Ancient Monuments Laboratory
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Summary

Stayley Hall, comprising a central hall and east and west jettied cross-wings, and located on a spur overlooking the Tame valley and Millbrook, is a grade II listed manor house in an advanced stage of decay reflected in its status as a category A building at risk. Dendrochronological analysis of samples from the hall and cross wings suggest that they are broadly contemporary, having been constructed in the mid-1550's. The timber framing was subsequently clad in stone, some time after AD 1557. A felling date of AD 1556 is associated with an inserted door in the western wall of the west wing providing access to a stair turret. A further inserted door in the same wall, dated to AD 1563, suggests alterations in anticipation of the construction of a western extension dated to AD 1565. The results date primary construction of the hall to the mid-sixteenth century. Hence, cusped windbraces observed in the roof prior to its collapse could not have been in situ medieval survivals, although they could have been reused from an earlier building indicated by documentary evidence.

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from the now much decayed manor house of Stayley Hall (NGR SJ976996), a grade II listed building and a category A Building at Risk (English Heritage 1998a). 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.

Documentary evidence suggests that the present house, located on a spur overlooking the Tame valley and Millbrook, occupies the site of an older hall associated with the De Staveley family. The main house, comprising a central hall and east and west jettied cross-wings, is of timber framed construction on two storeys, now clad in later stonework with an attic floor inserted. The timber frame was thought to date to the later sixteenth century but the presence of cusped windbraces in parts of the roof, and of moulded principals in two of the trusses in the west wing raises the possibility that the house encapsulated elements of a medieval building, or that timbers from an earlier hall had been reused. A ceiling over the first floor with an attic above seems unusual if it was part of the original construction as it would have obscured the decorated roof elements. To the west, on a slightly different alignment, a two-storey timber-framed range of three bays, separated from the main house by a large chimney stack but joined to it by a timber-framed stair turret, is thought to be somewhat later in date, possibly seventeenth century.

Leggett (1980) had undertaken dendrochronological analysis of timbers from the hall as part of a post-graduate thesis. The study was undertaken during the pioneering days of buildings' dendrochronology, before sampling strategies had been developed which concentrated on addressing questions raised during structural analysis. Hence this previous analysis had not resolved the dating of the individual ranges within the building complex adequately and has the added complication that it is not now possible to determine which individual timber elements were actually sampled. A new dendrochronological survey was therefore commissioned by Jane Harding of English Heritage to inform restoration and repair in due course and to promote action on this now derelict building. The main objectives of the survey were to provide precise dating evidence for the construction of the main house and hence establish whether the hall, the two flanking cross-wings, the central porch, and the two-storey bay in each of the hall/cross-wing re-entrant angles, were, as suggested by architectural evidence, all contemporary. In addition it was hoped to clarify whether the attic floor frame was a later insertion and to identify whether the cusped windbraces were reused timbers from an earlier building or were *in situ* survivals of a medieval building. Dating evidence was also sought for the western extension thought to date to the seventeenth century.

Methodology

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

An assessment survey identified those oak timbers 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. 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 whilst also meeting health and safety requirements.

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. The ring sequences in the cores were revealed by sanding.

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 micro-computer 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, where these figures indicate the 95% confidence limits of the range. These figures are applicable to oaks from the British Isles (Tyers 1998). Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. 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

On visiting the buildings, it was immediately apparent that the building had decayed considerably since recording by the Royal Commission for Historic Monuments in 1976, and the production of a report on the buildings' condition and possible future by the Greater Manchester Council (Millar 1976). At that time, although the southern half of the east-wing roof had collapsed, the majority of the roof cover of large gritstone slabs on the main house was still in place. Now none of this roof survives. A substantial collapse in the early 1990s (of the west wing, stair turret, and western extension) led to the removal of a large number of dislocated timbers to storage in an adjacent eighteenth-century barn where they still remain (Fletcher pers comm).

In the east wing, no timbers survive *in situ* above the first-floor/ground-floor ceiling where dragon beams and bridging beams are held propped in position in a dangerous and poor condition. Not all the ground-floor storey posts survive and sill beams are either absent or rotted. Some roof trusses and cusped windbraces survive *in situ* in the central hall but the majority of the roof and attic floor has been lost and what survives is not safely accessible. The first floor of the hall range has slumped with the collapse of a number of bridging beams and is held in position by softwood props. The west wing is in a similar condition to that on the east with timbers surviving only on the ground floor except in the south-west corner. No roof cover survives in the western extension and apart from the partial survival of two roof trusses in the south-west, remaining timbers are limited to window lintels in the stone walling.

Given the poor condition of the building and the lack of safe access to roof level, the tree-ring sampling programme was constrained to timbers on the ground floor or those accessible from the ground using a ladder. The sampling programme also excluded the timbers stored in the nearby barn. There was clearly a mixture of timber, including some softwoods, and at the time of sampling no architectural information concerning their approximate location within the building and hence their importance to the understanding of the building complex was available. This, combined with the obvious unsuitability of those which were accessible, led to the rejection of all of these dislocated timbers. Hence it was apparent during assessment that it would not be possible to address some of the original objectives of the exercise, namely dating of the cusped windbraces and other decorated roof elements, and that of the attic floor.

A total of 30 timbers were selected as most suitable for sampling (Table 1; Figs 1-3). The samples were numbered **1-30** inclusive. Attempts to sample two of these timbers (**5** and **28**) were abandoned during coring. The sill beam in the western extension (**5**) proved to be completely rotten and no sample was recovered. The core from a door/storey post (**28**) broke into many pieces during drilling, and sampling was abandoned. Three samples (**1**, **2**, and **19**) when examined in the laboratory were rejected due to an insufficient number of rings for reliable analysis (Table 1). The resultant 25 series were initially compared with each other. Twenty of the samples cross-matched to form an internally consistent group (Table 2). A 179-year twenty-timber mean named STAY20 was calculated and then compared with dated reference chronologies from throughout the British Isles and northern Europe. Table 3 shows the correlation of the mean sequence at the dating position identified at AD 1387-1565 inclusive. Table 4 lists the mean sequence STAY20 and the dated series are indicated graphically in Figure 4.

The five measured samples that did not match the rest of the material were compared with dated reference chronologies from throughout the British Isles and northern Europe without any dating being obtained.

Interpretation

All the dated samples where felling date ranges can be estimated, given the presence of the heartwood/sapwood boundary or partial sapwood, appear to derive from trees felled in the latter half of the sixteenth century (Fig 4; Table 1). None of the timbers from which samples were taken showed signs of reuse (such as redundant joints) but some of the timbers in the western extension which were rejected as unsuitable for sampling were probably reused. The results are interpreted below with reference to the ranges from which the dated samples were taken.

The single dated sample from the east wing (a storey post, sample **18**) indicates construction after AD 1533.

A total of nine samples from the hall range have been dated. It is unlikely that these represent a single episode of felling because the date of the heartwood/sapwood boundary in sample **13** is significantly later than that in the other dated samples from this range. Caution would seem advisable in the interpretation of the *tpq* indicated for this rail (**13**) as the timber was dovetailed into the rail to its south and ran north into the stone cladding (Fig 2). Hence it may have more bearing on the date of the addition of the stone casing (after AD 1557) than the original construction of the hall range. In contrast, the four samples from storey posts, two on the ground floor (**16** and **29**), and two from the first floor (**20** and **25**), provide dates which are consistent with a single episode of felling in AD 1549-78. As storey posts, particularly from the ground floor, are structurally significant and difficult to replace, it is likely that these timbers form part of the original construction. The results from the studs (**11** and **12**), sill (**17**) and dragon beam (**30**) are consistent with the results from the storey posts and so there is no reason, from the dendrochronological results, not to assume that the storey posts, studs, sill, and dragon beam are contemporary. The estimated felling date range for all these, apparently primary, timbers from the hall range is AD 1552-1575.

However, this estimate can be further refined because it was noted at the time of sampling that sample **30** was from a timber with bark edge and approximately 3mm of sapwood from the bark was lost on coring. From the average ring width of this sample as a whole (Table 1) and that of the later, narrower sapwood rings, it can be seen that probably between two and five rings have been lost, suggesting a felling date range for this timber of AD 1554-9.

A total of seven samples from the west wing have been dated indicating construction of this range in the felling date range AD 1554-?62, with a bark edge date from a rail suggesting construction in AD 1556. Interpretation of the results is not straightforward, with the insertion of doors into the west wall to allow entrance to a stair turret and the later extension, creating complications. Three dated storey posts (**7**, **22**, and **24**) provide a secure combined felling date range of AD 1554-82 for the original construction of this wing. The sample from the sill (**8**) could be consistent with this felling range possibly refining it to AD 1554-?62. It should however be stressed that the identification of the heartwood/sapwood boundary on this timber was not definite (Table 1). Three samples from this wing with bark edge have dated. Sample **23**, from a rail carved to form the head of a door produced a felling date of winter AD1556. This doorway provided an opening from the northernmost room in the west wing, westwards to a passage adjacent to the stair turret, north of the chimney stack in the western extension. It is debatable whether this doorway is original especially as the north-south sill of the west wall of the main house has apparently been cut through to form the opening. It has also been argued (RCHME notes 1976) that this communicating doorway is not as neatly pegged in as a similar doorway which once existed overhead on the first floor. The two other timbers (samples **9** and **10**), which have both produced a felling date of AD 1563 were observed to derive from the same tree on morphological grounds during sampling. The high *t*-value of 8.96 between their ring-width sequences supports this interpretation (Table 2). The parent timbers of these samples were both studs in the west wall, to the north and over a further inserted door that led from the southern room in the west wing to the western extension south of the chimney stack.

Three samples from the western extension have produced dates (**3**, **6**, and **21**) suggesting construction in AD 1565. In contrast to expected dating on stylistic/structural grounds to the seventeenth century, all three samples indicate felling in the mid- to late-sixteenth century, with sample **3** from a first floor doorpost providing a felling date of AD1565. This is only two years after that of the pair of dated studs in the west wing. It could be argued that the window lintel (sample **21**, felled AD 1550-86) could have been reused but this hardly seems a credible line to take with respect to both the girding beam (sample **6**, felled AD 1534-70) and doorpost.

Interpretation of the dendrochronological results as a whole point to an AD 1554-78 felling date range for the main house with the possibility, assuming that the dragon beam in the hall and the rail in the west wing are associated with the primary construction phase, that it was constructed in the AD 1550s. The studs over the southern inserted door in the west wall of the west wing, felled in AD 1563, could indicate the date of this door's insertion and suggest that construction of the western extension, dated to AD 1565, was anticipated at this time.

Conclusion

Extensive sampling has produced a robust, well-replicated chronology. All 20 dated samples are clearly broadly contemporaneous. The 16 timbers for which it has been possible to provide either precise felling dates or felling date ranges appear to be derived from trees felled in the mid- to late-sixteenth century. The *termini post quem* provided for the four remaining dated timbers lie in the early- to mid-sixteenth century and are therefore not inconsistent with felling in the mid- to late-sixteenth century.

This site master curve matches well with that produced by Leggett with a high *t*-value of 9.95 (Table3). The new master is somewhat shorter (179 years compared with 190 years) although its runs slightly later (to AD 1565 compared with AD1554), and exhibits improved computer correlations against a range of regional chronologies and site masters, probably due to the large number of samples it contains.

Due to the lack of safe access, and the collapse and loss of a number of the relevant timbers, it has not proved possible to address the dating of the cusped windbraces and moulded principals. Given the consistent dating of ground floor timbers to the sixteenth century however, these decorated elements could not be *in situ* survivals of a medieval precursor to the present hall, though it is clearly not impossible that they are reused elements.

The dendrochronological analysis has indicated that the main house was constructed from timbers felled in the mid- to late-sixteenth century, though it is not possible to determine whether the individual ranges within this main complex are precisely contemporary. Unexpectedly the three dated timbers from the western extension also appear to imply a construction date in the mid- to late-sixteenth century.

The apparent construction of the western extension only shortly after that of the hall and its cross-wings would tend to support a suggestion posited in RCHME notes (1976) that this extension was anticipated during the construction of the hall. Dating of the now collapsed stair turret, located on the outside of the west wall of the west wing and subsequently enclosed within the western extension could prove illuminating in understanding the development of this building complex. Critical examination of timbers now held in store on the site in association with study of the archive produced during the clearance of these timbers by the Lancashire Archaeological Unit could address this issue.

Acknowledgements

The sampling and analysis programme was funded by English Heritage. Graham Hitchen of Cordingleys kindly provided access on behalf of the landowner. Mark Fletcher of West Yorkshire Archaeological Services explained the circumstances of the recent collapse of elements of the building in the early 1990's. Ian Tyers provided invaluable assistance with the programme of sampling in this unstable group of buildings.

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Figure 1 Plan of the ground floor of Stayley Hall showing position and orientation of elevation (B-B') and indicating sample locations. See Fig 2 for elevation (after RCHME)

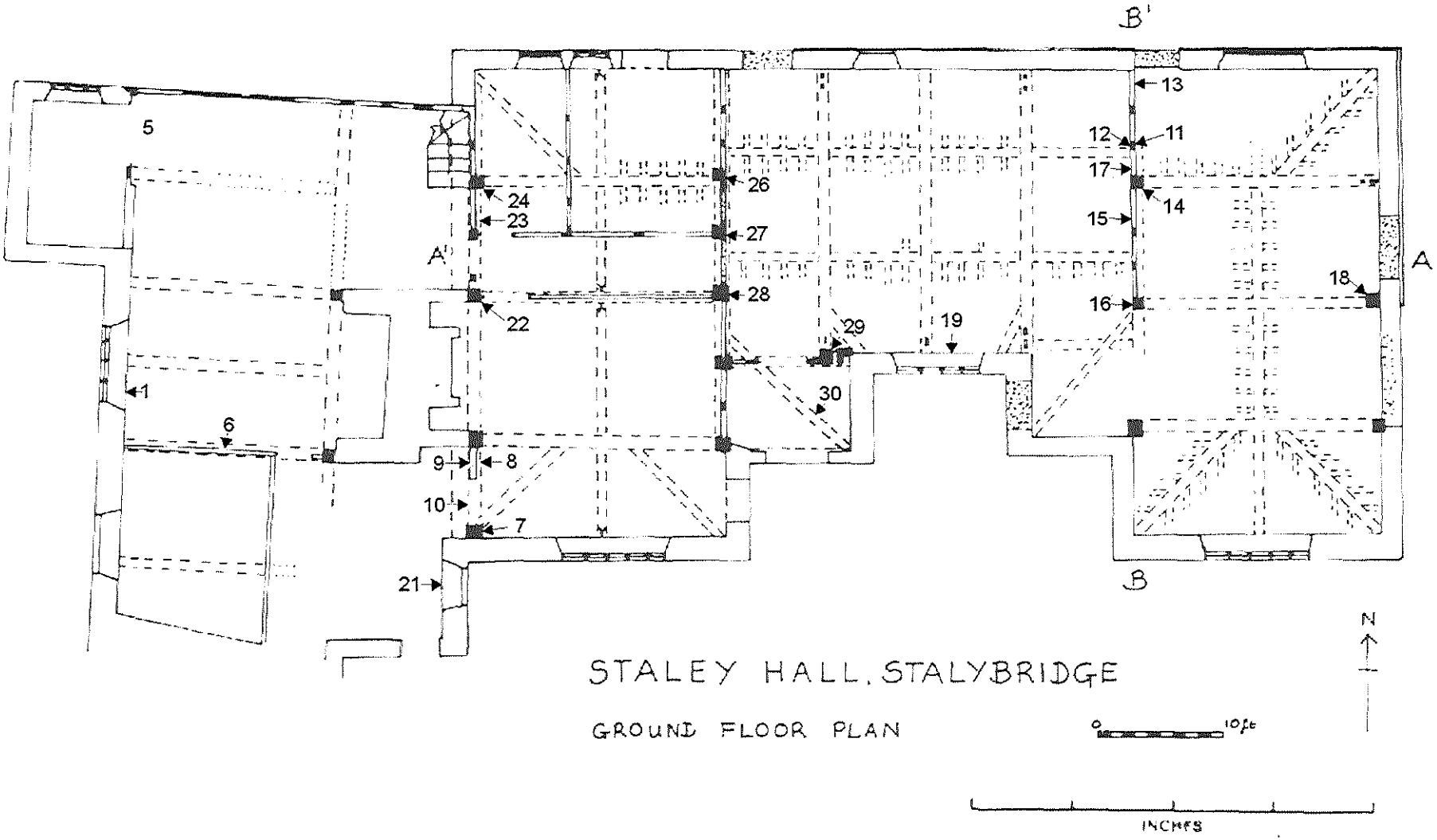


Figure 2 Elevation of partition wall between the hall range and the east cross-wing showing sample locations (B-B[1] in Fig 1) (after RCHME)

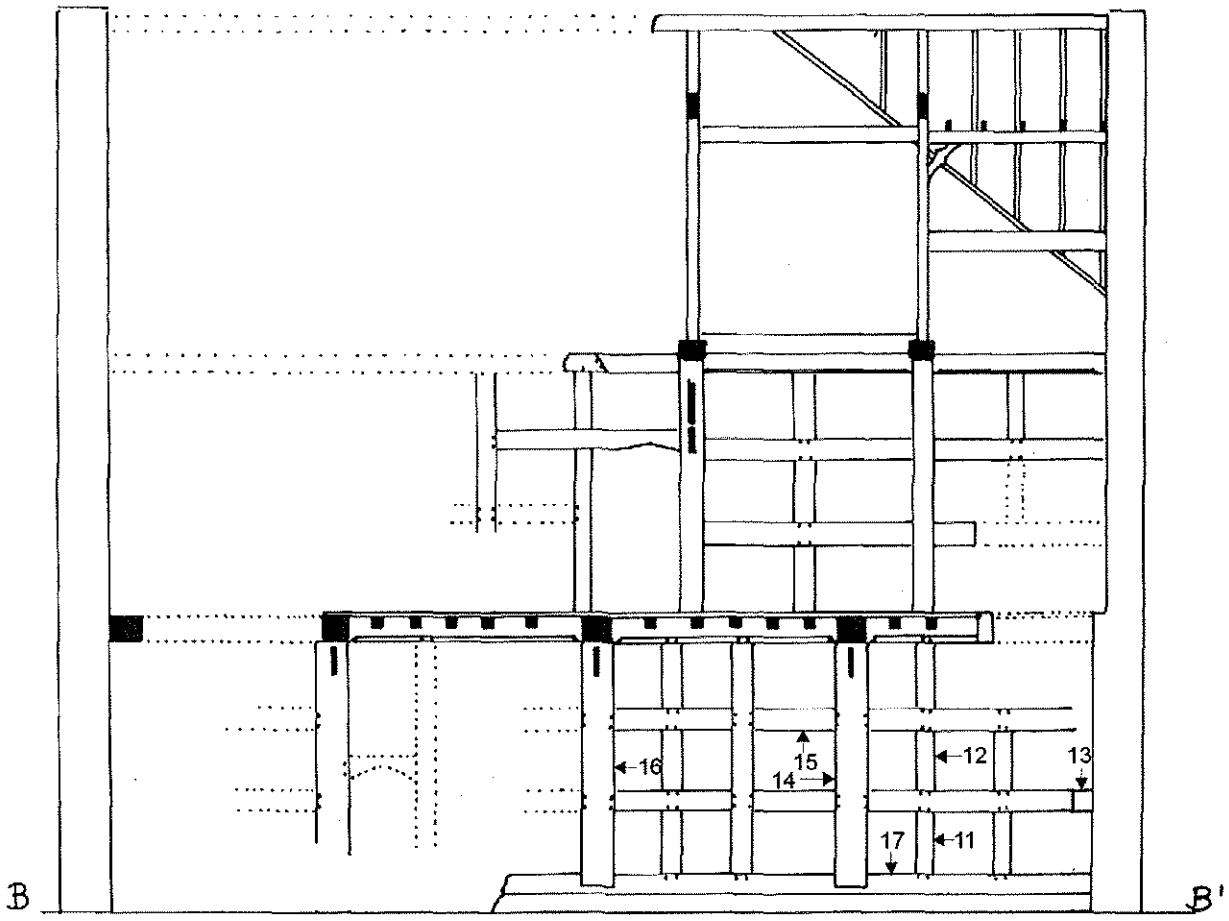


Figure 3 Plan of the first floor of Stayley Hall indicating sample locations (after RCHME)

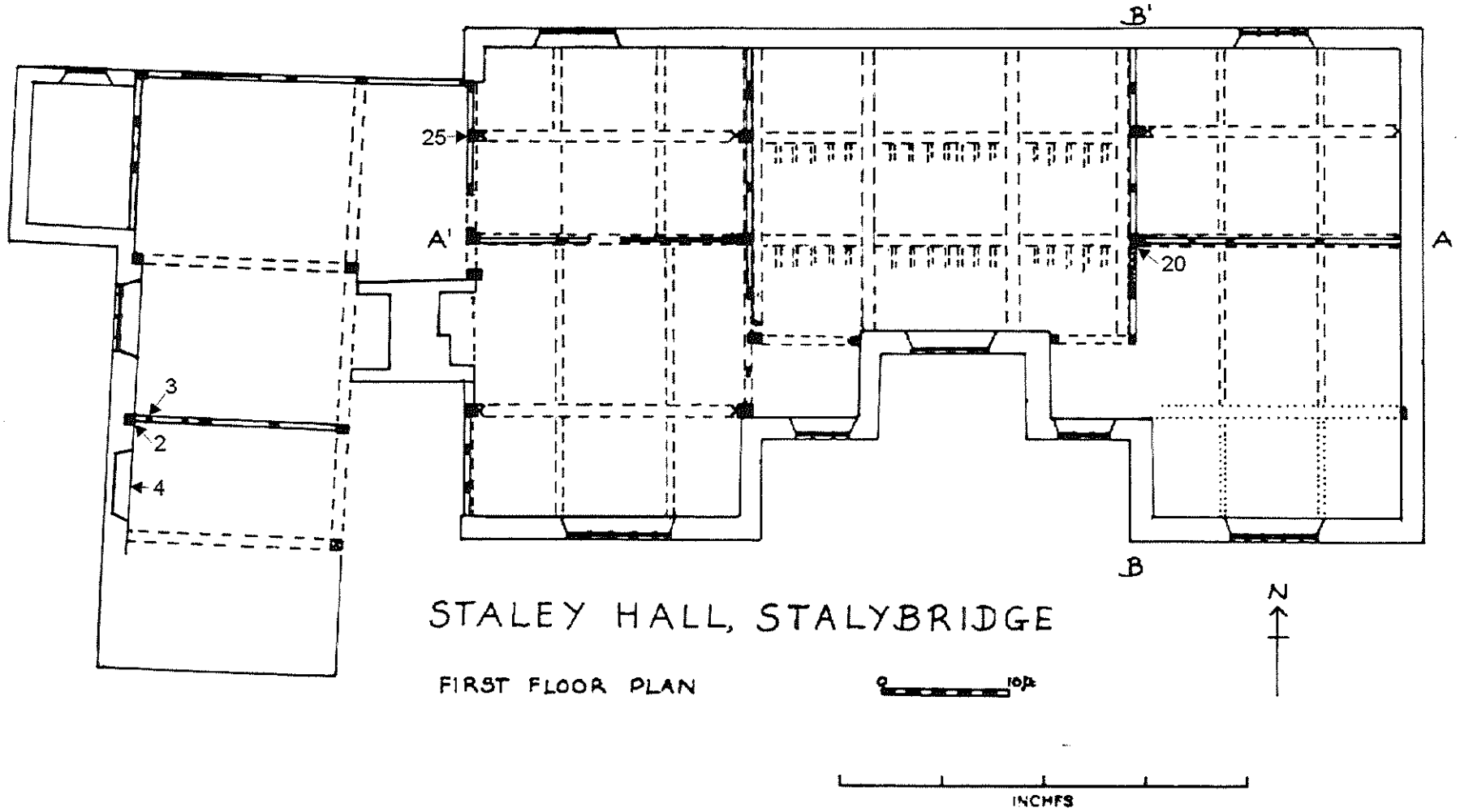
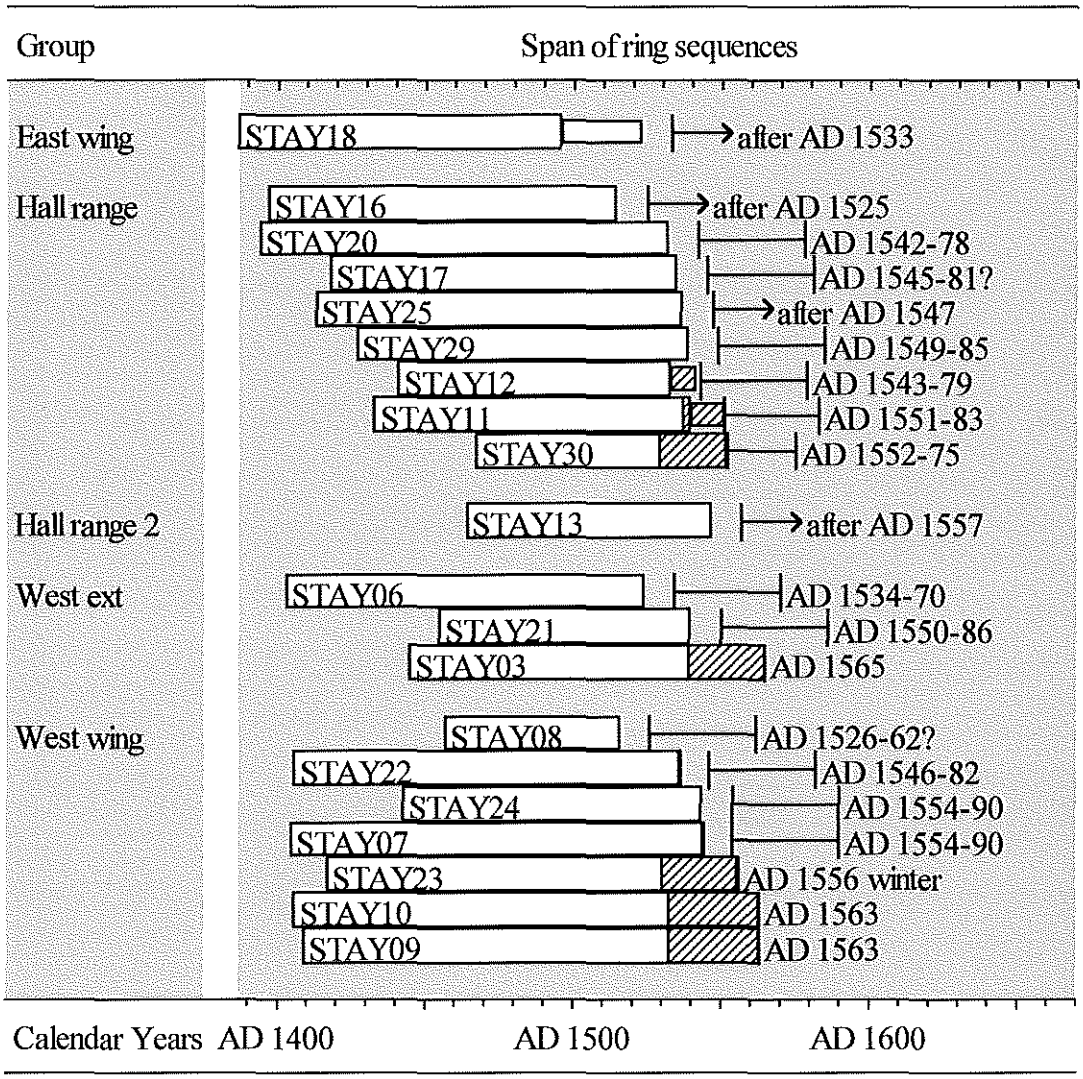


Figure 4 Bar diagram showing the chronological positions of the 20 dated timbers. The felling period for each sequence is also shown



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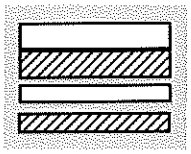

heartwood
sapwood
unmeasured heartwood
unmeasured sapwood

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	West extension, ground-floor window lintel	190 x 170	Whole	*c* 30	-	-	Unmeasured	
02	West extension, first-floor wall post	230 x 230	Whole	*c* 40	-		Unmeasured	
03	West extension, first-floor door post	200 x 95	Quarter	121	26+b	0.86	AD 1445-AD 1565	AD 1565
04	West extension, first-floor window lintel	235 x 140	Quarter	119	-	1.54	Undated	
05	West extension, sill beam (failed core)	-	-	-	-		Unmeasured	
06	West extension, girding beam	300 x 300	Whole	122	h/s	1.23	AD 1403-AD 1524	AD 1534-70
07	West wing, storey post, south-west corner	350 x 330	Whole	141	1	1.22	AD 1405-AD 1545	AD 1554-90
08	West wing, sill beam	260 x 250	Quarter	60	h/s?	2.18	AD 1457-AD 1516	AD 1526-?62
09	West wing, stud north of inserted door	235 x 110	Half	155	31+b	0.90	AD 1409-AD 1563	AD 1563
10	West wing, stud over inserted door	220 x 110	Half	158	31+b	0.99	AD 1406-AD 1563	AD 1563
11	Hall range, stud	220 x 110	Quarter	108+s11	3+s11	1.32	AD 1433-AD 1540	AD 1551-83
12	Hall range, stud	220 x 110	Quarter	93+s9	h/s+s9	1.98	AD 1441-AD 1533	AD 1543-79
13	Hall range, rail	220 x 110	Quarter	84	-	1.30	AD 1464-AD 1547	after AD 1557
14	Hall range, storey post	340 x 330	Whole	133	h/s	1.57	Undated	
15	Hall range, rail	220 x 110	Half	74	-	2.76	Undated	
16	Hall range, storey post	290 x 280	Whole	119	-	1.46	AD 1397-AD 1515	after AD 1525
17	Hall range, sill beam	250 x 235	Quarter	118	h/s?	1.96	AD 1418-AD 1535	AD 1545-81?
18	East wing, storey post	340 x 330	Whole	110+h27	-	1.76	AD 1387-AD 1496	after AD 1533
19	Hall range, lintel over window in south central gable	230 x 200	Whole	*c* 40	-	-	Unmeasured	
20	Hall range, first-floor storey post	450 x 260	Half	139	h/s	1.71	AD 1394-AD 1532	AD 1542-78
21	West extension, lintel over window in north-south wall	270 x 170	Half	86	h/s	1.15	AD 1455-AD 1540	AD 1550-86
22	West wing, storey post	350 x 330	Whole	132	1	1.19	AD 1406-AD 1537	AD 1546-82
23	West wing, rail carved to form head of door	300 x 120	Half	140	26+bw	1.02	AD 1417-AD 1556	AD 1556 (w)
24	West wing, storey post	350 x 330	Half	102	h/s	1.82	AD 1443-AD 1544	AD 1554-90
25	Hall range, first-floor storey post	400 x 230	Half	125	-	2.15	AD 1413-AD 1537	after AD 1547
26	Hall range, ground-floor storey post	340 x 315	Whole	146	-	1.77	Undated	
27	Hall range, ground-floor door post	380 x 200	Half	72	h/s	1.39	Undated	
28	Hall range, door/storey post (failed core)	-	-	-	-		Unmeasured	
29	Hall range, storey post	350 x 300	Whole	113	h/s	1.28	AD 1427-AD 1539	AD 1549-85
30	Hall range, dragon beam	340 x 320	Whole	86	23	1.48	AD 1467-AD 1552	AD 1552-75

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. ARW = average ring width of the measured rings. All timbers are oak (*Quercus spp.*)

Table 2 *t*-value matrix for the timbers forming the chronology STAY20 KEY: - = *t*-values under 3.0

	06	07	08	09	10	11	12	13	16	17	18	20	21	22	23	24	25	29	30
03	-	3.81	5.11	4.85	4.74	3.70	4.34	3.58	5.53	-	-	6.02	-	4.85	3.16	3.00	5.20	5.24	5.43
06	*	4.79	-	3.23	3.98	3.74	3.09	4.32	3.53	6.08	3.68	4.22	3.65	3.21	3.44	4.54	6.32	-	3.49
07	*	*	3.38	3.95	3.99	3.87	3.37	4.75	-	3.81	-	3.01	3.73	-	3.59	4.14	3.17	3.83	-
08	*	*	*	4.14	4.21	-	-	4.35	4.10	-	5.62	3.07	-	3.78	-	-	3.50	-	3.20
09	*	*	*	*	8.96	-	4.25	4.81	4.41	-	-	5.49	5.43	-	3.37	3.28	4.60	3.79	3.66
10	*	*	*	*	*	4.84	4.72	-	5.27	-	3.85	6.49	4.56	3.57	6.22	-	5.22	-	-
11	*	*	*	*	*	*	**10.10**	3.04	-	5.86	3.35	6.17	3.51	-	3.43	5.20	3.49	-	-
12	*	*	*	*	*	*	*	-	-	4.47	-	6.91	4.23	4.17	4.64	4.75	6.26	4.49	3.71
13	*	*	*	*	*	*	*	*	4.86	3.86	-	3.23	-	-	4.18	3.69	-	-	3.30
16	*	*	*	*	*	*	*	*	*	-	-	4.75	4.14	4.21	3.46	-	3.21	-	4.41
17	*	*	*	*	*	*	*	*	*	*	5.42	4.14	-	-	-	3.16	3.95	-	-
18	*	*	*	*	*	*	*	*	*	*	*	6.22	-	3.28	-	-	4.18	-	-
20	*	*	*	*	*	*	*	*	*	*	*	*	3.55	4.93	4.60	4.00	4.97	3.40	6.65
21	*	*	*	*	*	*	*	*	*	*	*	*	*	-	3.80	4.58	4.85	3.15	3.30
22	*	*	*	*	*	*	*	*	*	*	*	*	*	*	-	-	5.44	3.07	3.73
23	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	3.84	4.56	3.92	-
24	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	4.41	-	-
25	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	4.85	5.90
29	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	4.68

Table 3

a) Dating the mean sequence STAY20, AD 1387-1565 inclusive. *t*-values with independent reference chronologies

Area	Reference chronology	*t*-values
East Midlands	East Midlands (Laxton and Litton 1988)	9.66
Greater Manchester	Deardon Fold Farmhouse (Nayling and Tyers 1998)	7.36
Greater Manchester	Apethorn Fold Farmhouse (Tyers forthcoming)	8.58
Greater Manchester	Stayley Hall (Leggett 1980)	9.95
Lancashire	Lightshaw Hall, Golborne (Groves forth)	9.02
Herefordshire	Lower House Farm, Tupsley (Tyers 1997b)	6.00
Staffordshire	Black Ladies (Tyers 1999)	7.16
Staffordshire	Sinai Park (Tyers 1997c)	7.16
Welsh Border	Welsh Border (Siebenlist-Kerner 1978)	8.75
Northumberland	Aydon Castle, Corbridge (Hillam and Groves 1991)	6.93

Table 4

Ring-width data from site master STAY20 dated to AD 1387-1565 inclusive.

Date	Ring widths (0.01mm)										No of samples									
AD 1387							503	185	298	304							1	1	1	1
	368	322	315	357	372	342	420	472	417	415	1	1	1	2	2	2	3	3	3	3
AD 1401	404	308	375	384	368	357	278	315	331	236	3	3	4	4	5	7	7	7	8	8
	245	237	274	213	241	203	223	250	173	255	8	8	9	9	9	9	10	11	11	11
	234	182	249	224	233	212	210	207	235	219	11	11	11	11	11	11	12	12	12	12
	233	231	172	195	150	151	155	152	132	137	12	12	13	13	13	13	13	13	13	13
	143	112	163	185	154	114	147	162	165	139	14	14	15	15	16	16	16	16	16	16
AD 1451	159	157	142	172	133	145	153	142	125	138	16	16	16	16	17	17	18	18	18	18
	137	154	131	130	125	137	166	161	129	127	18	18	18	19	19	19	20	20	20	20
	126	101	127	118	148	155	121	113	134	126	20	20	20	20	20	20	20	20	20	20
	132	119	129	116	116	126	142	116	113	115	20	20	20	20	20	20	20	20	20	20
	95	86	84	88	123	131	89	93	104	93	20	20	20	20	20	20	19	19	19	19
AD 1501	67	59	75	93	111	135	130	106	151	135	19	19	19	19	19	19	19	19	19	19
	150	144	128	128	112	105	96	116	107	102	19	19	19	19	19	18	17	17	17	17
	139	120	113	120	118	114	134	119	98	97	17	17	17	17	16	16	16	16	16	16
	105	105	103	93	120	107	106	108	109	118	16	16	15	14	14	13	13	11	11	10
	114	86	96	93	64	71	57	58	65	65	8	8	8	8	7	6	6	5	5	5
AD 1551	69	72	71	53	53	58	48	53	53	47	5	5	4	4	4	4	3	3	3	3
	57	50	36	42	30						3	3	3	1	1					