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Oxford Dendrochronology Laboratory
Report 2018/01

THE DENDROCHRONOLOGICAL DATING OF TIMBERS FROM TY GWYN, BRYNEGLWYS, DENBIGHSHIRE.

(SJ 1321 4711)

Summary

Dendrochronology has identified two, or possibly three phases of construction: the primary phase of **1447**, the screen of **after 1520**, and the inserted chimney stack and fireplace of **1578**. It is possible that the screen might in fact be the same phase as the inserted stack, as would be the first floor, but further sampling would be required to confirm this assumption

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A report commissioned by the Discovering Old Welsh Houses Group in collaboration with the Royal Commission on the Ancient and Historic Monuments Wales (RCAHMW)

The Dendrochronological Dating of Timbers from Ty Gwyn, Bryn Eglwys, nr Corwen (SJ 132 471)

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. These include chronologies made by colleagues in other countries, most notably areas such as modern Poland, which have proved to be the source of many boards used in the construction of doors and chests, and for oil paintings before the widespread use of canvas.

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.

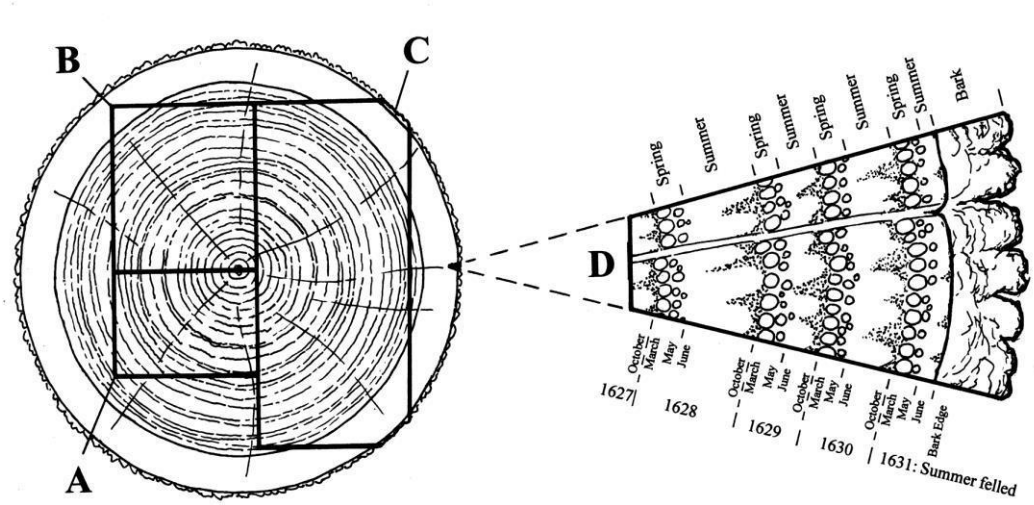
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation 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 in oak studies. Higher values are usually found with matching pine sequences. 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)

Ty Gwyn (Coflein entry by Richard Suggett)

Site Description 3-storey main block with rendered walls, slate roof and brick stacks. Three bay front with door to third bay and two sashes to the 1st and 2nd bays at ground floor level, three similar sashes to the first floor, and two gabled dormers to the first and third bays. 2-storey wing of similar design to the right with one sash to the ground floor and one gabled dormer above.
(Source: Site File DE/Domestic/SJ14NW) J Hill 18/08/2004

[Addition:] Ty-gwyn has two principal phases, clearly shown in the record photograph. A three-storey Georgian house of c. 1750 has been added to a downslope-sited late-medieval hall-house. The medieval house is of exceptional interest as a hallhouse of gentry type with substantial trusses and probably early trusses. Three smoke-blackened trusses survive defining the upper part of the hall and the inner-room of a gentry hall: the upper-end truss (cruck); the dais partition (box-framed), and the central open truss of the hall (cruck). The trusses are all very substantial, the central cruck-truss exceptionally so, and all have a king-strut rising from the collar. The central truss is archbraced with a shaped king-strut with central

half-round moulding. It is difficult to determine if the king-strut moulding is medieval or not though it is smoke stained. If medieval, it relates to other non-cusped ornament, notably 'zig-zag' mouldings and the concave mouldings on high-status central trusses.

In a second phase a large fireplace was built against the central truss in the outer bay of the hall. The hall ceiling presumably dates from this phase. It is unclear if the post-and-panel partition dates from this or the earlier phase. The entry at this phase is unclear but it may have been from the cross-passage. The lower end of the range was probably demolished when the Georgian house was constructed and a new doorway created internally as the old house became a service range.

The Georgian house has a fine framed oak stair with slender turned balusters, square newel-posts, and hand-rail with residual grip. There is a near-perfect first-floor Georgian room with panelled dado and lugged fireplace surround.

The patterned tiled floor in the hall/kitchen may also be noted. This floor was apparently laid by Italian prisoners of war using Ruabon tiles.

Survey by the Dating Old Welsh Houses Group. R.F. Suggett/RCAHMW/Nov. 2017

SAMPLING

Samples were taken in November 2017. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled with the prefix **tgb**, with samples 1- 6 from the cruck hall, samples 11 - 19 from the western down-slope range of both later phases, and sample 20 from the fireplace lintel between the stack at the west end of the cruck hall. The samples were polished with 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 programs written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker, as well as DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

The locations and details of the samples are described in Table 1, and illustrated in Figs 1 and 2.

The house was initially assessed in 2016 but whilst considered dateable, it was not considered top priority due to the lack of suitable samples available. Only two timbers were taken from the primary phase, two from the screen and truss above, and one from the fireplace mantel beam, which presumable was from the same phase as the inserted floor. From the primary cruck phase, only the main open cruck truss retained bark edge on the east cruck blade (**tgb01a**, **tgb01bi**, and **tgb01bii**) with a 138 rings. The other cruck blade was clearly from the same tree, and three samples were taken from it (**tgb02a, tgb02b**, and **tgb02c**), with 194 rings. All individual radii were thus combined together at the relative offsets (Table 2) and combined to form the 251-year mean **tgb0102m**.

This same-tree mean was then compared with the reference chronologies and was found to date extremely well, spanning the years 1196–1446 (Table 3a). There was evidence of growth after the last measured ring, and the tree was felled in the spring of 1447.

Two samples were taken from the screen and the truss above, as it was not clear if this dated to the same phase as the primary cruck. One of these dated, **tgb03**, with 78 rings. This dated, spanning the years

1432–1509. Although the matches were not as high as the cruck phase, they were nevertheless consistent and matched with local chronologies (Table 3b). As the last measured ring finished at 1509 having no sapwood or heartwood/sapwood boundary, only a *terminus post quem* of 1520 could be offered for this timber. Sample **tgb04** from the east principal rafter of the screen truss failed to date, most likely due to there being only 55 rings.

Finally a core from the mantel beam of the inserted stack extracted with bark edge and 118 rings. This dated especially well, spanning the years 1460-1577 (Table 3c). As with the cruck blade, the sample retained the spring growth for the following year and was found to be felled in the spring of 1578.

Thus dendrochronology has identified two or possibly three phases of construction: The primary phase of 1447, the screen of after 1520, and the inserted chimney stack and fireplace of 1578. It is possible that the screen might in fact be the same phase as the inserted stack, as would be the first floor, but further sampling would be required to confirm this assumption.

The relative positions of overlap of the dated samples are shown in Fig 3.

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

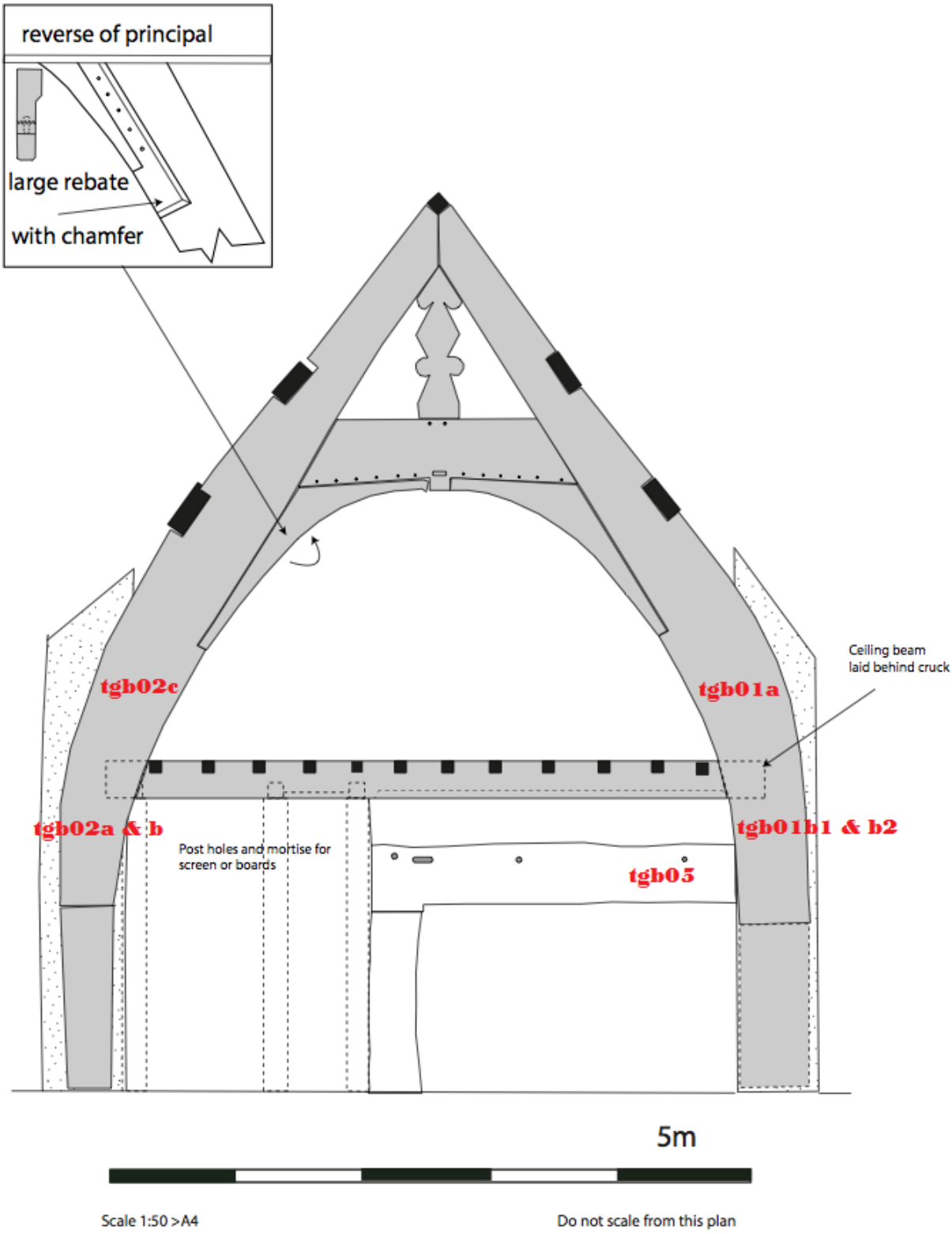

Figure 1: Drawing of the sampled cruck truss showing the approximate location of samples, adapted from an original drawing by Peter Thompson.

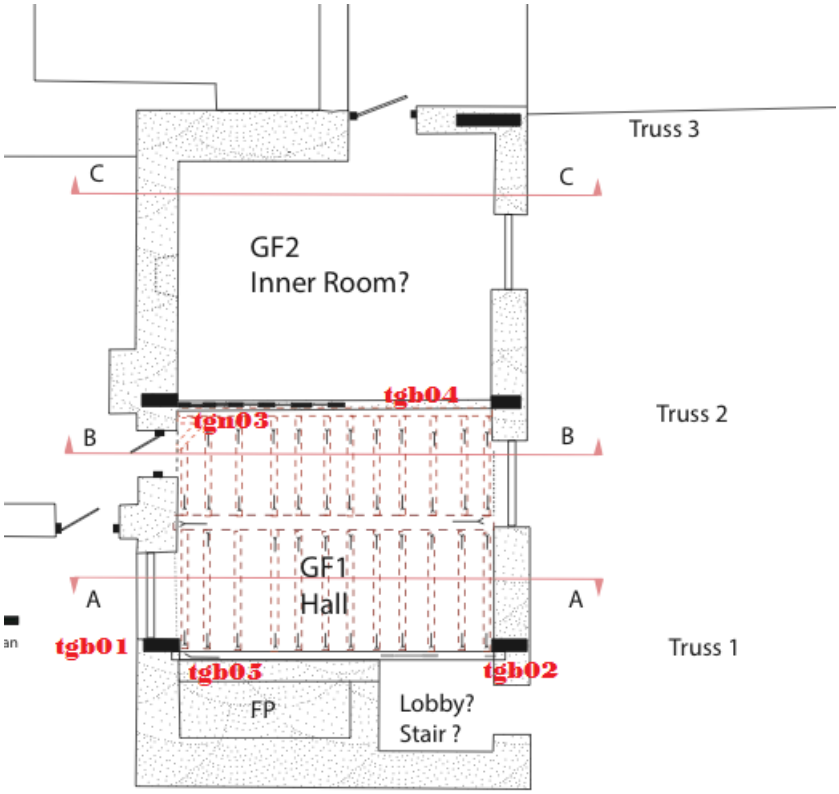

Figure 2: Ground floor plan of Ty Gwyn showing the approximate location of samples taken, adapted from an original plan by Peter Thompson.

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Table 1: Details of samples taken from Ty Gwyn.

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
Primary Phase - Cruck Range									
tgb01a	West cruck, open truss	*1222–1350*		-	*129*	*1.90*	*0.79*	*0.26*	
tgb01bi	*ditto*	*1269–1312*		-	*44*	*1.56*	*0.62*	*0.22*	
tgb01bii	*ditto*	*1309–1446*	*1421*	*25¼C*	*138*	*1.21*	*0.38*	*0.18*	
tgb02a	East cruck, open truss	*1196–1389*		-	*194*	*1.42*	*0.81*	*0.24*	
tgb02b	*ditto*	*1201–1362*		-	*162*	*1.58*	*0.71*	*0.24*	
tgb02c	*ditto*	*1298–1433*	*1419*	*14*	*136*	*1.09*	*0.38*	*0.21*	
tgb12	Mean of **01a**, **01bi**, **01bii**, **02a**, **02b** & **02c**	1196–1446	1420	26¼C	251	1.40	0.59	0.19	Spring 1447
Screen									
tgb03	Screen sill beam	1432–1509	-	-	78	1.71	0.86	0.27	After 1520
tgb04	East principal rafter, screen truss	-	-	6	55	2.63	0.98	0.22	
Inserted fireplace									
tgb05	Mantel beam	1460–1577	1528	49¼C	118	1.56	0.91	0.21	Spring 1578

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; ¼C = complete sapwood, felled the following spring; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

Table 2: Cross-matching between the dated samples in site sequence **tgb0102m**

t-values					
Sample	**tgb01bi**	**tgb01bii**	**tgb02a**	**tgb02b**	**tgb02c**
tgb01a	5.0	5.6	9.4	13.6	5.4
tgb01bi		-	5.9	4.8	1.2
tgb01bii			9.3	7.0	11.2
tgb02a				11.2	11.9
tgb02b					7.0

Table 3a: Dating evidence for the site sequence **tgb12 AD 1196–1446** against dated reference chronologies

County or region:	***Chronology name:***	***Reference***	***File name:***	***Spanning***	***Overlap: (yrs)***	***t-value:***
Regional Chronologies						
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881–1745	251	8.0
Yorkshire	Yorkshire Buildings Chronology	(Hillam pers comm)	**YORKS2**	1192–1663	251	6.5
Northern England	Northern England Master	(Hillam and Groves 1994)	**NORTH**	440–1742	251	6.0
Site Chronologies						
Herefordshire	Wigmore Abbey	(Tyers 2002)	WIGALL46	1055–1729	251	7.7
Shropshire	All Forces Club, Bridgenorth	(Miles and Worthington 2000)	ALLFORCE	1290–1386	97	7.0
Radnorshire	Hengoed, Llanynys	(Miles *et al* 2005)	HENGOED	1167–1439	244	6.9
Oxfordshire	Christ Church Chapter House, Oxford	(Worthington and Miles 2003)	CHCHCH	1142–1260	65	6.5
Gloucestershire	Westgate St, Gloucester	(Tyers and Wilson 2000)	WGATE1	1209–1518	238	6.2
Shropshire	Ightfield Hall barn, Whitchurch	(Groves 1997)	IGHTFELD	1341–1566	106	6.2
Shropshire	Barrow Street, Much Wenlock	(Miles and Haddon-Reece 1994)	MWNLOCK5	1320–1435	116	5.9
Worcestershire	Upwich salt making site	(Groves and Hillam 1997)	UPWICH2	946–1415	220	5.8
Shropshire	Coats Farm	(Miles and Haddon-Reece 1996)	COATSFM	1346–1485	101	5.8

Table 3b: Dating evidence for the site sequence **tgb03** **AD 1432–1509** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Regional Chronologies						
North Wales	North Wales Master Chronology	(Bridge 2016)	**NWALES**	1306–1758	78	4.9
Site Chronologies						
Caernarvonshire	Derwyn-bach, Dolbenmaen	(Miles *et al* 2007)	BDGLRT15	1385–1548	78	5.7
Lancashire	Whalley Abbey	(Arnold and Howard 2015)	WHLYSQ01	1362–1559	78	5.6
Merioneth	Hafodysybyty, Ffestiniog	(Miles *et al* 2012)	HDYSBYTY	1374–1497	66	5.5
Merioneth	Pengwern Old Hall	(Miles *et al* 2003)	PENGWERN	1353–1521	78	5.5
Cumbria	Clifton Hall Tower	(Arnold *et al* 2003)	CHTASQ02	1454–1537	56	5.4
Merioneth	Cwm Farm, Cwm Cynfal	(Miles *et al* 2012)	CWMFM1	1364–1567	78	5.4
Merioneth	Tyddyn Sais, Trawsfynydd	(Bridge *et al* 2016)	TYDDSAIS	1405–1527	78	5.3
Merioneth	Plas y Dduallt, Maentwrog	(Miles *et al* 2011)	GWYNEDD5	1355–1604	78	5.2
Montgomeryshire	Blaen-y-cwm, Pennant Melangell	(Miles *et al* 2005)	BLNYCWM3	1457–1646	53	5.2

Table 3c: Dating evidence for the site sequence **tgb05** **AD 1460–1577** against dated reference chronologies

County or region:	*Chronology name:*	*Reference*	*File name:*	*Spanning*	*Overlap: (yrs)*	*t-value:*
Site Chronologies						
Merioneth	Gwernbraichdwr, Llandderfel	(Bridge *et al* 2016)	GWRNBRDW	1404–1585	118	8.4
Montgomeryshire	Kerry Church	(Miles *et al* 2011)	KERRY	1402–1567	108	7.0
Denbighshire	Branas-Uchaf, Llandrillo	(Miles *et al* 2010)	DENBY6	1388–1763	118	7.0
Herefordshire	Pikes Farm, Michaelchurch, Escley	(Miles *et al* 2006)	MLCHRCH2	1342–1590	118	7.0
Radnorshire	Nannerth-Ganol Rhayader	(Miles and Haddon-Reece 1996)	nan2	1454–1554	95	6.7
Denbighshire	Ty Mawr, Druid, Corwen	(Miles *et al* 2010)	DENBY1	1440–1583	118	6.6
Merioneth	Rhydywernen, Llanfor	(Bridge *et al* 2015)	RHYDYWRN	1403–1530	71	6.5
Montgomeryshire	Rhos-fawr-isaf, Meifod	(Miles *et al* 2005)	RHOSFAWR	1430–1576	117	6.3
Merioneth	Cae'r March, Llanfachreth	(Bridge *et al* 2016)	CAERMCH1	1405–1541	82	6.2

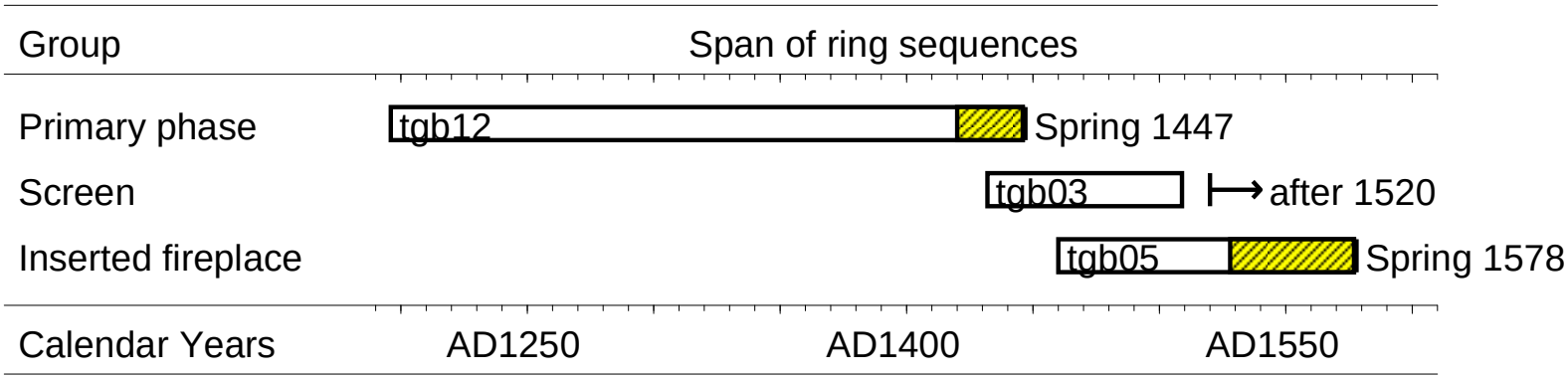

Figure 3: Bar diagram showing the relative positions of overlap of the dated samples, with their actual or likely felling dates / date ranges. White sections represent heartwood rings and yellow hatched sections represent sapwood.