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Summary

This report describes the results of the dendrochronological analysis of samples taken from the gable ends of cross frames of the White House, Vowchurch, Herefordshire (NGR SO349357) a grade II* listed building presently undergoing renovation of its north-facing frontage. The removal of render from this frontage had exposed previously obscured timber framing indicating multi-period construction, which can be divided into four main phases on structural grounds.

The earliest phase, the easternmost surviving cross frame, has been dated to AD 1540, although subsequent alteration to give a close studded framing pattern remains undated. The second phase, comprising a single corner post immediately to the east, felled AD 1537-73, may represent reuse of a timber from phase 1 during construction of the cross frames of phase 3 or an intermediate phase. Phase 3, visible in the frontage as the remnants of a cross frame carrying two roof trusses, has been dated to AD 1602. Again, the frame pattern has been subsequently altered through the addition of close studding. One of these studs has given a felling date of AD 1532-68 suggesting possible reuse of phase 1 timbers. The latest phase of timber-frame construction, phase 4, a series of jettied gables, has not been dated by dendrochronology although the discovery of a drawing dated AD 1812 indicates that this phase pre-dates construction of a gothic wing to the east and can be placed in the date range AD 1602-1812.

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from the White House, Vowchurch, Herefordshire (NGR SO349357, Fig 1). Analysis of the timbers was requested by John Yates of English Heritage in order to date the development of the timber-framed phases of the house exposed during renovation of the gable ends following the removal of rendering and so inform listed building consent and subsequent renovation works.

Prior to the removal of render, which largely obscured the gable ends of the timber-framed elements of the White House, the complexity of the building's history had not been anticipated. Whilst it was clear that the gothic eastern wing was a nineteenth century addition, a seventeenth-century date had been assigned to the three surviving, north-south oriented wings (Pevsner 1977, 301). The obscurity of the building's origins was compounded by the lack of internally visible timberwork due to the lining of interior wall faces, presumably again in the nineteenth century. Once the render on the gable ends was removed, in order to restore the timber-framed frontage, a minimum of four phases of construction were noted on structural grounds (Fig 2). Phase 1 comprises the west wing, seen in its north-facing gable frontage as a two-storey cross frame. Phase 2 consists of a single corner post incorporated into the phase 3 cross frame, along with a small, half-lapped strut joining it to the phase 1 corner post. Phase 3 survives as a two-storey cross frame supporting the remnants of two roof trusses to the east of the phase 1 frame and joined to the phase 2 post. The raised roof line over the phase 3 wings and the jetted gables along the full suriving frontage of the timber framed wings is assigned to phase 4.

A sketch dated 1812, apparently showing the building prior to the construction of the east, gothic wing appears to confirm the multi-period nature of the timber-framed wings (Fig 3). The interpretation of this drawing is not however straightforward as the timber-framing, inserted mullion windows, and porch depicted cannot be directly equated with the observable timbers now exposed by renovation works. The accuracy of the drawing must be seen as questionable, although it does highlight a number of pertinent points. The presence of angled timbers, apparently bracing the northeast and northwest corners suggest the building was in poor structural condition, which may have encouraged its partial demolition in advance of the construction of the gothic wing and a porch at the west end. At least some of the gables are jettied at this time, suggesting that phase 4 pre-dates AD 1812. Finally, whilst the arrangement of earlier gables depicted in the drawing does not closely accord with those observable today (as with that of the inserted windows), it is nonetheless clear that the artist has depicted principal rafters associated with phase 3, and possibly phase 1 which had become encompassed by the raised phase 4 roof and timber framing. Having reviewed the evidence for the building's development through previous observations, the results of the dendrochronological analysis are interpreted below within the framework of the proposed phasing.

It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. As part of a multifaceted and multidisciplinary study of the building, elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication or an archive deposition on the building. The conclusions may therefore have to be modified in the light of subsequent work.

Methodology

Methods employed at the Lampeter Dendrochronology Laboratory in general follow those described in English Heritage (1998). Details of the methods used for the dating of this building are described below.

A brief survey identified those oak timbers from four successive phases with the most suitable ring sequences for analysis. Those with more than 50 annual rings and some survival of the original sapwood and bark-edge were sought. Timbers with less than 50 rings present were rejected as such short ring patterns may not be unique in time and may be repeated at a period of time other then the one over which the parent tree was growing (English Heritage 1998, 12; Mills 1988). The dendrochronological sampling programme attempted to obtain cores from as broad a range of timbers, in terms of structural element types, scantling sizes, and carpentry features, as was possible within the terms of the request.

The most promising timbers were sampled using a 15mm diameter corer attached to an electric drill. The cores were taken as closely as possible along the radius of the timbers so that the maximum number of rings could be obtained for subsequent analysis. The core holes were left open. Sanding revealed the ring sequences in the cores.

The complete sequences of growth rings in the samples that were selected for dating purposes were measured to an accuracy of 0.01mm using a microcomputer based travelling stage (Tyers 1997a). The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition cross-correlation algorithms (Baillie and Pilcher 1973; Munro 1984) were employed to search for positions where the ring sequences were highly correlated. These positions were checked visually using the graphs and, where these were satisfactory, new mean sequences were constructed from the synchronised sequences. The *t*-values reported below are derived from the original CROS algorithm (Baillie and Pilcher 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative or absolute position must be obtained from a range of independent sequences, and that satisfactory visual matching supports these positions. Timbers originally derived from the same parent tree generally have *t*-values greater than 10.0. Lower values from timbers obviously derived from the same parent tree (eg on morphological grounds) are however quite common. It is the visual similarity in medium term growth trends of the samples that is the critical factor in determining 'same tree' origin.

All the measured sequences from this assemblage were compared with each other and any found to cross-match were combined to form a site master curve. These and any remaining unmatched ring sequences

were tested against a range of reference chronologies, using the same matching criteria: high *t*-values, replicated values against a range of chronologies at the same position, and satisfactory visual matching. Where such positions are found these provide calendar dates for the ring-sequence.

The tree-ring dates produced by this process initially only date the rings present in the timber. The interpretation of these dates relies upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem (tpq)* for the felling of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings which are missing. This *tpq* may be many decades prior to the real felling date. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have been present. The sapwood estimates applied throughout this report are a minimum of 10 and maximum of 46 annual rings, following sapwood estimates given by Tyers (Tyers 1998a; English Heritage 1998). Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. Where the bark edge is particularly well preserved it may be possible to determine the season of felling. Where the final ring contains both earlywood, laid down in the spring, and complete latewood, laid down in the summer, then it is reasonable to conclude that the parent tree had been felled during the tree's dormant period. This is commonly referred to as 'winter felled'. Where only earlywood, or a combination of earlywood and incomplete latewood is present in the final ring, then the tree has been felled during its period of active growth. This is commonly referred to as 'spring/summer felled'. The dates obtained by the technique do not by themselves necessarily indicate the date of the structure from which they are derived. It is necessary to incorporate other specialist evidence concerning the re-use of timbers and the repairs of structures before the dendrochronological dates given here can be reliably interpreted as reflecting the construction date of phases within the structure.

Results

A total of eighteen samples were taken from seventeen timbers exposed in the gable ends, from at least four separate phases. The samples were numbered **1-18** inclusive (Table 1; Fig 2). The number of timbers present or suitable for analysis in each phase was limited, as were the opportunities for sampling timbers with surviving bark edge. Hence it was not possible to sample the recommended minimum number of samples for each phase (English Heritage 1998).

Following cleaning of the cores, one sample (**9**) was rejected for analysis as it had insufficient rings. The remaining seventeen samples were measured and the resultant ring sequences compared. Two samples from the same post at the northeast corner of the gable end of the phase 1 west wing (**2** and **12**) readily crossmatched (*t*-value = 15.52). A combined 157-year, raw ring width sequence for these was calculated (**2_12**). This sequence and eight other ring sequences crossmatched to form a 239-year site master chronology representing three mains phases and one sub-phase. The *t*-values for the computer correlations between these nine raw sequences, from which a site master sequence (WVT9) was calculated, are given in Table 2. This mean sequence and the sequences from the remaining, unmatched, individual timber

measurements were then compared with dated reference chronologies from throughout the British Isles and northern Europe. Table 3 shows the correlation of the mean sequence WVT9 with dated series at the dating position identified of AD 1364-1602. Table 4 lists the dated mean chronology and the relationships between the dated timbers are indicated graphically in Figure 4. None of the remaining sequences could be reliably dated.

Interpretation

Five samples from four separate timbers (one corner post, two beams, and one principal rafter) from phase 1 have dated. The date ranges produced for the felling of those samples with heartwood/sapwood boundaries are consistent with the bark edge date of AD 1540 derived from the corner post (Fig 4). Sample **3** matched well with these samples and could also have been felled in AD 1540. This date is earlier than that suggested by previous observation (Pevsner 1977, 301) or anticipated in the dendrochronology brief. During examination of the studs of this phase, as part of the assessment prior to sampling, it was noted that differences in the arrangement of pegs suggest that the frame was originally more open and that closer studding (including studs **6** and **8**) were inserted at a later date (phase 1a), possibly requiring the removal of rails which would originally have given the cross frame a square panel pattern. Neither sample has dated so dendrochronology can neither confirm nor refute this hypothesis.

The presence of a vertical rebate in the single corner post assigned to phase 2 has encouraged interpretation of this timber as a reused element. The felling date range of AD 1537-73 produced by the dendrochronological analysis shows that it predates the felling of timbers for the major structural elements of phase 3. It is possible that this timber originally formed part of the phase 1 building as the date of phase 1 (AD 1540) just falls within its felling date range. Alternatively, it could derive from an intermediate building phase not evident in the north-facing gables.

It would appear that the phase 3 wings had originally extended further to the east but were partially demolished in advance of construction of the gothic wing. A girding beam and a tiebeam (**11** and **14**) and one post (**16**) have produced dates consistent with felling in AD 1602 (Fig 4). As with the phase 1 cross frame, an originally open pattern of studding appears to have subsequently been altered with additional studs giving a close-studded pattern of framing, designated phase 3a. A sample from one of these studs (**10**), which appears to have blocked a possible doorway between the phase 2 corner post and the inserted window to the east, has given a felling date range of AD 1532-68. The most probable explanation for this date is the reuse of timber elements, possibly from phase 1 construction, in the closing up of the stud pattern. It is perhaps worth noting that the phasing of the undated sill beam (**4**) is uncertain as the timber was not completely exposed and could also be a later insertion.

It proved difficult to find timbers from the phase 4 jettied gables (Fig 2) which had sufficient rings to merit sampling and were also accessible for sampling. Combining the dendrochronological evidence for the date of phase 3 with the pictorial evidence in the drawing of 1812 (Fig 3) suggests a date of AD 1602-AD1812 for this phase. The dating of this phase could most probably be resolved by further tree-ring investigation

of timbers in the roof space of the central gable.

Acknowledgements

The sampling and analysis programme was funded by English Heritage. The owners, Mr and Mrs Marlow, were most accommodating in providing access, an insight into the history of the building and allowing reproduction of a nineteenth-century drawing of the property (see Fig 3). Peter Taylor of Stainburn Taylor Architects provided the elevation drawing employed in Figure 2 and generated useful discussion on potential phases of construction. The on-site contractor, Mr M P Davies, kindly assisted with the sampling programme by supplying ladders.

References

Baillie, M G L, and Pilcher, J R, 1973 A simple crossdating program for tree-ring research, *Tree Ring Bulletin*, **33**, 7-14

Boswijk, G, and Tyers, I, 1997 *Tree-ring analysis of Booth Hall and 16-18 High Town, Hereford*, Anc Mon Lab Rep, **101/97**

English Heritage, 1998 *Dendrochronology: guidelines on producing and interpreting dendrochronological dates*, London

Groves, C, and Hillam, J, 1993 *Tree-ring analysis of oak timbers from the medieval barn, King's Pyon, near Leominster, Hereford and Worcester, 1992 - Interim report*, Anc Mon Lab Rep, **24/93**

Groves, C, and Hillam, J, 1997 Tree ring analysis and dating of timbers, in *A multi-period salt production site at Droitwich: Excavations at Upwich 1983-4* (ed J D Hurst) CBA Res Rep, **107**, 121-6

Howard, R E, Laxton, R R, and Litton, C D, 1996 *Tree-ring analysis of timbers from Mercer's Hall, Gloucester*, Anc Mon Lab Rep, **13/96**

Laxton, R R, and Litton, C D, 1988 *An East Midlands master tree-ring chronology and its use for dating vernacular buildings*, University of Nottingham, Dept of Classical and Archaeological Studies, Monograph Series, **III**

Mills, C, 1988 Dendrochronology: the long and the short of it, in *Science and Archaeology, Glasgow 1987* (eds E A Slater and J O Tate), BAR Brit Ser, **196**, 549-65

Munro, M A R, 1984 An improved algorithm for crossdating tree-ring series, *Tree Ring Bulletin*, **44**, 17-27

Pevsner, N, 1977 *Herefordshire: the buildings of England*, London

Tyers, I, 1995 *Tree-ring analysis of St Bartholomew's Church, Lower Sapey, Hereford and Worcester*, Anc Mon Lab Rep, **14/95**

Tyers, I, 1996 *Tree-ring analysis of the tower of St John The Baptist Church, Mamble, Hereford and Worcester*, Anc Mon Lab Rep, **22/96**

Tyers, I, 1997a *Dendro for Windows program guide*, ARCUS Rep, **340**

Tyers, I, 1997b *Dendrochronological analysis of timbers from Lower House Farm, Tupsley, near Hereford*, ARCUS Rep, **296**

Tyers, I, 1997c *Tree-ring analysis of timbers from Sinai Park, Staffordshire*, Anc Mon Lab Rep, **80/97**

Tyers, I, 1998a *Tree-Ring analysis and wood identification of timbers excavated on the Magistrates Court Site, Kingston upon Hull, East Yorkshire*, ARCUS Rep, **410**

Tyers, I, 1998b *Tree-Ring analysis of oak timbers from Penrhos Court, near Kington, Herefordshire*, Anc Mon Lab Rep, **31/98**

Tyers, I, 1998c *Tree-Ring analysis of oak timbers from St Nicholas' Church, Warndon, Worcestershire*, Anc Mon Lab Rep, **34/98**

Tyers, I, 1999a *Tree-ring analysis of the bell tower of the Church of St Mary, Pembridge, Herefordshire*, Anc Mon Lab Rep, **1/99**

Tyers, I, 1999b *Dendrochronological analysis of timbers from Black Ladies, near Brewood, Staffordshire*, ARCUS Rep, **484**

Tyers, I, and Boswijk, G, 1998 *Tree-ring analysis of oak timbers from Dore Abbey, Abbey Dore, Herefordshire*, Anc Mon Lab Rep, **18/98**

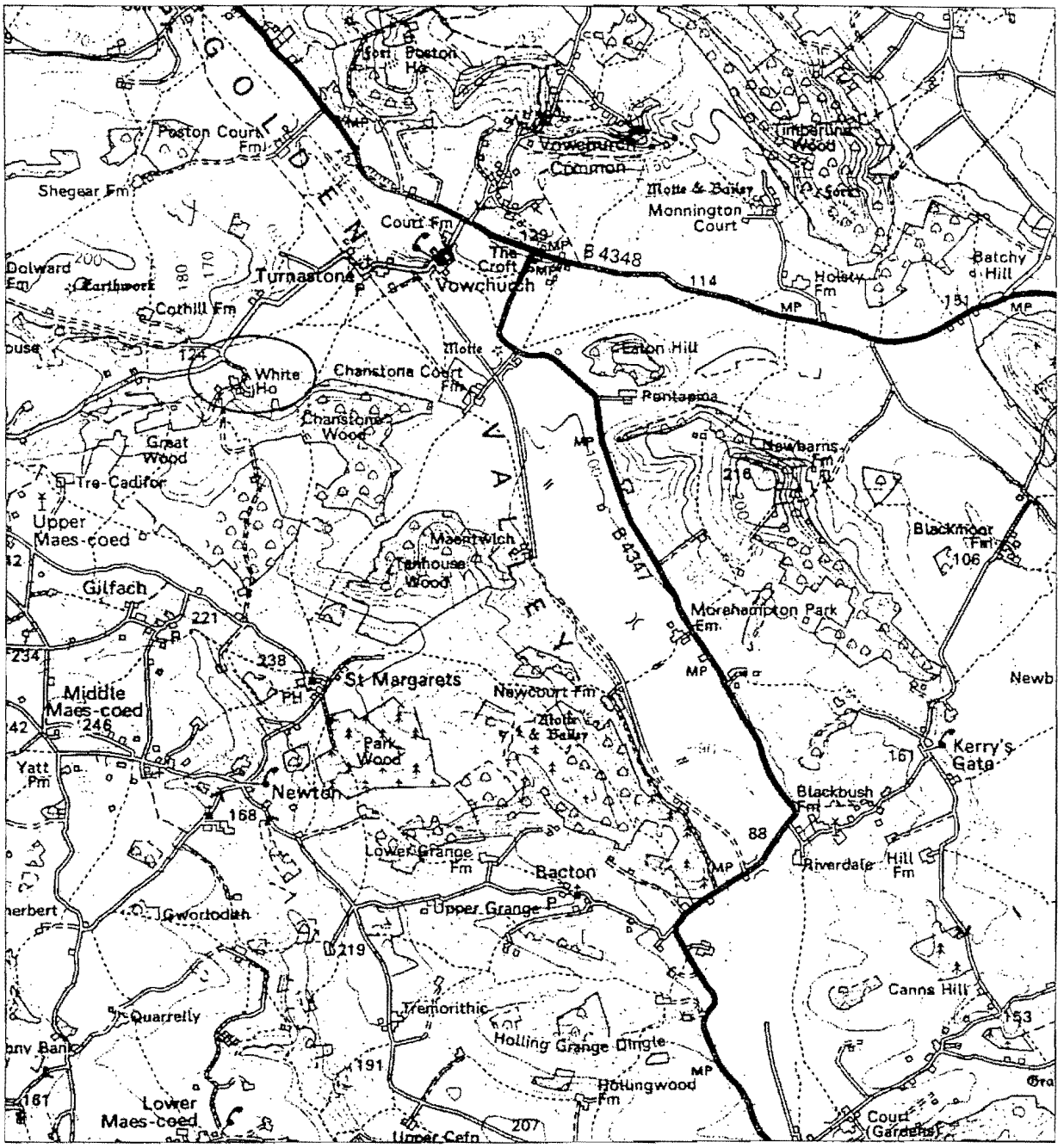

Figure 2 Elevation drawing of the north-facing gable ends of the White House, Vowchurch indicating the main phases (see legend) and showing sample locations (after drawing supplied by Stainburn Taylor Architects)

Figure 3 Anonymous drawing of the White House, Vowchurch dated 1812 prior to the construction of the Gothic wing (by kind permission of the owners, Mr and Mrs Marlow).

Figure 4 Bar diagram showing the chronological positions of the dated timbers by phase.

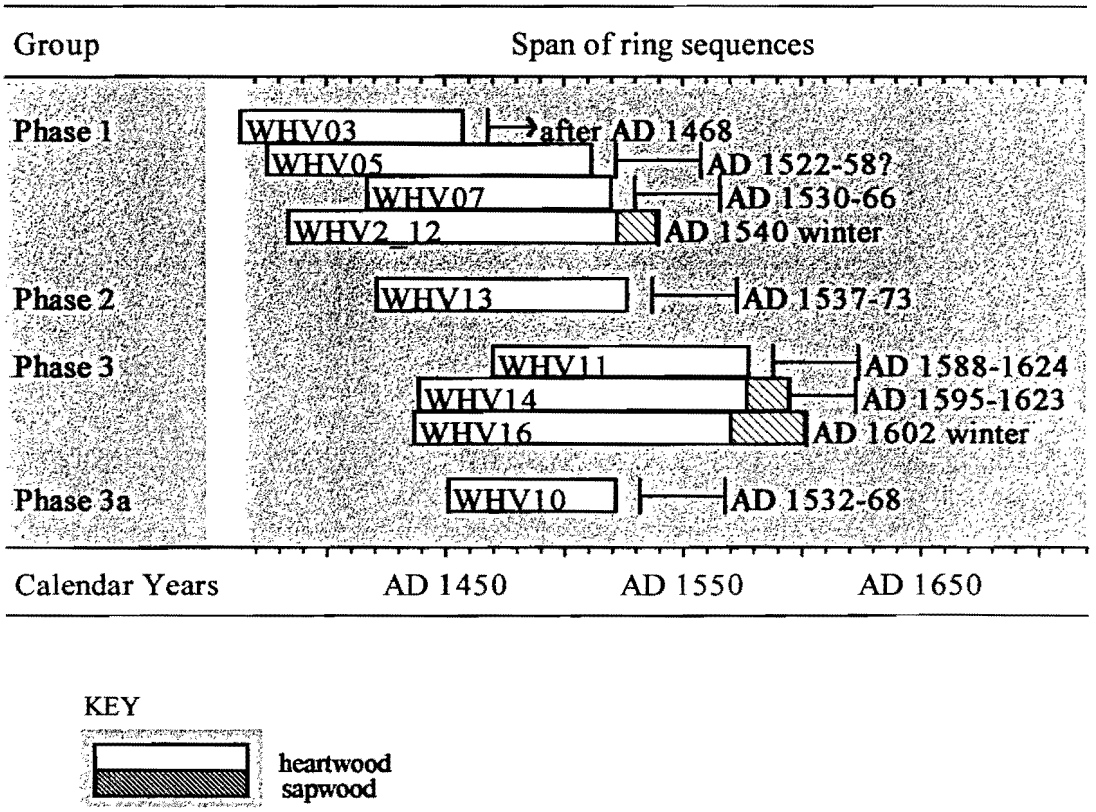

Table 1

List of samples

Core no	Origin of core	Cross-section size (mm)	Cross-section of tree	Total rings	Sapwood rings	ARW mm/year	Date of sequence	Felling period
01	Sill beam, phase 1	320 x 300	whole	55	h/s	3.61	Undated	
02	Post, phase 1 (same timber as sample 12)	260 x 250	quarter	120	?h/s	2.19	AD 1384-1503	AD 1513-49?
03	Girding beam, phase 1	240 x 150	quarter	95	0	2.29	AD 1364-1458	after AD 1468
04	Sill beam, phase 3	240 x 240	whole	66	30+b	2.08	Undated	
05	Principal rafter, phase 1	400 x 160	half	138	?h/s	1.52	AD 1375-1512	AD 1522-58?
06	Stud, phase 1a	230 x 100	radial	67	0	3.54	Undated	
07	Girding beam, phase 1	240 x 120	half	104	h/s	1.51	AD 1417-1520	AD 1531-67
08	Stud, phase 1a	230 x 100	radial	115	47+b	1.81	Undated	
09	Principal rafter, phase 1	380 x 150	half	<50		-	Unmeasured	
10	Stud, phase 3a	115 x 105	quarter	72	h/s	1.58	AD 1451-1522	AD 1532-68
11	Girding beam, phase 3	290 x 140	quarter	109	h/s	2.00	AD 1470-1578	AD 1588-1624
12	Post, phase 1 (same timber as sample 02)	260 x 210	quarter	150	18+bw	2.10	AD 1391-1540	AD 1540 winter
13	Post, phase 2	310 x 280	quarter	107	?h/s	3.34	AD 1421-1527	AD 1537-73
14	Tie beam, phase 3	235 x 165	quarter	157	18	1.09	AD 1439-1595	AD 1595-1623
15	Principal rafter, phase 3	390 x 145	radial	118	h/s+17s+bs	1.20	Undated	
16	Post, phase 3	275 x 160	half	166	32+bw	1.53	AD 1437-1602	AD 1602 winter
17	Principal rafter, phase 4	245 x 125	quarter	115	0	1.46	Undated	
18	Stud, phase 4	145 x 100	quarter	74	11	1.23	Undated	

Total rings = all measured rings, +value means additional rings were only counted, the felling period column is calculated using these additional rings.
Sapwood rings: h/s heartwood/sapwood boundary, ?h/s possible heartwood/sapwood boundary, +bw = bark-edge winter felled, +bs = unmeasured spring growth also present; ARW = average ring width of the measured rings

Table 2

t-value matrix for dated samples grouped by phase. \ = overlap < 15 years. - = t-values less than 3.00

Phase		1			2	3			3a
	Sample	03	05	07	13	11	14	16	10
1	2_12	7.10	5.55	4.12	5.05	-	6.34	4.68	6.70
	03	*	5.26	-	-	\	-	-	\
	05	*	*	3.10	3.66	-	-	-	3.22
	07	*	*	*	3.04	-	4.21	3.90	3.71
2	13	*	*	*	*	3.53	3.92	5.06	3.71
3	11	*	*	*	*	*	3.76	5.68	-
	14	*	*	*	*	*	*	3.80	3.93
	16	*	*	*	*	*	*	*	-

Table 3

Dating the mean sequence WVT9, AD 1364-1602 inclusive. *t*-values with independent reference chronologies

Area	Reference chronology	*t*-values
East Midlands	East Midlands (Laxton and Litton 1988)	9.65
Gloucestershire	Mercer's Hall, Gloucester (Howard *et al* 1996)	10.77
Herefordshire	Dore Abbey Church (Tyers and Boswijk 1998)	11.45
Herefordshire	16-18 Hightown/Booth Hall, Hereford (Boswijk and Tyers 1997)	8.70
Herefordshire	Kings Pyon barn, Herefordshire (Groves and Hillam 1993)	9.82
Herefordshire	St Bartholomews, Lower Sapey (Tyers 1995)	9.33
Herefordshire	Mamble Church, phase B (Tyers 1996)	7.65
Herefordshire	Pembridge Belltower (Tyers 1999a)	8.37
Herefordshire	Penrhos Court, Kington (Tyers 1998b)	8.45
Herefordshire	Lower House Farm Tupsley (Tyers 1997b)	7.80
Staffordshire	Black Ladies, nr Brewood (Tyers 1999b)	10.43
Staffordshire	Sinai Park (Tyers 1997c)	9.67
Worcestershire	Droitwich (Groves and Hillam 1997)	8.06
Worcestershire	St Nicholas' Church, Warndon (Tyers 1998c)	8.17

Table 4

Ring-width data from site master WVT9 dated to AD 1364-1602 inclusive.

Date	Ring widths (0.01mm)											No of samples							
AD 1364				613	414	455	430	350	524	339			1	1	1	1	1	1	1
-	322	364	370	363	275	280	237	213	332	275	1	1	1	1	2	2	2	2	2
-	220	250	271	334	320	385	285	336	269	195	2	2	2	3	3	3	3	3	3
-	278	215	274	209	244	312	231	232	261	289	3	3	3	3	3	3	3	3	3
AD 1401	252	210	310	251	205	219	196	249	255	204	3	3	3	3	3	3	3	3	3
-	142	170	201	234	251	219	233	227	138	263	3	3	3	3	3	3	4	4	4
-	305	215	299	274	306	308	272	311	289	277	5	5	5	5	5	5	5	5	5
-	262	284	197	227	247	235	230	216	173	182	5	5	5	5	5	5	6	6	7
-	199	168	176	231	175	199	206	193	207	186	7	7	7	7	7	7	7	7	7
AD 1451	210	183	188	195	169	219	196	193	171	224	8	8	8	8	8	8	8	8	7
-	200	189	217	138	150	211	209	184	151	177	7	7	7	7	7	7	7	7	8
-	177	148	141	148	196	192	171	160	178	155	8	8	8	8	8	8	8	8	8
-	197	184	203	180	148	151	186	157	147	134	8	8	8	8	8	8	8	8	8
-	122	121	137	126	126	188	152	130	162	160	8	8	8	8	8	8	8	8	8
AD 1501	133	145	134	144	153	136	173	157	174	150	8	8	8	8	8	8	8	8	8
-	161	171	174	167	167	128	157	170	232	134	8	8	7	7	7	7	7	7	7
-	191	227	190	190	163	180	158	179	161	142	6	6	5	5	5	5	5	4	4
-	172	125	138	162	167	161	145	150	156	172	4	4	4	4	4	4	4	4	4
-	162	123	124	144	139	131	143	157	155	178	3	3	3	3	3	3	3	3	3
AD 1551	156	107	108	130	148	118	111	138	151	148	3	3	3	3	3	3	3	3	3
-	152	132	129	161	130	116	116	124	137	142	3	3	3	3	3	3	3	3	3
-	125	110	121	156	141	165	134	104	99	108	3	3	3	3	3	3	3	2	2
-	77	96	88	117	110	104	115	111	117	100	2	2	2	2	2	2	2	2	2
-	110	116	125	141	127	133	129	157	142	130	2	2	2	2	2	1	1	1	1
AD 1601	146	147									1	1							