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Tree-Ring Analysis of Timbers from Wolfeton Riding House, Wolfeton House, Charminster, Dorset

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Summary

Three timbers from an original floor were most likely felled in the late sixteenth or early seventeenth century, confirming that this is indeed an early example of a riding house in this country. A large section of sapwood, retaining the outermost ring, was removed from one beam, adjacent to the core hole, but it is not possible to say if rings had been lost between the inner part of this section and the heartwood-sapwood boundary because, as in the core, the innermost sapwood rings were so degraded. If so, measurement of the core length and core hole depth enabled one to determine that few rings had been lost. This one timber is likely to have been felled *circa* AD 1600, which could perhaps suggest that this riding house may predate the oldest example in the country previously documented.

Six timbers from the later replacement roof were all probably felled in, or shortly after AD 1720, indicating that this major phase of modification and repair took place just over a century after the construction of the riding house.

Keywords

Dendrochronology
Standing Building

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Introduction

The Riding House (NGR SY 6785 9225; Fig 1) is situated a little more than 100 metres north of Wolfeton House, near the village of Charminster. It is described in detail in a report by Rodwell (1986) from which the following brief notes have been taken. The rectangular stone-built property (Fig 2) is approximately 33.5m by 9.1m, and originally had two ranges projecting at right angles to the north wall. Although latterly used as a barn, the Royal Commission on the Historical Monuments of England (1970) recognised it as having been built as a riding house. The first documented purpose-built riding house in England was erected for Prince Henry at St James' Palace in AD 1607–9, and other examples followed in the early seventeenth century. Wolfeton Riding House is rather narrower than most known examples, and it had a ceiling, where most examples were open to the roof. As a building, Rodwell suggests that its closest parallel is with the 'hospice' at Ansty, Wiltshire, on the Wardour Castle Estate, which is almost identical in size, and very similar in layout. That building is thought to have been built shortly after AD 1594. Other similarities with a riding house at Lulworth Castle, Dorset, built between *c* AD 1588 and *c* AD 1610, suggest a date for the Wolfeton riding house around AD 1600, but Rodwell (1991) thought it unlikely to predate the example at St James' Palace.

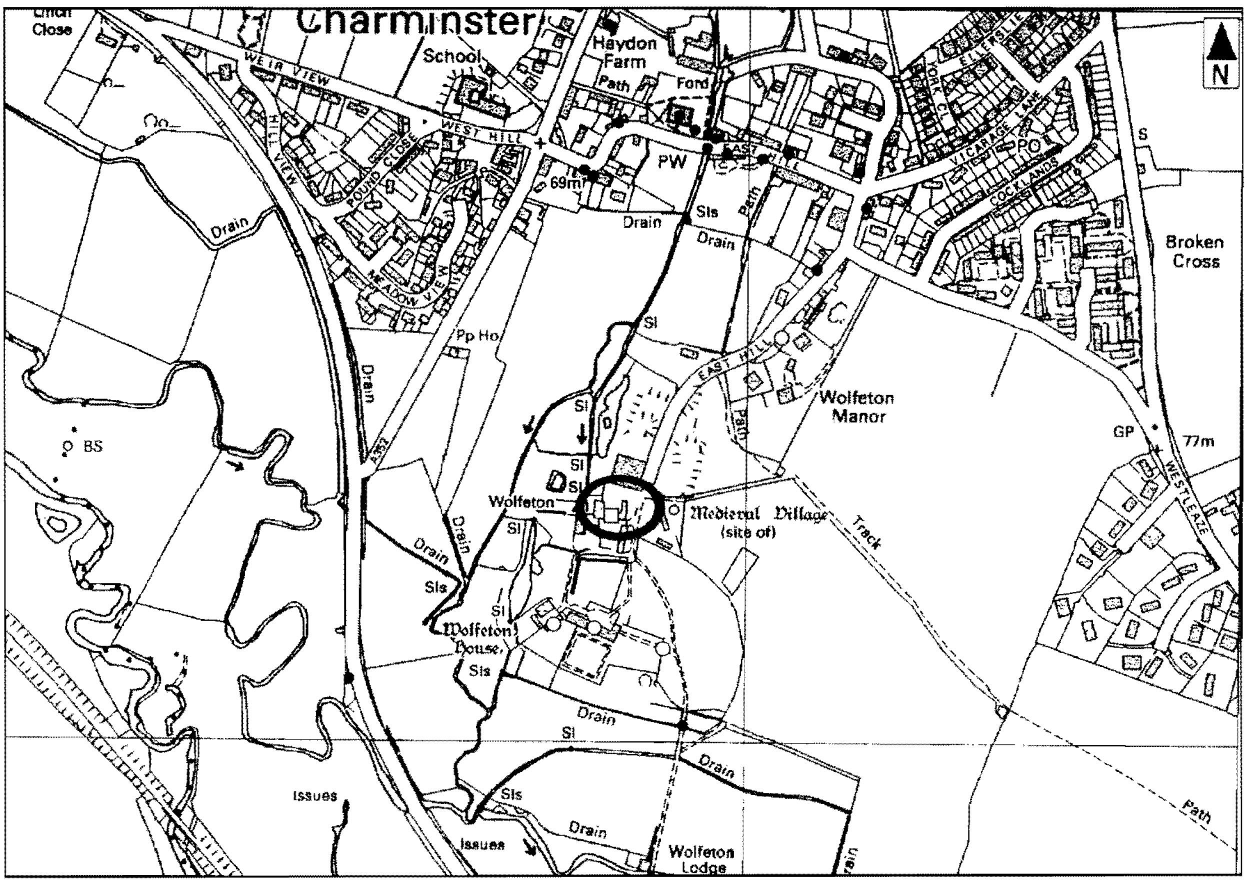

Figure 1: Map showing the location of Wolfeton Riding House.

Figure 2: Exterior view of the Riding House from the south east, looking north west

The interior (Fig 3) has an extant inserted floor of coniferous wood construction, now somewhat unsafe in some areas, but providing a good platform for access to the older timbers in many areas. Eight large floor beams, 0.3m square, of which the second from the west end now remains only as a stump in the north wall, are set nearly 1m below wallplate level. Each of these supported 21 ceiling joists, represented by mortices in the east underside of each beam. On the west side a continuous pulley mortice enabled the joists to be inserted after the beams had been set in position. The upper edges of these beams bear mortices for 17 attic floor joists. Holes for the joists in the south wall indicate that at least some of the joists were inserted before the wall was built around them.

Figure 3: Internal view of the Riding House, looking towards the east end

Eleven roof trusses are set on the walls, though it is clear that the original wallplates have gone and the principals must have been reset. Pairs of principals were joined by a single tenoned and pegged collar and there were three trenched purlins (Fig 4). A long series of modifications has taken place since, as the roof structure proved inadequate to prevent lateral spread. Trusses four and five, numbered from the west end, have doubled principal rafters immediately adjacent to each other, and it is thought that these represent two pairs of original roof trusses and later repairs. The older principals are highly degraded and one had been truncated before reaching wallplate level.

Dendrochronological dating was requested on the floor beams, the original principal rafter pairs and the other roof trusses, to inform a grant-aided condition survey being carried out by Philip Hughes and commissioned by English Heritage.

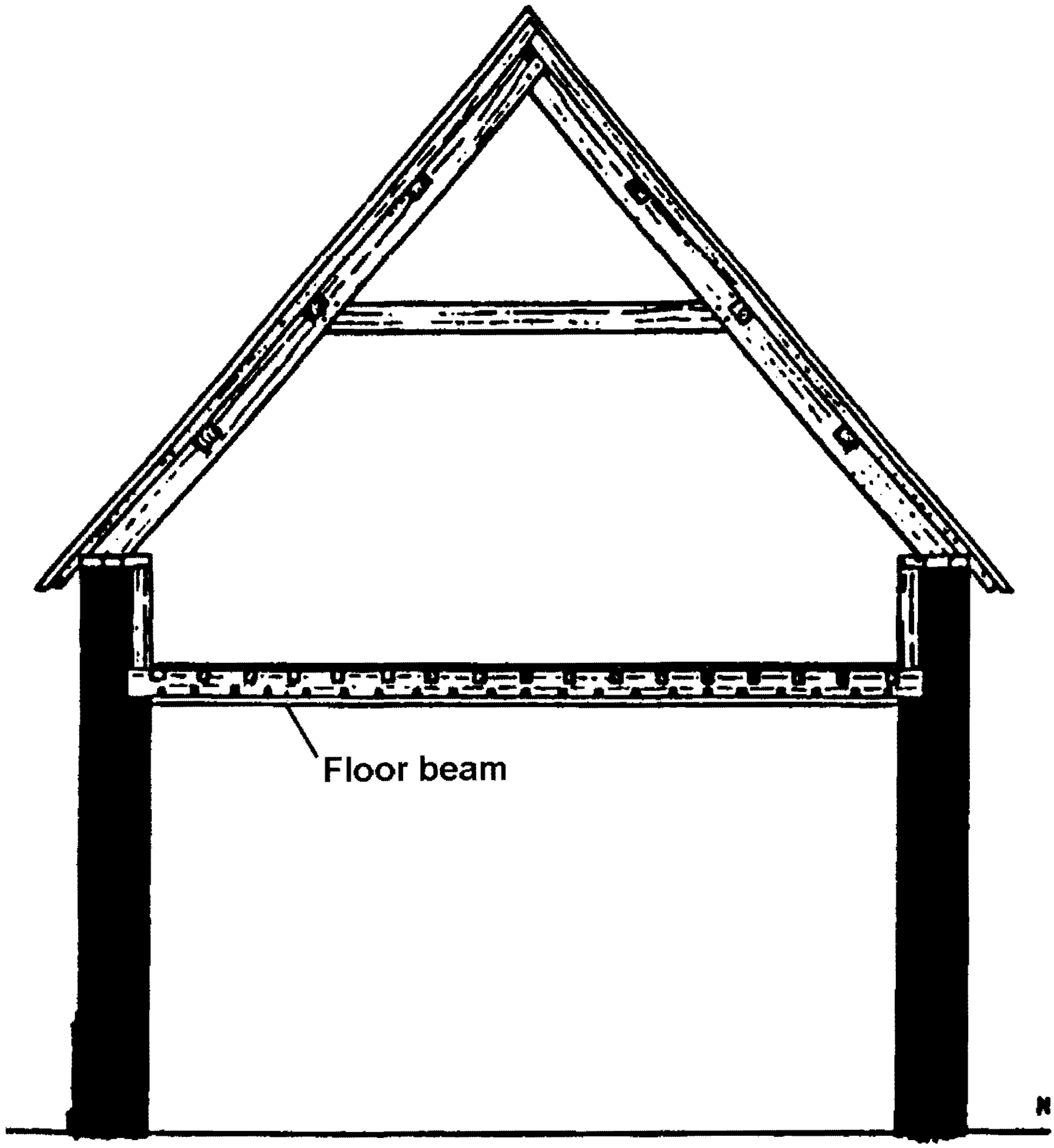

Figure 4: Drawing of the original form of the roof trusses, showing the position of the floor beams, adapted from Rodwell (1991, fig 15)

Methodology

The site was visited in August 2005. In the initial assessment, accessible oak timbers with more than 50 rings and traces of sapwood were sought. Those building timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, and stored for subsequent analysis.

The cores were prepared for measuring by sanding, using an electric belt-sander with progressively finer grit papers down to 400 grit. Any further preparation necessary, eg where bands of narrow rings occurred, was done manually. Suitable samples had their tree-ring sequences measured to an accuracy of 0.01, mm using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (1999). Cross-matching and dating was accomplished by a combination of visual matching and a process of qualified statistical comparison by computer. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted to allow visual comparisons to be made between sequences on a light table. This method provides a measure of quality control in identifying any errors in the measurements when the samples cross-match.

In comparing one sequence or site sequence against another, *t*-values over 3.5 are considered significant, although in reality it is common to find *t*-values of 4 and 5 which are demonstrably spurious because more than one matching position is indicated. For this reason, it is necessary to obtain some *t*-values of 5, 6, and higher, and for these to be well replicated from different, independent chronologies and with local and regional chronologies well represented, unless the timber is imported. Where two individual sequences match with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they most likely came from the same parent tree.

When cross-matching between samples is found, their ring-width sequences are averaged to form an internal 'working' site mean sequence. Other samples may then be incorporated after comparison with this 'working' master until a final site sequence is established. This is then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date it. Individual long series which are not included in the site mean(s) are also compared with the database to see if they can be dated.

The dates thus obtained represent the time of formation of the measured rings in each sample. These dates require interpretation for the construction date of the phase under investigation to be determined. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. The sapwood estimates used here are based on those proposed for this area by Miles (1997a), in which 95% of oaks contain 9–41 rings. Where complete sapwood or bark is present, the exact date of tree felling may be determined.

The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the building. However, evidence suggests that, except in the re-use of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

Results

Weakness in the floor meant that not all areas of the roof could be easily accessed, and the necessity to work from ladders restricted sampling to the lower timbers of the roof only. Seven of the eight floor beams were sampled, the second beam being now only a stub in the north wall, not readily accessed. The lower major roof timbers were sampled where access was possible and the timbers looked suitable. Of the two remaining older trusses (the western pairs of trusses 4 and 5), only the north principal rafter of truss five was sampled (WRH15), the southern rafter of this truss and the north principal of truss 4 being judged to have too few rings, and the south principal of truss 4 not being accessible as a result of it having been cut off well above wallplate level.

All of the samples taken were of oak (*Quercus* spp.). Details of the samples are given in Table 1. The sample locations are marked on Figure 5. Sample WRH05 split into two pieces, and it was not clear that the break was a clean one with no loss of material. These were therefore treated as two separate series, 05i and 05ii. Several timbers had complete sapwood, but this was very fragile, and some outer rings were lost on several samples. A large section of sapwood, retaining the outermost ring, was removed from beam 7 adjacent to the core hole (WRH06), but it is not possible to say if rings had been lost between the inner part of this section and the heartwood-sapwood boundary because, as in the core, the innermost sapwood rings were so degraded. If so, measurement of the core length and core hole depth enabled one to determine that few rings had been lost. The common rafter WRH12 was the only timber on which the complete sapwood remained intact, and a second sample of this timber was taken in order to confirm that the complete sapwood had indeed been retained. Although the sequences were short, the visual plots were nearly identical, allowing the second series to be clearly matched against the first series from the same timber.

Three series from the original floor beams cross-matched (Table 2) and these were combined to make a 77-year site chronology, **WOLFETN1**. This was subsequently dated to the period AD 1509–85, the evidence being presented in Table 3. The relative positions of overlap of the dated timbers are shown in Figure 6.

Six roof timbers were found to cross-match (Table 4) and these were combined to produce a second site chronology of 137 years, **WOLFETN2**. This was dated to the period AD 1583–1719 by comparison with the reference chronologies, the best results being shown in Table 5. The relative positions of overlap of the dated timbers in this chronology are also illustrated in Figure 6.

The data for both site chronologies are given in Tables 6 and 7.

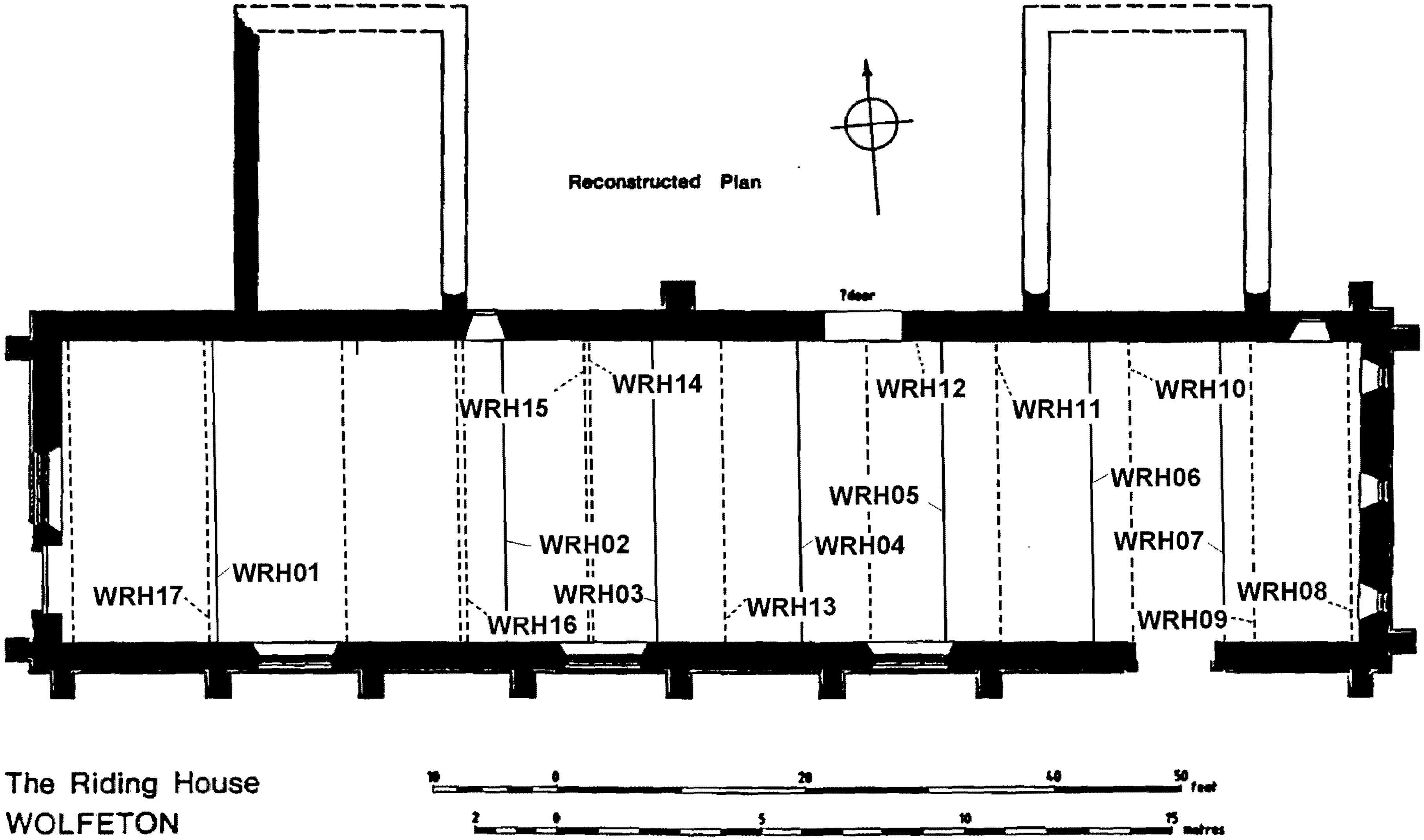

Figure 5: Plan of the Riding House showing the approximate locations of the samples taken for dendrochronology. Note that the positions of the trusses and floor beams are approximate. Adapted from Rodwell (1991, fig 1)

Table 1: Details of oak (*Quercus* spp.) timbers sampled from Wolfeton Riding House. Beams and trusses are numbered from the west end

Sample Number	Timber and position	No of rings	Mean width (mm)	Mean sens (mm)	Dates AD Spanning	H/S bdry AD	Sapwood complement	Felling seasons and dates/date ranges (AD)
Original floor beams								
WRH01	Floor beam 1	70	3.36	0.31	1516–85	1585	h/s	1594–1626
WRH02	Floor beam 3	135	1.63	0.34	undated	-	h/s	unknown
WRH03	Floor beam 4	72	2.94	0.28	1509–80	1580	h/s	1589–1621
WRH04	Floor beam 5	33	NM	-	undated	-	h/s	unknown
WRH05i	Floor beam 6	45	2.95	0.21	undated	-	-	unknown
WRH05ii	Floor beam 6	29	1.71	0.20	undated	-	h/s	unknown
WRH06	Floor beam 7	46(+22)*	2.25	0.19	1525–70	1570	h/s+*c*27C NM	*circa* 1600
WRH07	Floor beam 8	33	NM	-	undated	-	h/s	unknown
Roof timbers								
WRH08	Principal rafter 11 south	120	2.29	0.23	1595–1714	1695	19	1719–36
WRH09	Principal rafter 10 south	88	2.42	0.19	1606–93	1692	1	1701–33
WRH10	Principal rafter 9 north	115	2.86	0.22	1583–1697	1691	6	1700–32
WRH11	Principal rafter 8 north	49	4.43	0.28	1628–76	-	-	after 1685
WRH12a	Common rafter bay 7-8 north	96	1.43	0.25	1624–1719	1703	16½C	summer 1720
WRH12b	Common rafter bay 7-8 north	23	1.46	0.20	1697–1719	1703	16½C	summer 1720
WRH13	Principal rafter 6 south	42	NM	-	undated	-	h/s	unknown
WRH14	Principal rafter 5 north (east)	19	NM	-	undated	-	h/s	unknown
WRH15	Principal rafter 5 north (west)	51	2.36	0.31	undated			unknown
WRH16	Principal rafter 4 south (east)	24	NM	-	undated	-	h/s	unknown
WRH17	Principal rafter 2 south	63	4.74	0.35	1605–1717	1713	4	1712–44

Key: h/s bdry = heartwood/sapwood boundary - last heartwood ring date; NM = not measured; mean sens = mean sensitivity; ½C = complete sapwood with partial ring of the next year, summer felled. The (+22) under number of rings on sample WRH06 refers to additional heartwood rings before the measured sequence. There are another 27 sapwood rings on the separate sapwood section, which are not part of the measured core. Sapwood estimate of 9–41 used (Miles 1997)

Table 2: Cross-matching between sample series from the original floor beams

	t - values	
Sample number	**WRH03**	**WRH06ii**
WRH01	5.2	3.3
WRH03		6.0

Table 3: Dating evidence for the site chronology **WOLFETN1,** AD 1509–1585
(regional multi-site chronologies have the file name in **bold**)

County or region	***Chronology name***	***Short publication reference***	***File name***	***Spanning (yrs AD)***	***Overlap (yrs)***	***t-value***
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443–1972	77	9.9
Shropshire	Rowton Grange, Clungunford	(Miles and Worthington 2002)	CGFE	1407–1597	77	7.4
Hampshire ‡	Chawton House	(Miles and Worthington 2002)	CHAWTON6	1289–1589	77	7.3
London	London Master Chronology	(Tyers pers comm)	**LONDON**	413–1728	77	7.0
Wales	Welsh Master Chronology	(Miles 1997b)	**WALES97**	404–1981	77	6.9
Oxfordshire	Oxfordshire Master Chronology	(Haddon-Reece *et al* 1993)	**OXON93**	632–1987	77	6.8
Berkshire	Windsor Castle kitchen	(Hillam and Groves 1996)	WC KITCH	1331–1573	65	6.6
London	White Tower, Tower of London	(Miles and Worthington 1997)	WHTOWER5	1463–1602	77	6.4
Shropshire	High Ercall Hall	(Miles and Worthington 2002)	HIERCALL	1390–1607	77	6.4

‡ component of HANTS02

Table 4: Cross-matching between sample series from the roof trusses

	t - values				
Sample number	**WRH09**	**WRH10**	**WRH11**	**WRH12**	**WRH17**
WRH08	5.2	7.6	5.0	4.8	3.9
WRH09		3.3	4.5	3.6	3.7
WRH10			4.2	2.6	3.2
WRH11				3.9	4.7
WRH12					2.7

Table 5: Dating evidence for the site chronology **WOLFETN2,** AD 1583–1719
(regional multi-site chronologies have the file name in **bold**)

County or region	***Chronology name***	***Short publication reference***	***File name***	***Spanning (yrs AD)***	***Overlap (yrs)***	***t-value***
Hampshire	Hampshire Master Chronology	(Miles 2003)	**HANTS02**	443–1972	137	9.3
Oxfordshire	Oxfordshire Master Chronology	(Haddon-Reece *et al* 1993)	**OXON93**	632–1987	137	8.1
London	London Master Chronology	(Tyers pers comm)	**LONDON**	413–1728	137	7.4
Wiltshire	Bishop's Palace, Salisbury	(Miles and Worthington 2000)	SARUMBP7	1562–1661	79	6.8
Berkshire	Oracle	(Miles pers comm)	ORACLE6	1638–1783	82	6.8
Shropshire	Shropshire Master Chronology	(Miles 1995)	**SALOP95**	881–1745	137	6.6
Hampshire	Hampshire Master Chronology	(Barefoot 1975)	**BAREFOOT**	1635–1972	85	6.6
Buckinghamshire	Home Farm Barn, Stowe	(Miles *et al* 2003)	STOWE7	1652–1781	68	6.3
Worcestershire	Croome Court	(Arnold *et al* 2004)	CRMASQ01	1639–1753	81	6.2

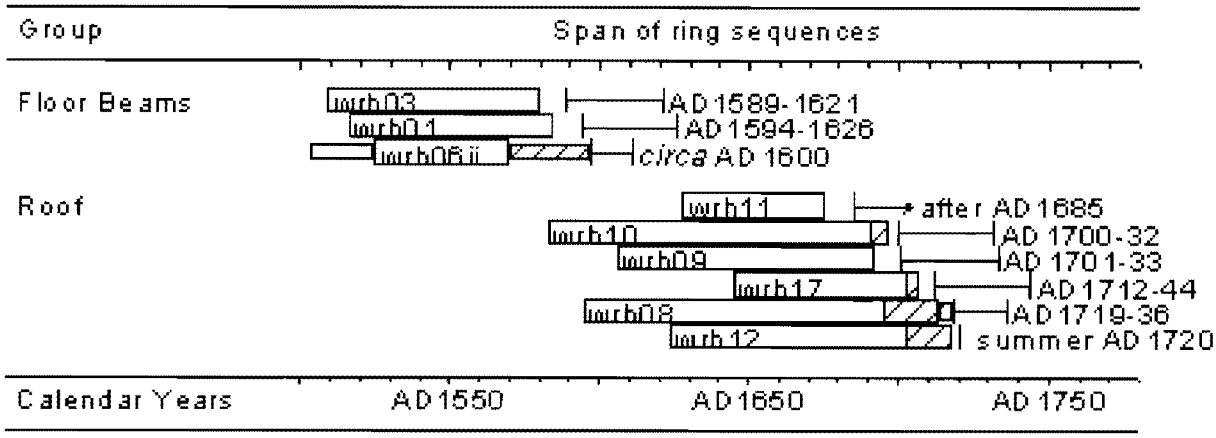

Figure 6: Bar diagram showing the relative positions of overlap of the dated timbers in chronologies **WOLFETN1** and **WOLFETN2**, along with their interpreted felling dates. Narrow bars represent unmeasured sections of the cores, and hatched areas represent sapwood rings

Interpretation and Discussion

The three dated timbers from the group of original floor beams appear to represent a group of timbers likely to have been felled at around the same time. Adding the appropriate sapwood estimate to the mean heartwood-sapwood boundary date (AD 1576) gives a likely felling date range for these timbers of AD 1585–1617. The section of sapwood from beam 7 (WRH06) which retained the outermost rings, but may have lost a few of the earliest sapwood rings, allows the felling of this timber to be placed within the few years after AD 1597, probably around AD 1600, and most likely before AD 1607, the date of the earliest previously dated riding house at St James' Palace. It is very inadvisable to date a whole phase on the basis of a single timber, which may have been stock-piled prior to use, but this does suggest that a date in the first decade of the seventeenth century is likely. With so few timbers from this phase available, and with only one retaining complete sapwood, it is not possible to confirm this early date dendrochronologically.

None of the timbers in the paired trusses 4 and 5 gave samples that were suitable for dating as they contained too few rings, and it is therefore not possible to ascertain whether these do actually represent both original principal rafter pairs and later repairs to the failing roof structure.

Six of the timbers from elsewhere in the roof did date. One timber retained complete sapwood, allowing its felling date to be determined as summer AD 1720. Other timbers have felling date range estimates that incorporate this date, and it seems highly probable that all the timbers were felled in this year, or within a very few years either side of it. This makes the likely construction date of the present roof AD 1720, or within one or two years after this date, post-dating the initial construction of the riding house by just over a century. The only way to confirm this date would be to sample more timbers with complete sapwood, and this may be possible if access were made possible to higher areas than could be safely sampled from a ladder.

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References

Arnold, A J, Howard, R E, and Litton, C D, 2004 *Tree-ring analysis of timbers from the roof of the 'Red Wing', Croome Court, Croome D'Abitot, near Upton on Severn, Worcesteshire,* Centre for Archaeol Rep, **80/2004**

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

Barefoot, A C, 1975 A Winchester dendrochronology for 1635-1972 AD - its validity and possible extension, *J Instit Wood Sci,* **7(1),** 25–32

Haddon-Reece, D, Miles, D H, Munby, J T, and the late Fletcher, J M, 1993 Oxfordshire Mean Curve - a compilation of master chronologies from Oxfordshire, unpubl computer file OXON93, Oxford Dendrochronology Laboratory

Hillam, J, and Groves, C, 1996 Tree-Ring Research at Windsor Castle: Aims and Initial Results, in *Tree Rings Environment and Humanity* (eds J S Dean, D M Meko, and J W Swetnam), 515–23, Arizona Univ

Hollstein, E, 1965 Jahrringchronologische von Eichenholzern ohne Walkande, *Bonner Jahrbuecher,* **165,** 12–27

Miles, D H, 1995 Working compilation of 71 reference chronologies centred around Shropshire by various researchers, unpubl computer file SALOP95, Oxford Dendrochronology Laboratory

Miles, D, 1997a The interpretation, presentation, and use of tree-ring dates, *Vernacular Architect,* **28,** 40–56

Miles, D H, 1997b Working compilation of 58 reference chronologies centred around Wales by various researchers, unpubl computer file WALES97, Oxford Dendrochronology Laboratory

Miles, D, 2003 Dating Buildings and Dendrochronology in Hampshire, in *Hampshire Houses 1250–1700: Their Dating and Development* (ed E Roberts), Southampton (Hampshire County Council), 220–6

Miles, D H, and Worthington, M J, 1997 Tree-ring dates, *Vernacular Architect*, **28**, 159–81

Miles, D H, and Worthington, M J, 2000 Tree-ring dates, *Vernacular Architect*, **31**, 90–113

Miles, D H, and Worthington, M J, 2002 Tree-ring dates, *Vernacular Architect*, **33**, 81–102

Miles, D H, Worthington, M J, and Bridge, M C, 2003 Tree-ring dates, *Vernacular Architect*, **34**, 109–13

Royal Commission on the Historical Monuments of England, 1970 *Historical monuments in the county of Dorset*, v.3 part 1, Royal Commission on Historical Monuments England

Rodwell, K A, 1986 The Riding House, Charminster, Dorset: an investigation of its structural archaeology, unpubl report

Rodwell, K A, 1991 The Architecture of Entertainment: Two examples of a late sixteenth-century building type, *Archaeol J*, **148**, 269–95

Salzman, L F, 1952 *Building in England down to 1540,* Oxford

Tyers, I, 1999 *Dendro for Windows Program Guide 2nd edn*, ARCUS Rep, **500**

Table 6: Ring width data for the site chronology **WOLFETN1**, AD 1509–1585

Ring widths (0.01mm)										no of trees									
290	367	465	319	257	328	281	252	369	424	1	1	1	1	1	1	1	2	2	2
410	260	470	460	482	352	276	467	497	516	2	2	2	2	2	2	3	3	3	3
374	386	431	334	334	390	496	404	358	364	3	3	3	3	3	3	3	3	3	3
462	359	451	229	251	277	294	232	220	259	3	3	3	3	3	3	3	3	3	3
362	245	270	174	202	247	291	145	241	218	3	3	3	3	3	3	3	3	3	3
215	248	205	320	181	259	190	133	224	236	3	3	3	3	3	3	3	3	3	3
239	220	293	150	166	260	158	111	166	113	3	3	2	2	2	2	2	2	2	2
147	246	170	179	135	190	198				2	2	1	1	1	1	1			

Table 7: Ring width data for the site chronology **WOLFETN2**, AD 1583–1719

Ring widths (0.01mm)																			
385	431	484	500	364	470	476	179	279	373	1	1	1	1	1	1	1	1	1	1
368	471	419	455	401	386	371	337	458	437	1	1	2	2	2	2	2	2	2	2
328	303	246	273	311	323	214	274	304	253	2	2	2	3	3	3	3	3	3	3
371	316	280	220	278	334	300	305	312	272	3	3	3	3	3	3	3	3	3	3
323	212	278	248	223	296	308	274	232	338	3	4	4	4	4	5	5	5	5	5
291	213	285	239	309	400	377	375	298	317	5	5	5	5	5	5	5	5	5	5
224	247	327	299	248	491	352	350	314	256	5	5	6	6	6	6	6	6	6	6
346	278	445	298	287	311	206	307	266	291	6	6	6	6	6	6	6	6	6	6
274	374	311	264	166	313	237	201	185	239	6	6	6	6	6	6	6	6	6	6
357	291	219	166	225	184	189	289	234	326	6	6	6	6	5	5	5	5	5	5
249	176	155	277	254	264	271	221	263	217	5	5	5	5	5	5	5	5	5	5
276	202	204	323	255	260	189	197	216	229	5	4	4	4	4	3	3	3	3	3
340	233	144	148	163	143	154	142	156	132	3	3	3	3	3	2	2	2	2	2
142	127	127	149	115	170	155				2	2	1	1	1	1	1			