Oxford Dendrochronology Laboratory
Report 2014/34

THE TREE-RING DATING OF FEDW DEG OLD HOUSE PENMACHNO, CONWY (CAERNARVONSHIRE) (NGR SH 789 533)

Summary

Seven timbers were sampled, one of them twice to gain maximum information. The timbers were characterised by having more than normal numbers of sapwood rings, but the outer rings were very narrow indeed, usually making the resolution of individual rings impossible, although a single timber with complete sapwood was measured, and found to have been from a tree felled in **Spring 1588**. The other samples broadly agree with this date, which is therefore given as the likely construction date, or within a couple of years after this date.

Authors: Dr M. C. Bridge FSA and Dr. D. Miles FSA
Oxford Dendrochronology Laboratory
Mill Farm
Mapledurham
Oxfordshire
RG4 7TX

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The Royal Commission on the Ancient and Historical Monuments in Wales (RCAHMW).

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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.

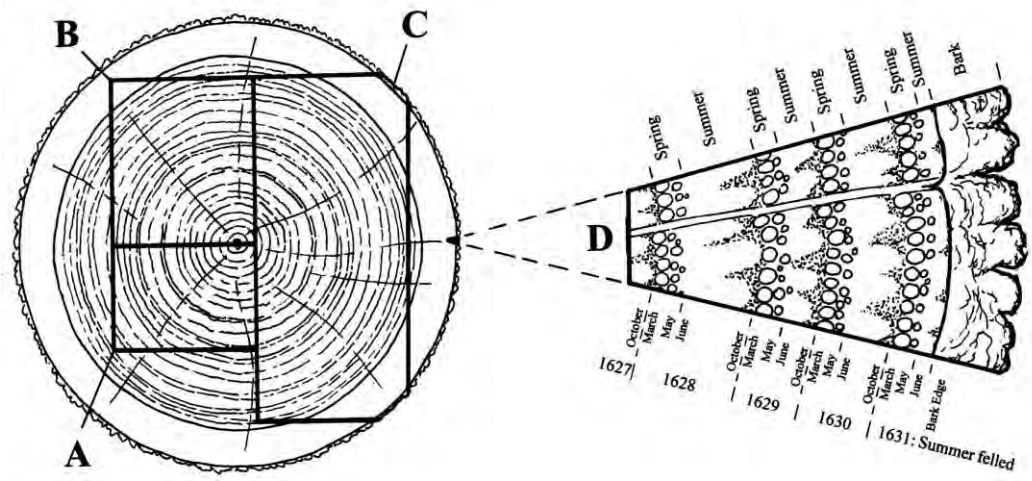
One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence 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 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 1997a, 42)

FEDW DEG OLD HOUSE (notes by Richard Suggett)

Fedw-deg – like so many Caernarvonshire houses – combines robust masonry walls with high-quality internal timberwork. However, the lobby-entry plan of Fedw-deg is a rarity in a region dominated by the two-unit Snowdonian House. Fedw-deg originally had a three-unit lobby-entry plan with a central chimney, more characteristic of Denbighshire and Flintshire than Caernarvonshire but sometimes indicating a hall-house conversion. The outer bay has been demolished but the house is still entered from an impressive Cyclopean doorway. The hall and inner-room retain a ceiling of stop-chamfered

beams and joists. The hall is divided from inner-room by a post-and-panel partition with reed-moulded posts and twin doorways with double-ogee doorheads. The windows have mullions of diamond section and chamfered lintels. The truss ('a semi-cruck' according to the *Inventory*) is set into the partition beam. Fedw-deg was vested in the Ministry of Works by the Forestry Commission during World War II. Much of the timberwork has been replaced but, it seems, faithfully reproduced by the Ministry of Works craftsmen. It is now in the care of Cadw and a scheduled ancient monument.

Survey by RCAHMW. Plan and account in RCAHMW, *An Inventory of the Ancient Monuments of Caernarvonshire, Volume I: East* (London, 1957), p. 173a. Coflein (RCAHMW's on-line database) entry: NPRN 26449. R.F. Suggett/RCAHMW/November 2014.

SAMPLING

Sampling took place in June 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 **fedw**. 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).

A series pf photographs of the areas worked on are to be found in the Appendix, along with an illustration of the screen, a significant feature of the building.

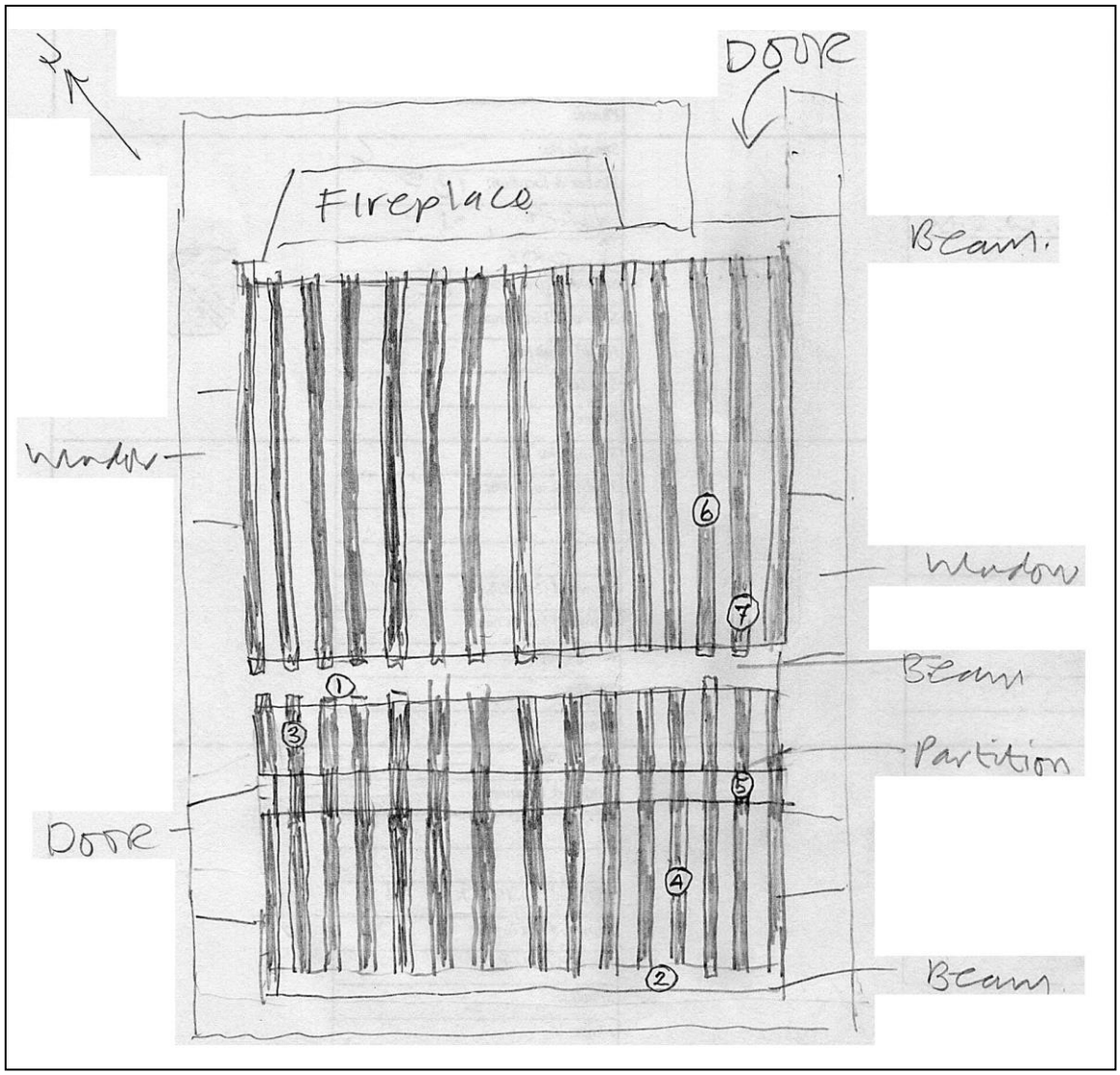


Figure 1. Field sketch, (Ann Morgan and Tony Scharer) showing the locations of samples taken for dendrochronology

RESULTS AND DISCUSSION

Basic information about the samples and their origins are shown in Table 1, with the locations of the samples being shown in Fig 1. The series proved to be incredibly difficult to measure, as they nearly all exhibited a long period of very reduced growth in the outer rings where the resolution of individual rings was mostly impossible. Cross-matching between the series (Table 2) was in many cases quite low, although a few individual series were checked by dating them against the independent dated reference material.

The samples also exhibited many more than normal numbers of sapwood rings, making the normal sapwood estimates non-applicable at this site. A single timber retained complete sapwood, and could be measured throughout its length. This sample, a joist, was found to have come from a tree felled in Spring 1588. The other series look as if they were probably felled at around the same time (Fig 2), although with the number of sapwood rings being impossible to determine in nearly all cases, this is not

entirely clear. The restricted growth towards the end of the trees' lives, and the abnormally high sapwood numbers, suggest that the trees probably grew in the same conditions, and the lack of good cross-matching reflects the nature of the growth exhibited, with many changes of growth rate.

When the series are combined into a single site series the resulting 174-year site chronology actually gives strong matches with the dated reference material (Table 3).

ACKNOWLEDGEMENTS

This study was commissioned by Margaret Dunn of the charity Dating Old Welsh Houses, in collaboration with Richard Suggett of the Royal Commission on Ancient and Historic Monuments of Wales who provided useful background information. This building is owned by CADW and is a Scheduled Ancient Monument, this work being carried out with the appropriate consent (dated 19th May 2014). We are very grateful to Ann Morgan and Tony Scharer who provided transport, did the field sketch, and assisted during the fieldwork. We thank our fellow dendrochronologists for permission to use their data.

Table 1: Details of samples taken from the Fedw Deg Old House

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
*** fedw1**	Transverse beam	1419–1558	1516	42 (+*c*28 NM)	140	1.10	0.47	0.24	1586–90
*** fedw2**	South-west half beam	1429–1536	-	-	(73NM) + 108	0.74	0.24	0.14	after 1547
*** fedw3**	2nd joist, south-west side	1500–1565	1540	25 (+ 20-25 NM)	66	1.68	0.92	0.19	1585–90
*** fedw4**	12th joist, south-west side	1414–1496	1496	H/S (+30NM)	83	1.63	1.32	0.26	after 1526
fedw5a	14th joist, south-west side	*1468–1532*	*1527*	*5*	*65*	*1.64*	*0.45*	*0.21*	
fedw5b	*ditto*	*1497–1537*	*1523*	*14 (+ 45-55 NM)*	*41*	*1.54*	*0.37*	*0.20*	
*** fedw5ab**	Mean of **a** + **b**	1468–1537	1523	14 (+ 45-55 NM)	70	1.63	0.45	0.21	1583–93
*** fedw6**	13th joist, north-east side	1483–1587	1538	49¼C	105	1.11	0.65	0.17	Spring 1588
*** fedw7**	14th joist, north-east side	1462–1563	1533	30	102	1.10	0.49	0.21	after 1564
***** = included in site master **FEDWDEG**		**1414–1587**			**174**	**1.21**	**0.74**	**0.16**	

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

Table 2: Cross-matching between the samples (values over 3.5 are significant)

	***t*-values**					
Sample	**fedw2**	**fedw3**	**fedw4**	**fedw5ab**	**fedw6**	**fedw7**
fedw1	2.2	0	1.4	2.4	1.2	3.1
fedw2		*	0.6	5.1	4.1	1.5
fedw3			*	*	6.3	2.1
fedw4				*	*	*
fedw5ab					3.3	4.0
fedw6						2.8

* = overlap too short to calculate meaningful *t*-value

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Table 3: Dating evidence for the site master **FEDWDEG AD 1414–1587** against dated reference chronologies, regional chronologies in **bold**

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap (yrs):*	*t-value:*
Regional chronologies						
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	174	11.5
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881–1745	174	9.7
Northern England	Northern England Master	(Hillam and Groves 1994)	**NORTH**	440–1742	174	8.8
Individual site chronologies						
Montgomeryshire	St Idloes Church, Llanidloes	(Miles *et al* 2003)	LNYDLOS2	1384–1593	174	9.2
Warwickshire	Gorcott Hall	(Nayling 2006)	GORC_T17	1385–1531	174	9.1
Shropshire	Roseleigh, All Stretton	(Miles *et al* 2007)	ALLSTRET	1386–1509	96	8.6
Lancashire	Worden Old Hall, Chorley	(Bridge 2003)	OLDWORD2	1415–1531	117	8.5
Merioneth	Cwrt Plas yn Dre	(Bridge *et al* 2013)	CWRTPLAS	1397–1508	95	8.3
Montgomeryshire	Gwernfyda Llanllugan	(Miles and Haddon-Reece 1996)	GWRNFYDA	1410–1551	138	8.3
Shropshire	Brookgate Farm	(Miles and Haddon-Reece 1993)	BROOKGT	1362–1611	174	8.2
Merioneth	Plas y Dduallt, Maentwrog	(Miles *et al* 2011)	GWYNEDD5	1355–1604	174	8.1
Montgomeryshire	Upper Wig, Dolfor	(Miles *et al* 2012)	UPPERWIG	1419–1571	153	8.1
Caernarvonshire	Bwthyn Cae-glas, Llanfrothen	(Miles *et al* 2006)	BDGLRT7	1386–1547	134	8.0
Montgomeryshire	Llanfihangel-yng-Ngwynfa, Pontrobert	(Miles et al 2004)	TYNCELYN	1375-1524	111	8.0

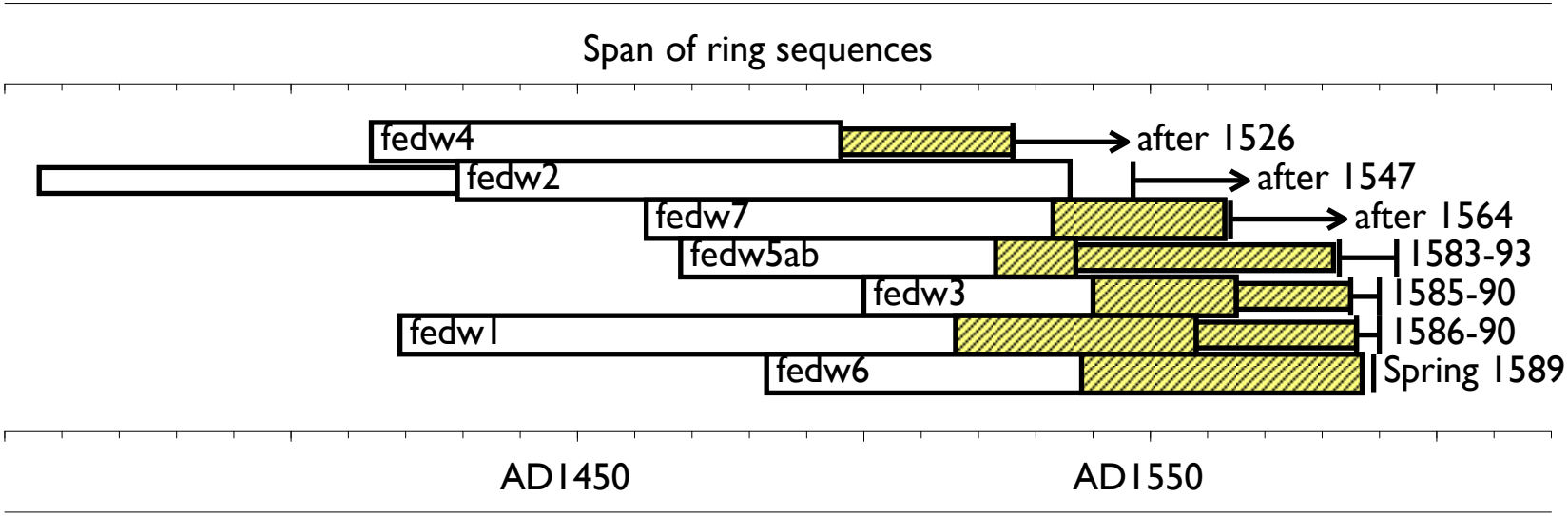

Figure 2: Bar diagram showing the relative positions of overlap of the cross-matched series. Hatched yellow sections represent sapwood rings, and narrow sections of bar represent additional unmeasured rings.

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APPENDIX Photos of areas sampled, after sampling

Figure 3. Photograph showing the locations of **fedw1** (main beam) and **fedw3** (joist)

Figure 4. Photograph showing the locations of samples **fedw2** (half beam), **fedw4** and **fedw 5** (joists)

Figure 5. Photograph showing the location of samples **fedw6** and **fedw7** (joists)

Figure 6. Screen (not sampled)