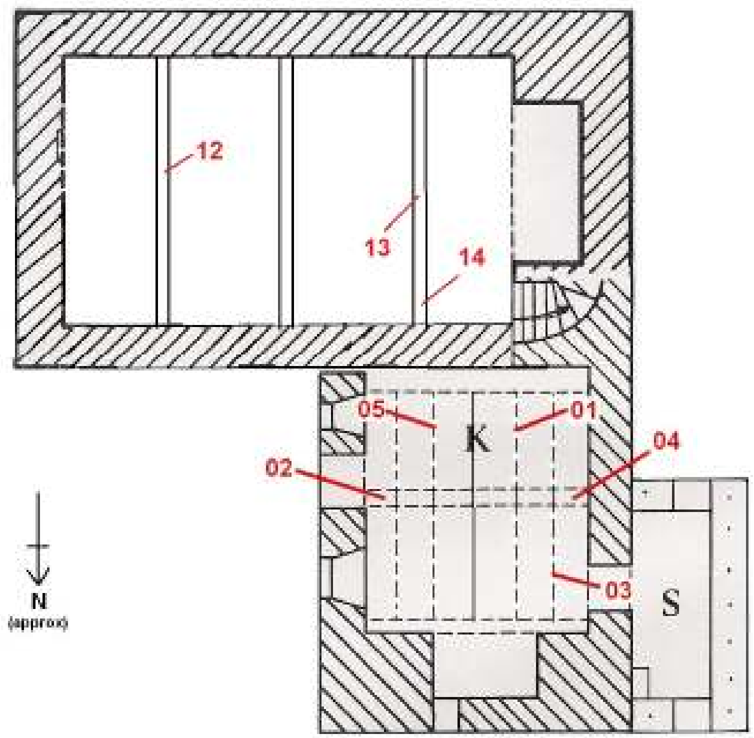


Figure 1b: Plan of the roof areas of the house showing the approximate positions of samples taken for dendrochronology

RESULTS AND DISCUSSION

All the timbers were sampled were of oak (*Quercus* spp.). Details of the samples and their positions are given in Table 1 and shown in Figs 1a and 1b. Table 2 shows the cross-matching between the sequences that were subsequently dated. Samples **byr02** and **byr08** could not be matched with other samples from the site, nor with dated reference material, and these remain undated.

The fireplace lintel had complete sapwood, though it is not certain that this was retained on coring. Its felling date is therefore given as *c*1503, much earlier than the main group of timbers.

Samples **byr01** and **byr03** matched with a *t* value of 13.0 – and are assumed to have come from the same parent tree. Their series were combined into a single series for further analysis. Sample **byr07** retained complete sapwood, but the outermost rings were very narrow, implying the tree was dying. These could not be measured with any certainty, but a reasonable estimate could be made of the numbers of heartwood and sapwood rings unmeasured, resulting in its estimated felling date of *c*1556. The outermost few rings of **byr11** could not be measured either, and this too has an estimated felling date of *c*1556. Sample **byr05** had complete sapwood, but this became detached from the core on sampling, and hence its derived felling date range has to allow for the possibility of a few rings missing between the heartwood/sapwood boundary and the start of the sapwood, thus giving 1555-

60. Three timbers (**16**, **13** and **12**) retained complete sapwood and were found to have been felled in winter 1555/56, summer 1556 and summer 1557 respectively. Samples **06** and **14** had traces of sapwood and give likely felling date ranges that make it likely that they were felled at around the same time.

It seems therefore that the main range, with its roof, screen and ground floor ceiling, was constructed in a single phase, most likely in **1557**, incorporating a large timber for the fireplace lintel that is earlier in date. The rear range has an axial beam felled in summer 1640, and a principal rafter that is later than 1597, and possibly also of 1640 age. The roof includes purlins of the same age as the main range.

The original cross-matched series were combined into a 199-year site master chronology, **BRYNRDYN**, which was subsequently dated to the period 1388–1586, the strongest matches being shown in Table 3a. The newly dated timbers were added in to create a new 252-year site chronology, **BRNRDYN2**, dated to 1388–1639, the dating evidence for which is given in Table 3b. Fig 2 shows the relative positions of overlap of all the dated samples, along with actual or interpreted felling dates/date ranges.

ACKNOWLEDGEMENTS

I wish to thank Richard Suggett for commissioning the original work on behalf of RCAHMW, and for giving background information on the site, Elinor Gray-Williams (architect) for her input, Pegi Gruffydd & Dafydd Rhys (owners) for their permission to sample and friendly welcome, and Ffion Jones of Fflic Cyf (television company) for her cheery assistance and refreshments. I also wish to thank my fellow dendrochronologists for permission to use their data. Dan Miles supplied the additional samples from the roof and rear wing, which were taken with the help of Matt Hurford, for the update to this report. The additional work was funded by the North West Wales Dendrochronology Project, with thanks to Margaret Dunn.

Table 1: Details of samples taken from Bryn yr Odyn, including additional samples taken in November 2010

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)
Rear (North) Wing									
byr01	South-west upper purlin	1450-1526	1524	2	77	1.21	0.36	0.20	1536-66
byr02	East principal rafter	undated	-	-	NM	-	-	-	unknown
byr03	North-west lower purlin	1420-1525	1525	H/S	106	1.20	0.34	0.25	1536–66
* **byr04**	West principal rafter	1458-1586	-	-	129(+5NM)	1.31	0.49	0.23	after 1597
* **byr05**	South-east upper purlin	1454-1531	1531	H/S	78 (+24NM)	1.22	0.45	0.22	1555–60
* **byr13m**	Mean of **01** and **03**	1450-1526	1525	H/S	107	1.21	0.33	0.22	1536–66
Cross passage screens									
* **byr06**	South door jamb in west screen	1421-1533	1533	H/S	113	0.98	0.38	0.24	1544–74
* **byr07**	Top-plate to east screen	1436-1518	*c1531*	25NM	83 (+38NM)	1.52	0.63	0.22	*c*1556
Ceiling joists									
byr08	9th joist from south, east room	undated	-	H/S	87	1.57	0.76	0.28	unknown
* **byr09**	4th joist from north, east room	1414-1515	1515	H/S	102	1.28	0.45	0.25	1526–56
byr11a	Main north-south beam	*1423-1536*	*1514*	*22*	*114*	*1.04*	*0.45*	*0.25*	-
byr11b	*ditto*	*1496-1552*	*1515*	*37(+4NM)*	*57*	*0.85*	*0.31*	*0.23*	-
* **byr11**	Mean of **11a** and **11b**	1423-1552	1515	37 (+4NM)	130	1.01	0.45	0.25	*c*1556
Fireplace lintel									
* **byr10**	Fireplace lintel, main GFlr room	1388-1503	1467	36 ?C	116	1.68	0.85	0.29	1503?
Roof timbers									
byr12	Collar to east truss	1410-1556	1523	33½C	147				Summer 1557
byr13	Collar to west truss	1408-1555	1526	29½C	148				Summer 1556
byr14	North principal rafter to west truss	1388-1516	1516	H/S+32NM	129				soon after 1549
Rear (North) Wing additional timbers									
byr15	Axial beam	1424-1639	1606	33½C	215				Summer 1640
byr16	Mantel beam	1436-1555	1518	37C	120				Winter 1555/56
* = included in site master **BRYNRDYN**		**1414-1586**			**173**	**1.19**	**0.37**	**0.20**	
New site master **BRNRDYN2**									

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; C = bark edge present, felled the following winter; NM = not measured. Sapwood estimate used 11-41 (Miles 1997).

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Table 2: Cross-matching between the dated sequences from Bryn yr Odyn.

SAMPLE	byr03	byr04	byr05	byr06	byr07	byr09	byr10	byr11	byr12	byr13	byr14	byr15	byr16
byr01	13.0	4.8	2.9	6.2	5.1	2.1	0.6	3.2	5.0	5.4	3.7	4.3	3.6
byr03		4.2	1.9	4.2	4.7	3.8	2.2	4.5	6.1	5.7	2.8	3.1	2.5
byr04			4.3	4.7	5.4	4.9	1.4	7.1	4.8	2.7	3.3	6.4	6.2
byr05				2.5	7.3	1.2	1.7	3.3	6.4	3.9	4.5	3.5	3.8
byr06					4.8	5.1	4.3	5.7	4.7	7.0	4.9	3.5	3.4
byr07						2.9	3.7	6.7	8.1	5.6	6.5	4.9	3.9
byr09							4.0	7.4	4.6	5.1	3.2	2.7	3.7
byr10								5.0	3.4	3.7	4.8	0.7	2.2
byr11									5.2	4.1	5.1	6.1	6.6
byr12										8.3	5.9	4.5	2.8
byr13											6.2	5.0	1.7
byr14												3.6	3.2
byr15													5.1

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Table 3a: Dating evidence for site master **BRYNRDYN 1388–1586** – regional multi-site chronologies in **bold**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales	Pengwern Old Hall	(Miles *et al* 2003)	PENGWERN	1353–1521	134	9.3
Wales	Bwthyn Cae-glas, Llanfrothen	(Miles *et al* 2006)	BDGLRT7	1386–1547	160	7.8
Wales	Y Gesail Gyfarch, Dolbenmaen	(Miles *et al* 2006)	BDGLRT6	1384–1609	199	7.5
Surrey	Apple Tree Cottage, Elstead	(Tyers 2000)	ELSTEAD	1396–1591	191	7.2
Wales	Parc Llanfrothen	(Miles *et al* 2006)	BDGLRT22	1386–1669	199	7.1
Wales	Clenennau, Dolbenmaen	(Miles *et al* 2006)	BDGLRT10	1406–1570	165	6.8
Shropshire	Old Hall Farm, All Stretton	(Miles and Haddon-Reece 1996)	OLDHLLFM	1379–1630	199	6.7
Wales	Welsh Master Chronology	(Miles 1997)	**WALES97**	404–1981	199	6.6
Shropshire	14 Callaughton, Much Wenlock	(Miles and Worthington 1997)	CALLGHTN	1335–1569	182	6.6
Shropshire	Whittington Castle	(Miles *et al* 2004)	WHITNGTN	1351–1628	199	6.5

Table 3b: Dating evidence for site master **BRNRDYN2 1388–1639** – regional multi-site chronologies in **bold**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Wales	Pengwern Old Hall	(Miles *et al* 2003)	PENGWERN	1353–1521	134	11.1
Wales	Bwthyn Cae-glas, Llanfrothen	(Miles *et al* 2006)	BDGLRT7	1386–1547	160	8.8
Wales	Bodwrda, Aberdaron	(Miles and Bridge 2010)	LYNA	1384-1527	140	8.7
Wales	Y Gesail Gyfarch, Dolbenmaen	(Miles *et al* 2006)	BDGLRT6	1384–1609	222	8.6
Wales	Parc Llanfrothen	(Miles *et al* 2006)	BDGLRT22	1386–1669	252	8.0
Wales	Clenennau, Dolbenmaen	(Miles *et al* 2006)	BDGLRT10	1406–1570	165	7.8
Durham	Low Harperley	(Howard *et al* 2006)	LWHBSQ01	1356-1604	217	7.3
Wales	Derwyn-bach, Dobenmaen	(Miles *et al* 2006)	BDGLRT15	1385-1548	161	7.1
Wales	Welsh Master Chronology	(Miles 1997)	**WALES97**	404–1981	252	7.1
Wales	Cae'nycoed-uchaf, Maentwrog	(Miles *et al* 2006)	BDGLRT17	1407-1592	186	7.1

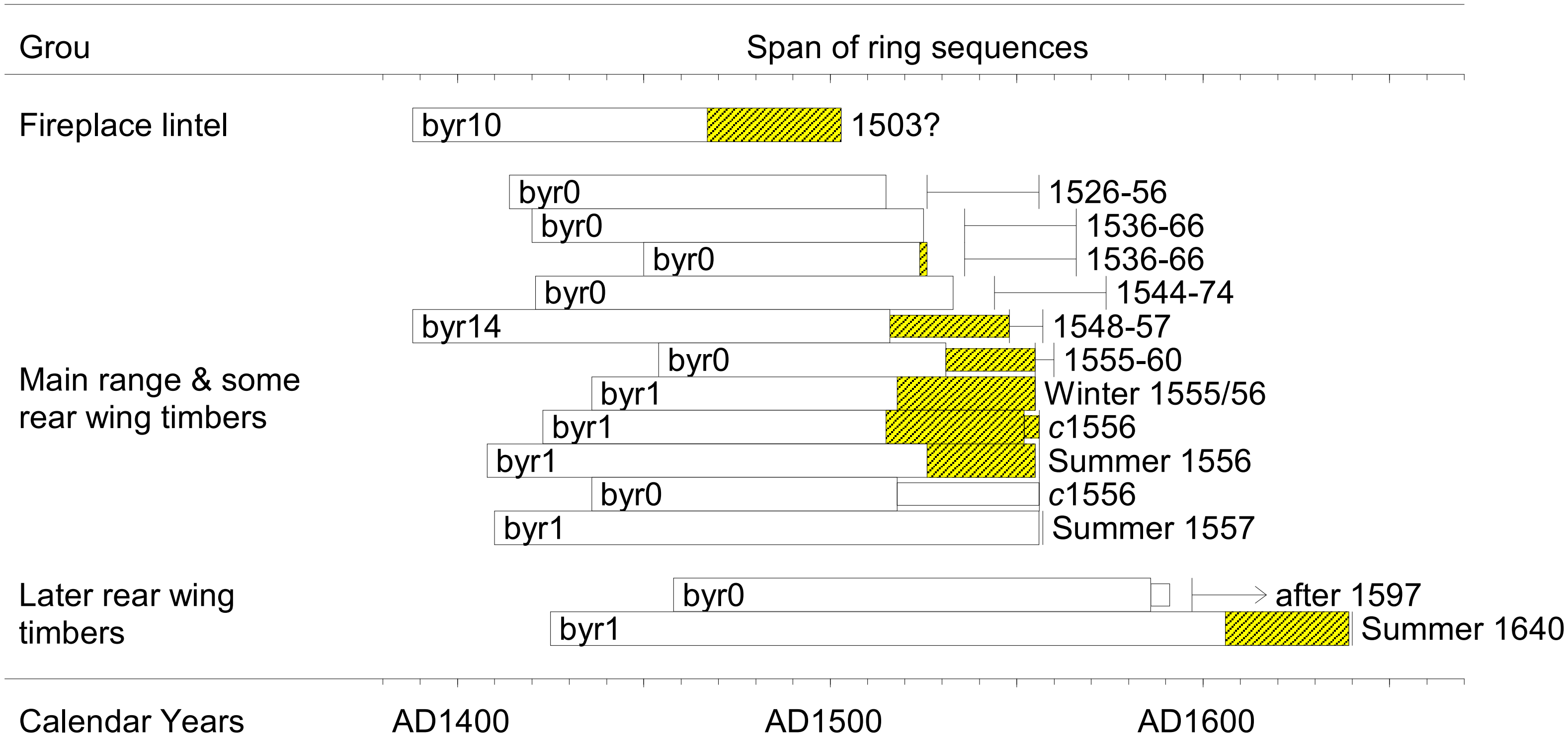

Figure 2: Revised bar diagram to show newly dated timbers. Yellow sections represent sapwood rings, narrow bars are additional unmeasured rings.

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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.

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

Howard, R. E., Litton, C. D. and Arnold, A. J. (2006) *Tree-ring analysis of timbers from Low Harperley Farmhouse, Wolsingham, Co Durham*, **Research Department Report Series**, 6/2006.

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. (1997) Tree-ring dates, **Vernacular Architecture**, 28, 159-181.

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. and Bridge, M. C. (2010) Tree-ring dates, **Vernacular Architecture**, 41, 102-110.

Tyers, I. (2000) *Dendrochronological analysis of timbers from Apple Tree Cottage, Elstead, Surrey*, **ARCUS Rep**, 561.

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

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