Centre for Archaeology Report 43/2005

Tree-Ring Analysis of Timbers from the Post Mill, Windmill Lane, Windmill Hill, Herstmonceux, East Sussex

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ISSN 1473-9224

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Summary

The timbers from this Grade II* listed post mill were in two groups: supporting timbers remaining *in situ* at Herstmonceux, and the majority of the buck, which was disassembled for repair *ex situ*. Four timbers from the buck dated: one, retaining complete sapwood being felled in winter AD 1813/14, and the other three apparently coming from a group of timbers most likely to have been felled at the same time. In addition, the main post was felled in winter AD 1813/14, and a crosstree was felled the previous winter (AD 1812/13). This corresponds with records of building by a Lewes-based millwright *c* AD 1814. It is suspected that many of the buck timbers are much earlier, but these were either of elm, or had insufficient rings to be sampled.

Keywords

Dendrochronology
Standing Building

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Introduction

The post mill at Windmill Hill, Herstmonceux (NGR TQ 647 121; Fig 1) is a grade II* listed building. The buck is the largest of any post mill in the country, and the tallest in Sussex. The three-storey timber-framed buck sits above a two-storey brick roundhouse. It is recorded as having been built *c* AD 1814 by a Lewes-based millwright named Medhurst. Whilst dismantling the buck, the mill experts at IJP Conservation noted that the setting-out details and race-knife markings suggested a date for construction well before AD 1814. It is known that some refurbishment took place to adapt the mill to steam power, and there is a carved date of AD 1856 associated with the crosstrees and quarter bars.

Dating was requested by the Historic Building Surveyor Zoe McMillan, and commissioned by English Heritage, to provide a precise date for this nationally important mill.

Methodology

The site, and the premises of IJP, Binfield Heath, were visited in June 2004. 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 on an IBM-compatible computer 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 crossmatch.

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 (1997), 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

Many of the timbers were found to be of elm (*Ulmus* spp.), softwood, or to be too small to contain sufficient rings for analysis. All of the samples taken were of oak (*Quercus* spp.). Details of the samples are given in Table 1, and those timbers sampled that can be indicated are shown in Figures 2 and 3. The lower breast beam was made from two pieces of wood, each of which was sampled (HXW 04 and 05).

Crossmatching between the series revealed six timbers that matched each other, as detailed in Table 2. The remaining series did not match each other, nor did they give acceptable consistent matches when compared to the dated reference material. The six dated timbers were combined into a single 103-year site chronology, **HRSTMNCX,** which was subsequently dated to the period AD 1711–1813. The dating evidence for this series is presented in Table 3. The data for the site chronology are presented in Table 4.

The relative positions of overlap of the dated timbers are illustrated in Figure 4, along with their felling dates. Three dated timbers retained complete sapwood. The other three dated timbers had no traces of sapwood.

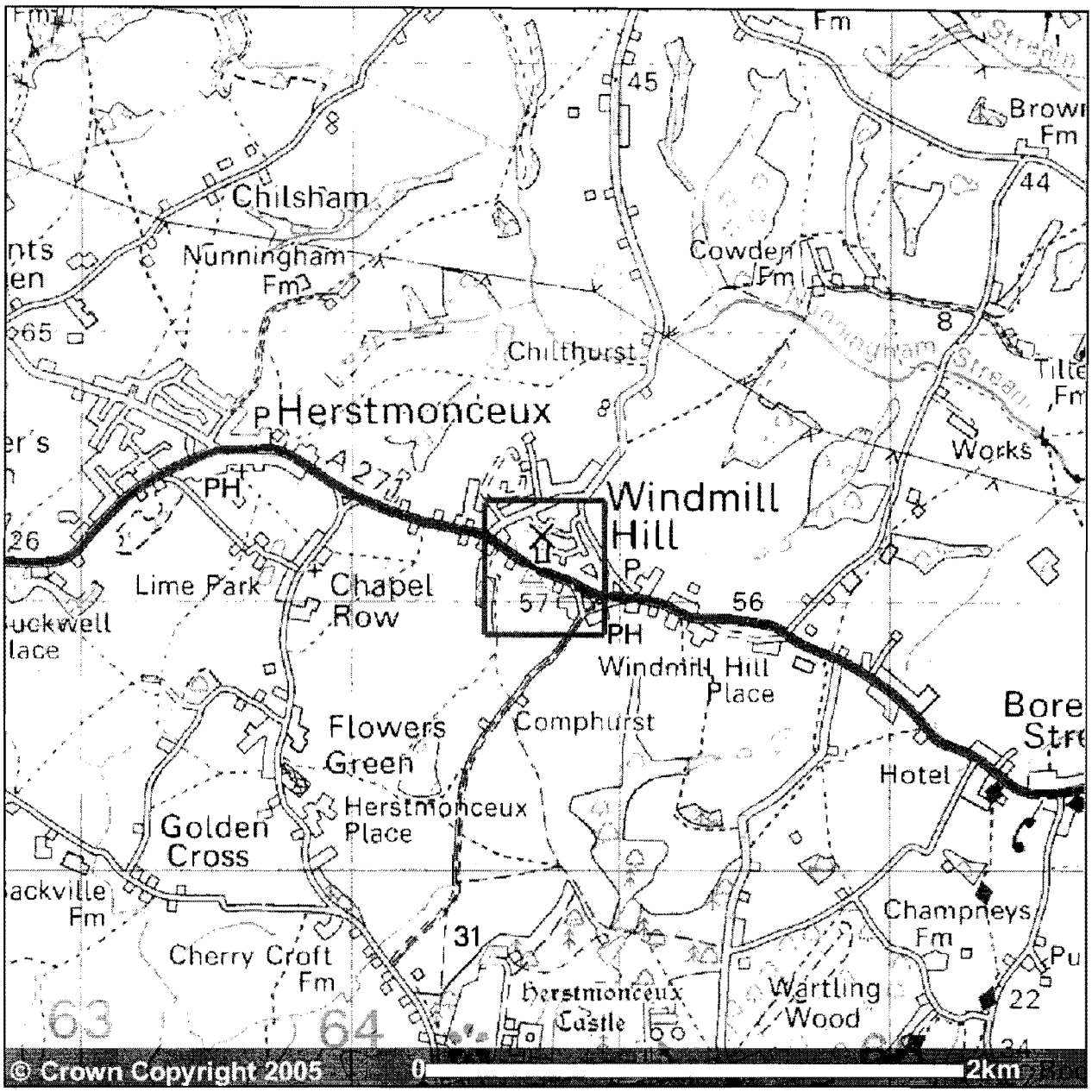

Figure 1: Map showing the location of the Windmill, Herstmonceux,

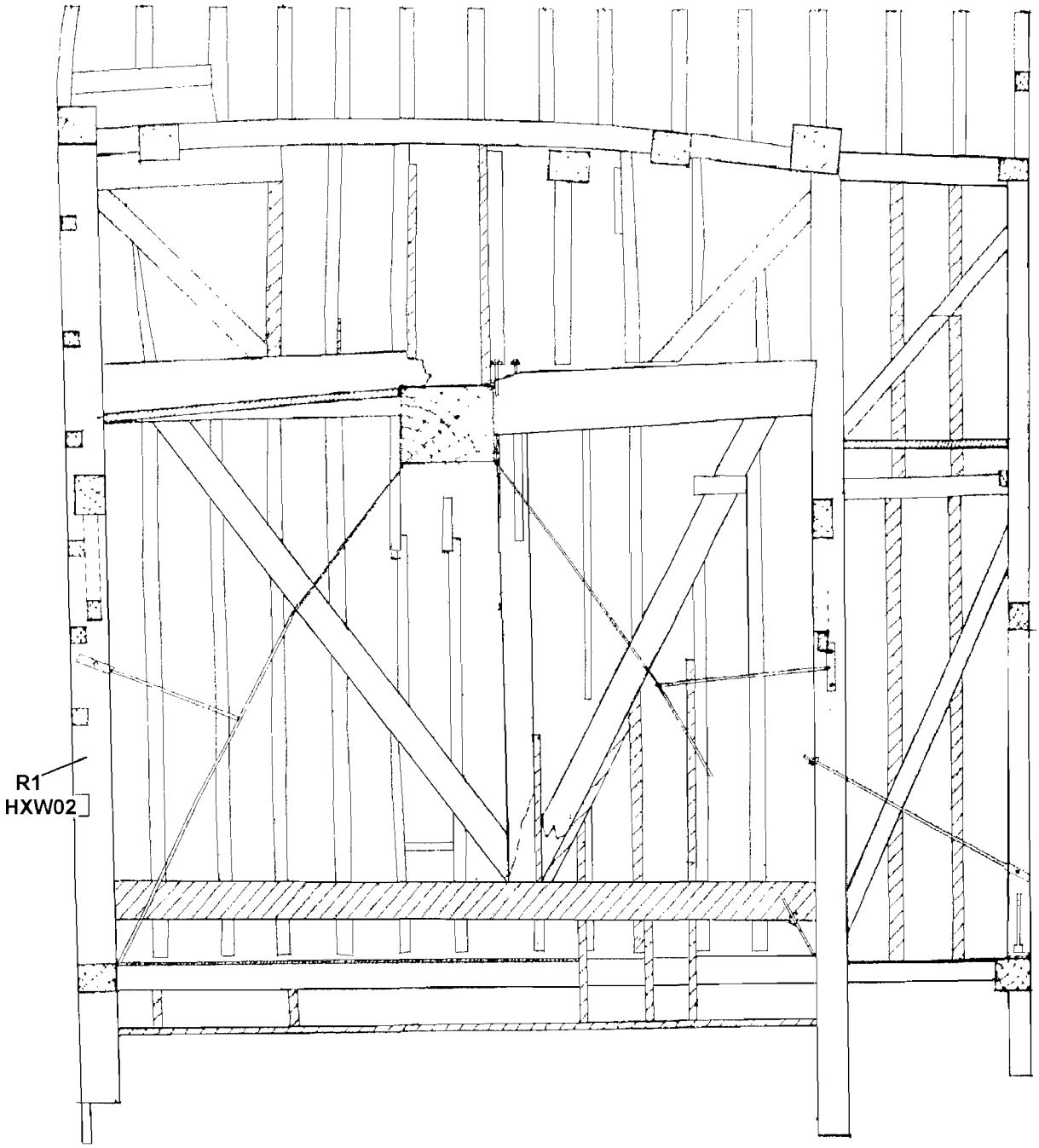

Figure 2: Elevation of the right side (looking towards the breast) showing timber R1 which was sampled for dendrochronology. The hatched timbers are softwood. Adapted from an original drawing by R G Martin

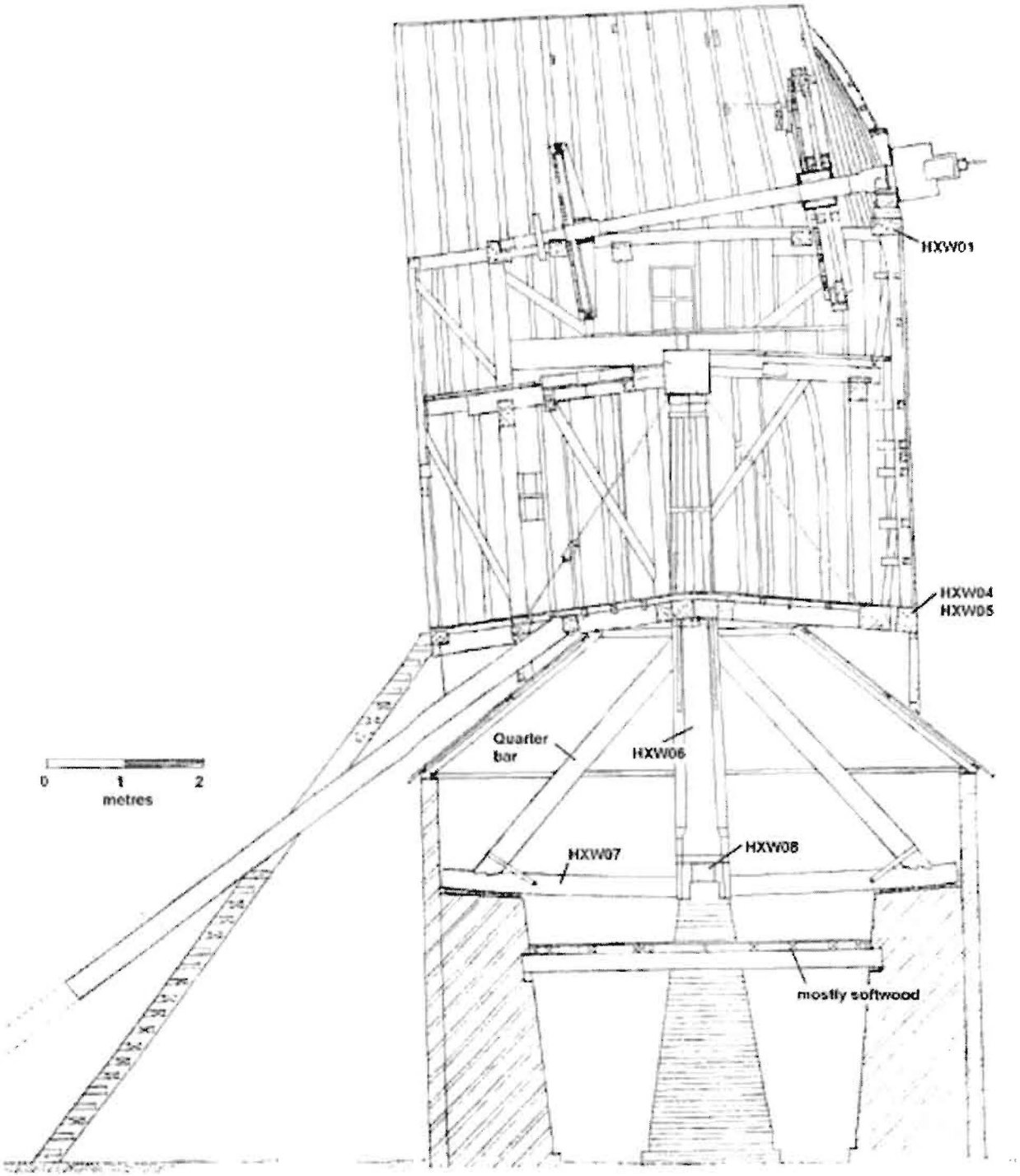

Figure 3: Section through the mill showing the original positions of some of the timbers sampled for dendrochronology, adapted from an original drawing by R G Martin

Table 1: Details of oak (*Quercus* spp.) timbers sampled from the Windmill

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)
***Ex situ* timbers from the buck**								
HWX01	Breast weather beam	85	2.52	0.22	1729–1813	1793	20C	winter 1813/14
HWX02	Timber R1 (front post?)	58	1.86	0.17	undated	-	-	unknown
HWX03	Shear	55	3.12	0.21	1734–1788	-	-	after 1797
HWX04	Composite breast beam	50	1.58	0.16	1744–1793	-	-	after 1802
HWX05	Composite breast beam	52	1.80	0.19	1730–1781	-	-	after 1790
***In situ* timbers**								
HWX06	Main post	103	2.88	0.20	1711–1813	1792	21C	winter 1813/14
HWX07	North-south crosstree	59	2.86	0.17	1754–1812	1798	14C	winter 1812/13
HWX08	East-west crosstree	54	3.55	0.23	undated	-	-	unknown
HWX09	North-east quarter bar	57	1.78	0.21	undated	-	-	unknown
HWX10	North-west quarter bar	89	1.49	0.24	undated	-	23C	unknown
HWX11	South-west quarter bar	130	1.29	0.24	undated	-	34 (+9½NM)	unknown

Key: C = complete sap, winter felling; h/s bdry = heartwood/sapwood boundary - last heartwood ring date; ½ = part of next sapwood ring formed; mean sens = mean sensitivity; NM = not measured. Sapwood estimate of 9–41 used (Miles 1997)

	t - values				
SAMPLE	**HXW03**	**HXW04**	**HXW05**	**HXW06**	**HXW07**
HXW01	6.1	4.2	4.4	4.1	4.6
HXW03		3.5	-	5.3	3.8
HXW04			6.9	-	3.2
HXW05				-	\
HXW06					-

Table 2: Crossmatching between the dated samples from the mill. A (-) indicates no significant match, and a (\) that there are insufficient rings overlapping to calculate a *t* -value

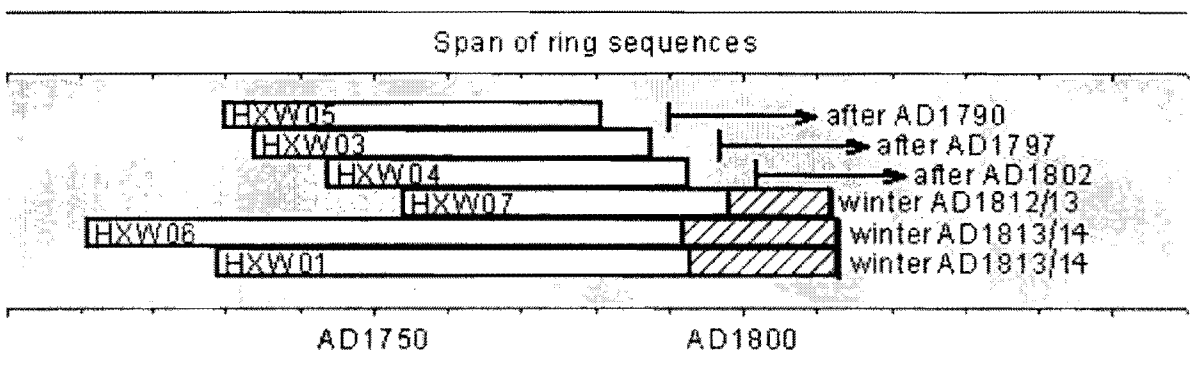

Figure 4: Bar diagram showing the relative positions of overlap of the dated timbers in chronology **HRSTMNCX**, along with their interpreted felling dates. Hatched bars represent sapwood rings

Table 3: Dating evidence for the site chronology HRSTMNCX, AD 1711–1813 (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	Barefoot 1975	BAREFOOT	1635–1972	103	8.1
	London	White Tower, Tower of London	Miles and Worthington 1997	WHTOWER7	1688–1782	72	6.9
	Hampshire	Hampshire Master Chronology	Miles 2003	**HANTS02**	443–1972	103	6.7
	Oxfordshire	Oriel College Tennis Court	Miles and Haddon-Reece 1994	ORIEL1	1534–1776	66	6.4
	Southern England	HMS Victory	Barefoot 1978	VICTORY	1640–1800	90	6.4
	Devon	Exeter Cathedral	Mills 1988	EXCATH2	1662–1783	73	6.1
	Oxfordshire	Manor Farm, Stanton St John	Miles and Worthington 1998	ssj51	1710–1800	90	5.5
	England	England Master Chronology	Baillie and Pilcher 1982	**ENGLAND**	404–1981	103	5.5
	Oxfordshire	Oxford Master Chronology	Haddon-Reece *et al* 1993	**OXON93**	632–1987	103	5.3
	Buckinghamshire	The Rotundo, Stowe	Miles and Worthington 1998	STOWE2	1683–1776	66	5.2
	Suffolk	Sotterley Park	Briffa *et al* 1986	SOTTERLY	1586–1981	103	5.1
	Wiltshire	Clarendon House Granary	Tyers 2000	CL_CHG	1675–1764	54	5.0
	Buckinghamshire	The Hovel, Ludgershall	Miles and Worthington 1999	THEHOVEL	1671–1811	101	4.7
	Oxfordshire	Mapledurham Mill	Miles and Haddon-Reece 1995	MDM17b	1664–1776	66	4.6

‡ Component of HANTS02

Interpretation and Discussion

Many timbers of the body (buck) of the mill were unsuitable for dating, as detailed above. The experts working on this mill at IJP were of the opinion that many of these timbers were considerably older than the dated nineteenth-century material. Clues to this came from the way the setting out of the timbers had been carried out, and the race -knife assembly marks on some timbers. Several post mills have now been found to contain timbers older than previously expected; these include Drinkstone in Suffolk (Bridge 2001), Nutley in Sussex (Bridge 2003), and Pitstone in Buckinghamshire (Bridge 2004). Similarly, many timbers still *in situ* at Herstmonceux, such as the components of the floor in the roundhouse, were unsuitable for dating. Sadly, only one timber that may be from this earlier phase (HXW02 the front post) had a sufficient number of rings to warrant further analysis, but even this had only 58 rings and did not date. The remaining undated timbers form part of the supporting framework and are likely to have come either from the early nineteenth-century phase, or the mid-nineteenth century alterations mentioned above.

The six timbers which did date include timbers from the supporting framework, the main post, and quarter bars, as well as two *ex situ* timbers from the buck, the breast weather-beam and a shear. The three timbers which retained their sapwood were found to have been felled in the winters of AD 1812/13 and AD 1813/14. The remaining three timbers had no traces of sapwood, but appear to belong to the same group of timbers, probably all felled in the same period. This strongly suggests construction in AD 1814, or a year or two after this date, which corresponds to the record of the Lewes-based millwright, Medhurst, constructing the mill in *c* AD 1814.

Acknowledgements

This work was commissioned by Derek Hamilton of the Scientific Dating Service, English Heritage. I would like to thank Mr Pritchard and his staff at IJP, Binfield Heath, for their cooperation and help during my visit, and Mrs Bee Frost for allowing my access to the mill site itself. Cathy Groves (Sheffield University) made useful comments on an earlier draft of this report.

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Table 4: Ring width data for the site chronology **HRSTMNCX**, AD 1711–1813

Ring widths (0.01mm)										no of trees									
369	387	369	238	319	394	385	314	297	337	1	1	1	1	1	1	1	1	1	1
470	376	438	588	501	454	650	430	407	311	1	1	1	1	1	1	1	1	2	3
262	341	332	399	339	277	344	345	310	302	3	3	3	4	4	4	4	4	4	4
232	233	317	259	301	295	263	258	224	236	4	4	4	5	5	5	5	5	5	5
294	243	280	267	271	277	220	284	249	263	5	5	5	6	6	6	6	6	6	6
273	191	304	273	230	304	287	328	287	257	6	6	6	6	6	6	6	6	6	6
193	223	242	257	170	250	227	187	231	222	6	6	6	6	6	6	6	6	6	6
242	323	224	234	214	225	242	207	203	171	6	5	5	5	5	5	5	5	4	4
159	200	138	169	220	181	172	164	186	173	4	4	4	3	3	3	3	3	3	3
172	211	125	138	178	171	228	207	245	174	3	3	3	3	3	3	3	3	3	3
216	175	132								3	3	2							