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Ancient Monuments Laboratory
Report 23/96

THE TREE-RING DATING OF MOTTISFONT ABBEY, ROMSEY, HAMPSHIRE

D W H Miles

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Summary

Twenty-four samples were taken from fourteen timbers from Mottisfont Abbey, Romsey, Hampshire (SU 326 269). Nine of the timbers sampled were from what was originally the nave. Five of these were from the principal trusses of the roof, while the other four were from the arch-braced couple roof in the middle of the nave range. A further five samples were taken from the roof of the west cloister range. At least one sample from each of these areas dated, giving precise dates which ranged from spring AD 1538 to spring AD 1539. One re-used purlin from the cloister roof also dated to the winter of AD 1734/5. The dating showed that all three roofs were coeval and clearly the work of Lord Sandys immediately after the Dissolution, making the principal chamber an important early example of non-royal domestic arrangement.

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Table 1: MOTTISFONT ABBEY, ROMSEY, HAMPSHIRE - SUMMARY OF TREE-RING DATING

Sample number		Timber and position	Dates AD spanning	H/S bdry	Sap-wood	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
MAIN RANGE - ARCH BRACED COUPLE ROOF BAY N4										
* *mfa1*	c	Lower collar 10th E of N3	1409-1538	1510	28¼C	130	1.27	0.43	0.208	spring 1539
* *mfa2*	c	Lower collar 9th E of N3	1398-1537	1513	34¼C	140	1.43	0.55	0.207	spring 1538
* *mfa3*	c	N rafter 3rd W of N5	1432-1538	1512	26¼C	107	1.30	0.38	0.191	spring 1539
mfa4	c	S rafter 1st E of N3	1353-1504	1504	H/S	152	1.26	0.39	0.227	1514-1559
MAIN RANGE - EAST & WEST OF BAY N4										
mfa11a	c	S principal rafter N3	-		1	124	1.75	0.91	0.255	
b	c	S principal rafter N3	-		20	20	0.73	0.09	0.152	
mfa12a	c	Collar N3	1388-1509	1509	H/S	122	1.43	0.50	0.218	
bi	c	Collar N3	1485-1538	1514	24¼C	54	1.45	0.31	0.219	spring 1539
bii	c	Collar N3	1497-1538	1514	24¼C	42	1.50	0.31	0.227	
b		Mean of mfa12bi & mfa12bii	1485-1538			54	1.47	0.29	0.204	
* *mfa12*		Mean of mfa12a & mfa12b	1388-1538			151	1.46	0.47	0.216	
mfa13	s	Mid rail N5	-		17C	105	2.24	1.11	0.203	
mfa14	c	S post N5	-		H/S	60	1.81	0.50	0.197	
mfa15	c	S doorpost N9	-			178	1.21	0.83	0.221	
WEST CLOISTER RANGE										
mfa21a	c	Tiebeam NW2	-			15	3.26	1.09	0.248	
b	c	Tiebeam NW2	1413-1470			58	2.85	0.94	0.205	
c	c	Tiebeam NW2	1421-1473			53	3.30	1.17	0.192	
d	c	Tiebeam NW2	1433-1484			52	2.99	0.73	0.211	
e	c	Tiebeam NW2	1472-1512	1512	H/S	41	2.84	0.78	0.182	
f	c	Tiebeam NW2	1487-1522	1512	10	36	2.18	0.84	0.185	
g	s	Tiebeam NW2	1511-1538	1512	25½C	28	1.54	0.67	0.209	summer 1538
* *mfa21*		Mean of mfa21b+c+d+e+f+g	1413-1538			126	2.67	1.02	0.179	
* *mfa22*	c	Kingpost *ex situ* TIIII	1396-1514	1513	1	119	1.57	1.18	0.188	1523-1568
mfa23	c	Tiebeam NW3	-			63	2.90	1.15	0.156	
mfa24	c	Tiebeam NW1	-			28	3.09	0.58	0.192	
mfa25	c	S most W purlin	1672-1734	1711	23C	63	2.66	1.50	0.224	winter 1734/5
= ***MOTISFNT***		**site master**	**1388-1538**			**151**	**1.65**	**0.51**	**0.142**	

Key: * = sample included in site-master; **c,s** = core, slice; ¼C,½C,C = bark edge present, partial or complete ring: ¼C = spring, ½C = summer/autumn, or C = winter felling;
H/S bdry = heartwood/sapwood boundary - last heartwood ring date; **std devn** = standard deviation; **mean sens** = mean sensitivity

THE TREE-RING DATING OF MOTTISFONT ABBEY, ROMSEY, HAMPSHIRE

1. Introduction and objectives

Mottisfont Priory was built at the turn of the thirteenth century and was consecrated in AD 1224. The aisleless church, which today largely survives within the fabric of the main house, formed part of a large Augustinian monastic complex. The remains of several of the other medieval buildings are visible today, surviving as parch marks and ruins directly to the south of the house. The medieval cellarium survives largely intact, forming the majority of the west wing of the house.

The priory was suppressed by the crown in AD 1536 and was granted to William, Lord Sandys of the Vyne, while holding the office of Lord Chamberlain to the King, in exchange for the villages of Chelsea and Paddington. By the time he died in AD 1540, renovation work had converted the property into a large Tudor mansion. Several of the priory church features appear to have been demolished including the chancel and the north chapel, but the buildings to the south seem to have survived as part of the Tudor fabric.

Although the buildings to the south were largely demolished in the mid-eighteenth century, a great deal of evidence for the Tudor mansion survives in the main house, formerly the priory church. Sandys contrived a large principal chamber at first-floor level with an arch-braced rafter-couple roof with several smaller chambers and a large kitchen area. Evidence suggests that the Tudor reconstruction included a chapel located towards the east of the building.

In the eighteenth century the Tudor principal chamber was divided up into smaller room spaces with the building being converted into a typical eighteenth-century country house. The gardens were extensively terraced and the water course to the east of the house added. In AD 1836 a large stable block was added to the complex, and in 1938/9 Rex Whistler redesigned the drawing room. In 1957 the Abbey was given to the National Trust and it is their present massive alterations of the house to convert it to a conference centre that have initiated the archaeological recording and dating programme. The successive phases of construction and modification over eight centuries have left the building a mixture of architectural styles.

The roofs are varied, and were initially surveyed by Martin Higgins, then of the National Trust, who identified the various forms of construction and recorded the sequence of assembly marks. His comprehensive report (Higgins 1994) clearly outlines what is existing and lays out the questions which any archaeological or architectural investigation should try to answer. The main roof over the original nave and crossing is of tiebeam and collar construction with two sets of butt purlins with wind braces to the upper set, and inner and outer wall plates. The substantial tiebeam had joists morticed into them running longitudinally, although the western side has had the floor lowered by two or three feet. The nave was enclosed by two bays of this roof at the west end, and seven more bays to the east, interrupted by a section of thirty rafter couples with ashlars, arch-braces, and an upper and lower collar. The main trusses seem to be integral with the timber-framed partitions below, but the common rafter couple roof over bay N4 does not at first glance seem to be part of the same structure. Over the west wing, four massive tiebeams survive which originally supported a low pitched lead roof, although the king posts, struts, and principal rafters have disappeared. However, one *ex situ* king post was found in an adjoining void and clearly came from this roof.

The primary objective for dating the building is to ascertain when the conversion from Priory church to country house took place. Also, it was thought the roof to the principal chamber (section N4) was part of the original Priory roof remaining *in situ*, and the large tiebeams in the west wing were also thought to be pre-Dissoloution in date. Therefore a secondary objective was to confirm or refute this.

The dating was arranged initially by the Test Valley Archaeological Trust who were conducting the archaeological recording and watching brief. The dendrochronological programme was subsequently expanded and commissioned by English Heritage.

2. Methods

All samples were of oak from what appeared to be primary first-use timbers. All accessible timbers were assessed and only those with complete sapwood or with reasonably long ring sequences were considered. Those timbers which looked most suitable for dendrochronological purposes were sampled through coring, using a 16mm diameter hollow auger. Additionally, two slices were used: one from an offcut of a rail (***mfa13***) and the other a secondary sapwood section (***mfa21g***). The dry samples were sanded without pre-treatment on a linisher using 60 to 1200 grit abrasive paper, and were cleaned with compressed air, to allow the ring boundaries to be clearly distinguished. They were then measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.001mm, rounded to the nearest 0.01mm.

After measurement, the ring-width series for each sample was plotted as a graph of width against year on log-linear graph paper. The graphs of each of the samples in the phase under study are then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, are averaged to form a mean curve for the site or phase. This mean curve and any unmatched individual sequences are compared against dated reference chronologies to obtain an absolute calendar date for each sequence.

Here this was accomplished by using a combination of both visual matching and a process of qualified statistical comparison by computer. The samples were first matched visually, and then independently matched by computer. The ring-width series were compared on an IBM compatible 486SX computer for statistical cross-matching using a variant of the Belfast CROS program. Statistical comparisons were made using a maximised t-value, those over $t = 3.5$ being considered significant (Baillie and Pilcher 1973). Nevertheless, most dendrochronologists prefer to see a well-replicated series of matches against local independent chronologies with at least a t = 5 or 6. A version of this and other programmes were written in BASIC by D Haddon-Reece, late of the Ancient Monuments Laboratory and latterly re-written in Microsoft Visual Basic by M R Allwright and P A Parker. The bar diagram graphics software was written by M R Coome.

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of or including bark, this process is relatively straight forward. Depending on the completeness of the final ring, ie if it has only the spring vessels or earlywood formed, or the latewood or summer growth, a *precise felling date and season* can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an *estimated felling date range* can be given for each sample. The number of sapwood rings can be estimated by using a statistically derived sapwood estimate with a given confidence limit. An accepted national sapwood estimate for British oaks is given as between 10 and 55 rings with a 95% confidence range (Hillam *et al* 1987). If no sapwood or heartwood/sapwood boundary survives, then the minimum number of sapwood rings is added to the last measured ring to give a *terminus post quem*.

Some caution must be used in interpreting solitary precise felling dates. Many instances have been noted where timbers used in the same structural phase have been felled a year or two apart. Where ever possible, a *group* of precise felling dates should be used as a more reliable indication of the *construction period*. It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure under study. However, it is common practice to build timber-framed structures with green or unseasoned timber (Charles 1984).

3. Results

North range and West cloister

Altogether nine timbers were sampled from various parts of the north range. Four samples were taken from the rafter couple roof over section N4, and five samples were taken from the trussed roof and partitions both to the east and west of N4. The truss reference numbers used throughout the report relate to those used in Martin Higgins' report and are as on the location plan (Fig 1). All were of oak and all showed evidence for subsequent shrinkage consistent with being converted prior to seasoning (Fig 2). These were identified by the distinctive shakes and deformed surfaces which would have been straight and true when initially cut by the saw or axe. Details of the samples taken are shown in Table 1.

Due to the advanced state of the remodelling, accessibility to suitable timbers was limited, and particular care had to be taken in extracting such samples as had complete sapwood. In the case of sample ***mfa1***, this required opening up a small hole in the plaster immediately to the east of the lower collar to enable the timber to be cored. Three of the samples from N4 had complete sapwood, a further sample, ***mfa4***, was taken because of its large number of rings and heartwood/sapwood boundary.

From the trussed roof adjacent, the south principal rafter to N3 was cored twice: the first core ***mfa11a*** had lost most of its sapwood, and a second core, ***mfa11b***, was taken. but was so short that no conclusive overlap could be effected so the two were never combined. The lower collar to the same truss was cored three times to allow complete sapwood to be obtained. The first sample, ***mfa12a***, was taken towards the southern end of the collar and had the heartwood/sapwood boundary and most of the rings to the centre, although physical restrictions precluded drilling at the optimum angle for maximum rings. Two further cores with complete sapwood, ***mfa12bi*** and ***mfa12bii***, were taken immediately adjacent to each other about 2m to the north, and had 54 and 42 rings respectively. These matched together with a *t*-value of 8.51 and were combined to form ***mfa12b***. This core was compared with ***mfa12a***, found to match with a *t*-value of 6.85, and were combined to form the mean ***mfa12***.

Other samples from this range included a section of rail (***mfa13***) removed in the course of the building works from a ground-floor partition which had complete sapwood. A post adjacent was sampled (***mfa14***) and included the heartwood/sapwood boundary but was found to be hollow inside. A door post in another partition was sampled (***mfa15***); this had an exceptionally large number of rings but no heartwood/sapwood boundary.

It became clear from the outset of the analysis that the samples from both sections of the north-range roof were coeval and matched each other. Five samples were found to match together (***mfa1***, ***mfa2***, ***mfa3***, and ***mfa12***) but ***mfa4*** was excluded from the master chronology as the ring pattern was clearly affected by distortion. An intermediate mean was constructed of these four sequences and was compared with the reference chronologies and dated to AD 1538. The remaining samples from this range were then compared against this dated sequence but failed to match conclusively, despite the long lengths of some of them. They also failed to date against the master chronologies when tested individually.

In the west cloister, five samples were taken, three from the original tiebeams, one from the *ex situ* king post, and one from a purlin (***mfa25***) which looked as if had been reused from an earlier joist or rafter. Only sample ***mfa21***, apart from the purlin, had any sapwood. However, the area of complete sapwood on ***mfa21*** was only about 150mm long and immediately above a decorated plaster ceiling. As the sapwood was on the lower arris of the timber, some 35mm above the ceiling, it was impossible to core upwards to the centre of the timber. Therefore it was necessary to take a series of six cores (***mfa21a-f***), plus a section of detached complete sapwood (***mfa21g***), to allow a sequence of rings to be built up from the centre of the timber to the bark edge. This is shown in Figure 3. Of the seven samples thus generated, six of them matched together to form a sequence of 126 rings and were combined to form sample ***mfa21***. The matching between the samples is shown in Table 2, and the bar diagram in Figure 4 illustrates the method of overlapping samples. Whilst the other two tiebeams sampled had no sapwood, the king post did have a heartwood/sapwood boundary and a core was taken to provide sample ***mfa22***.

Table 2: matrix of *t*-values and overlaps for components of ***mfa21***

	mfa21c 1473	***21d*** 1485	***21e*** 1512	***21f*** 1522	***21g*** 1538
mfa21b	<u>7.38</u>	<u>3.56</u>	-	-	-
	50	37	-	-	-
mfa21c		<u>4.46</u>	-	-	-
		40	-	-	-
mfa21d			<u>6.72</u>	-	-
			14	-	-
mfa21e				<u>6.52</u>	-
				26	-
mfa21f					<u>7.31</u>
					12

These samples were then compared against the existing intermediate mean and samples ***mfa21*** and ***mfa22*** were found to match conclusively. Therefore, all six samples were combined into the site master ***MOTISFNT*** of 151 rings (Table 3). This site master was again compared to the reference chronologies and were found to match at AD 1538. The *t*-value matches are shown in Table 4.

Table 3: *t*-values and overlaps for components of ***MOTISFNT*** plus ***mfa4***

	mfa2 1537	***mfa3*** 1538	***mfa4*** 1504	***mfa12*** 1538	***mfa21*** 1538	***mfa22*** 1514
mfa1	3.79 129	3.92 107	4.28 96	6.01 130	3.53 126	2.07 106
mfa2		2.77 106	3.69 107	3.62 140	4.02 125	3.96 117
mfa3			2.51 73	7.84 107	4.12 107	3.86 83
mfa4				3.44 117	1.52 92	3.73 109
mfa12					4.45 126	4.59 119
mfa21						3.20 102

Throughout the roof, the majority of the timbers were of boxed-heart section. Where possible sampling was mainly confined to those timbers which were quarter-sawn in order to obtain the longest ring sequences. Most of the timbers sampled came from trees which were between 100 and 200 years of age when felled.

Five of the seven dated timbers had complete sapwood intact on the samples. Allowing for partial rings for the following year, one sample (***mfa2***) had a felling date of spring AD 1538, another (***mfa21***) from the summer of the same year, and three (***mfa1***, ***mfa3***, and ***mfa12***) from the spring of AD 1539. Two other samples without complete sapwood provided felling date ranges. Sample ***mfa4*** had a heartwood/sapwood boundary and produced a felling date range of AD 1514-1559, and ***mfa22*** had one ring of sapwood, giving a felling date range of AD 1523-1568.

Table 4: Dating of ***MOTISFNT*** (AD 1388-1538) against reference chronologies at AD 1538

Reference chronology	Spanning	Overlap	t-value
OVERTON2 *(Miles and Haddon-Reece 1994)*	1351-1504	117	6.97
SENGLAND *(Bridge 1988)*	1083-1589	151	7.28
ALTON *(Hillam 1983)*	1348-1504	117	7.56
ROMSEY *(Hillam and Groves 1994b)*	1362-1496	109	7.66
* BROOKGT *(Miles and Haddon-Reece 1993)*	1362-1611	151	7.71
EXTON *(Miles and Haddon-Reece 1995)*	1376-1546	151	8.37
OXON93 *(Haddon-Reece et al 1993)*	632-1987	151	8.39
EASTMID *(Laxton and Litton 1988)*	882-1981	151	8.69
ACTON *(Haddon-Reece and Miles 1992)*	1328-1575	151	8.70
SOUTH *(Hillam and Groves 1994a)*	406-1594	151	9.32
REF3 *(Fletcher 1977)*	1399-1687	140	9.82
SALOP95 *(Miles 1995)*	881-1745	151	10.15
MASTERAL *(Haddon-Reece and Miles 1993)*	404-1987	151	12.04

* indicates component of SALOP95

West cloister roof reconstruction

One final sample, ***mfa25***, was taken from a purlin from the later reconstructed roof of the west cloister. Initially this was thought to have been a re-used timber from the original west cloister roof or the sixteenth-century reconstruction. However, there was no match with any of the other samples from either the north range or the west cloister, or with the site master ***MOTISFNT***. The sample was then compared individually against the master chronologies and dated to AD 1734 (see Table 5 below). As this timber had complete sapwood, it was felled in the winter of AD 1734/5.

Table 5: Dating of ***mfa25*** (AD 1672-1734) against reference chronologies at AD 1734

Reference chronology	Spanning	Overlap	t-value
SALOP95 *(Miles 1995)*	881-1745	63	4.71
MASTERAL *(Haddon-Reece and Miles 1993)*	404-1987	63	4.85
MDM13 *(Miles and Haddon-Reece 1995)*	1650-1722	51	4.95
* BARN *(Haddon-Reece et al 1987)*	1658-1739	63	5.11
OXON93 *(Haddon-Reece et al 1993)*	632-1987	63	5.17
ORIEL1 *(Miles and Haddon-Reece 1994)*	1534-1776	63	5.17
MDM17b *(Miles and Haddon-Reece 1995)*	1664-1776	63	5.32

* indicates component of OXON93

4. Conclusion

Although it was generally accepted that the trussed sections of the north range roof to the east and west of N4 were inserted, it had been thought that section N4 itself might have been the remains of the original nave roof. The low-pitched roof of the west wing was similarly thought to have been pre-dissolution in origin. However of the twenty-four samples taken from fourteen timbers, seven timbers, spread over both the north range and the west wing, dated, with five felling dates between spring AD 1538 and spring AD 1539, strongly suggesting that all the roofs sampled were built at the same time. The dating showed that this was the work of Lord William Sandys immediately after the Dissolution, making the principal chamber an extremely important early example of non-royal domestic arrangement. It also shows that the reconstruction of the building following the Dissolution was much more radical than had previously been thought.

A purlin from the cloister roof also dated to the winter of AD 1734/5. As this is integral with the existing roof structure, it likely dates the reconstruction of the south range which has hitherto been ascribed to *circa* AD 1740.

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Table 6: Ring-width data of the site master chronologies

MOTISFNT AD1388-1538 Mottisfont Abbey, Romsey - samples mfa1+2+3+12+21+22

ring widths (0.01mm)										**number of trees per year**									
172	165	107	105	103	134	139	146	223	278	1	1	1	1	1	1	1	1	2	2
315	382	326	251	187	232	203	244	275	261	3	3	3	3	3	3	3	3	3	3
234	214	215	178	175	178	195	249	208	182	3	4	4	4	4	5	5	5	5	5
262	180	232	244	199	277	265	229	203	188	5	5	5	5	5	5	5	5	5	5
247	205	174	206	210	146	149	195	191	189	5	5	5	5	6	6	6	6	6	6
170	128	142	185	209	194	194	174	148	174	6	6	6	6	6	6	6	6	6	6
145	150	152	196	154	151	171	152	173	154	6	6	6	6	6	6	6	6	6	6
146	137	123	086	099	143	121	147	166	171	6	6	6	6	6	6	6	6	6	6
189	188	220	171	169	180	170	218	145	117	6	6	6	6	6	6	6	6	6	6
141	160	144	188	148	145	174	136	168	163	6	6	6	6	6	6	6	6	6	6
145	141	165	184	148	148	163	152	192	152	6	6	6	6	6	6	6	6	6	6
106	122	115	098	103	117	125	115	128	123	6	6	6	6	6	6	6	6	6	6
111	143	116	153	159	136	142	119	110	110	6	6	6	6	6	6	6	5	5	5
124	132	094	100	122	100	108	089	106	119	5	5	5	5	5	5	5	5	5	5
107	095	083	135	097	120	127	134	144	139	5	5	5	5	5	5	5	5	5	5
153										4									

mfa25 AD1672-1734 Mottisfont Abbey Romsey - purlin west side west wing

ring widths (0.01mm)									
387	547	418	467	348	461	470	432	654	516
607	485	361	320	339	289	389	400	380	440
371	382	400	275	304	292	330	291	284	285
168	342	367	178	169	169	114	161	140	151
192	237	105	109	123	119	098	076	063	123
177	132	140	099	118	239	157	090	087	072
076	091	122							

Figure 1: Sample location plan *(M Higgins 1995)*

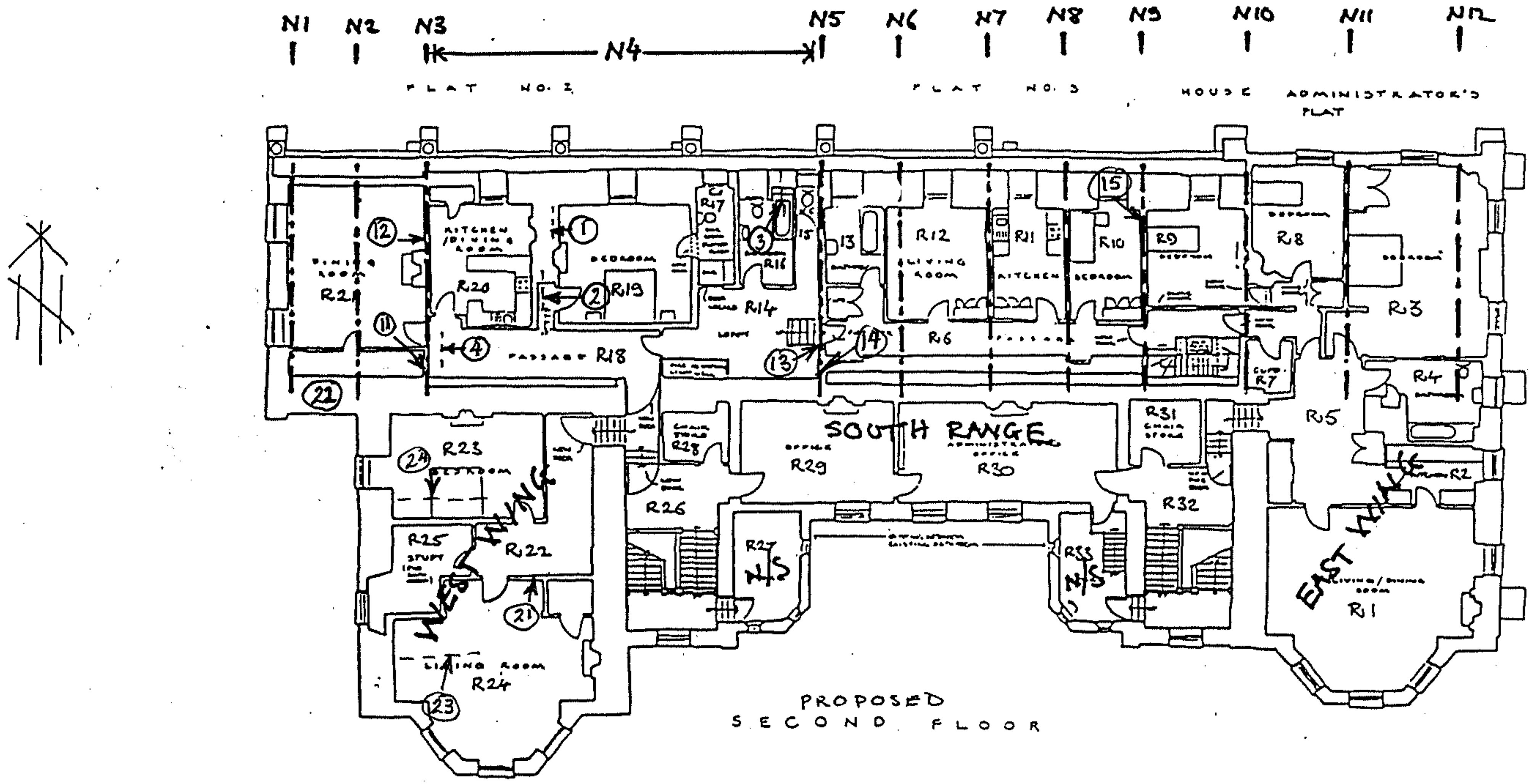


Figure 1: Sample location plan *(M Higgins 1995)*

Figure 2: Sections of timbers sampled 1:96

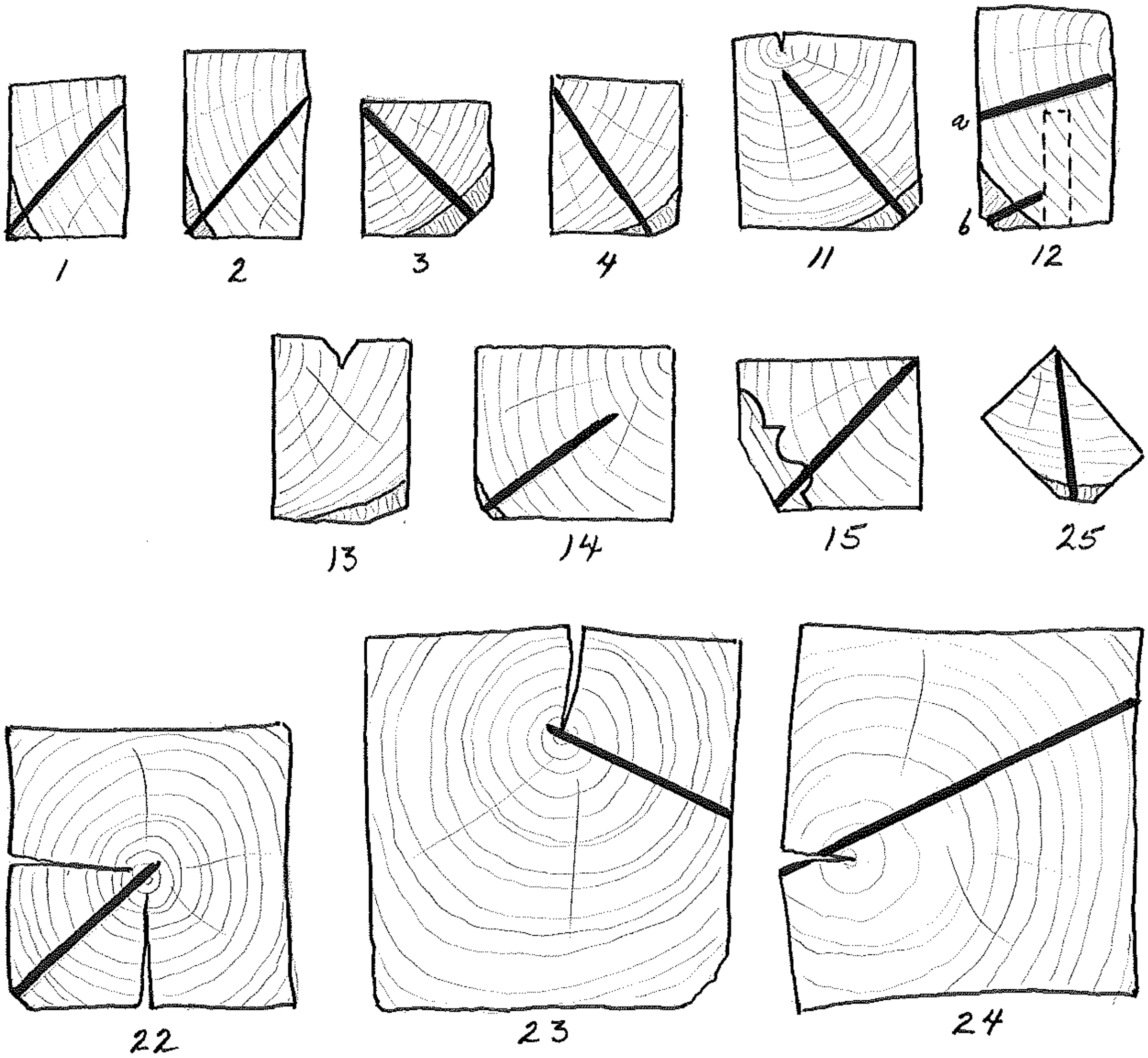
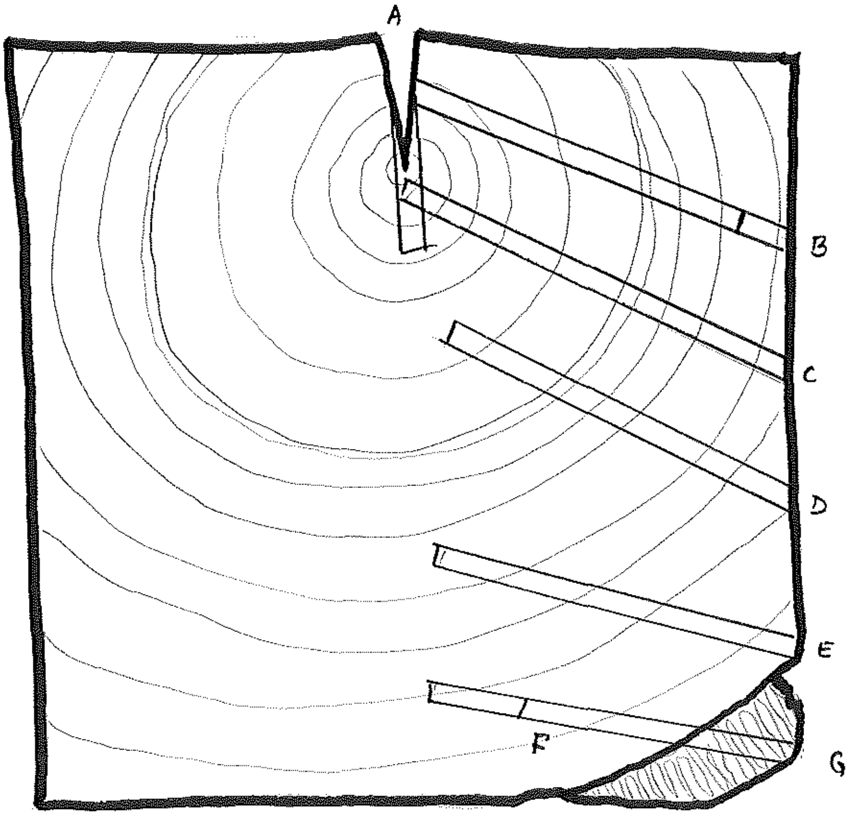


Figure 3: Section of ***mfa21***
1:48



CEILING 2

Mottisfont Abbey - Romsey

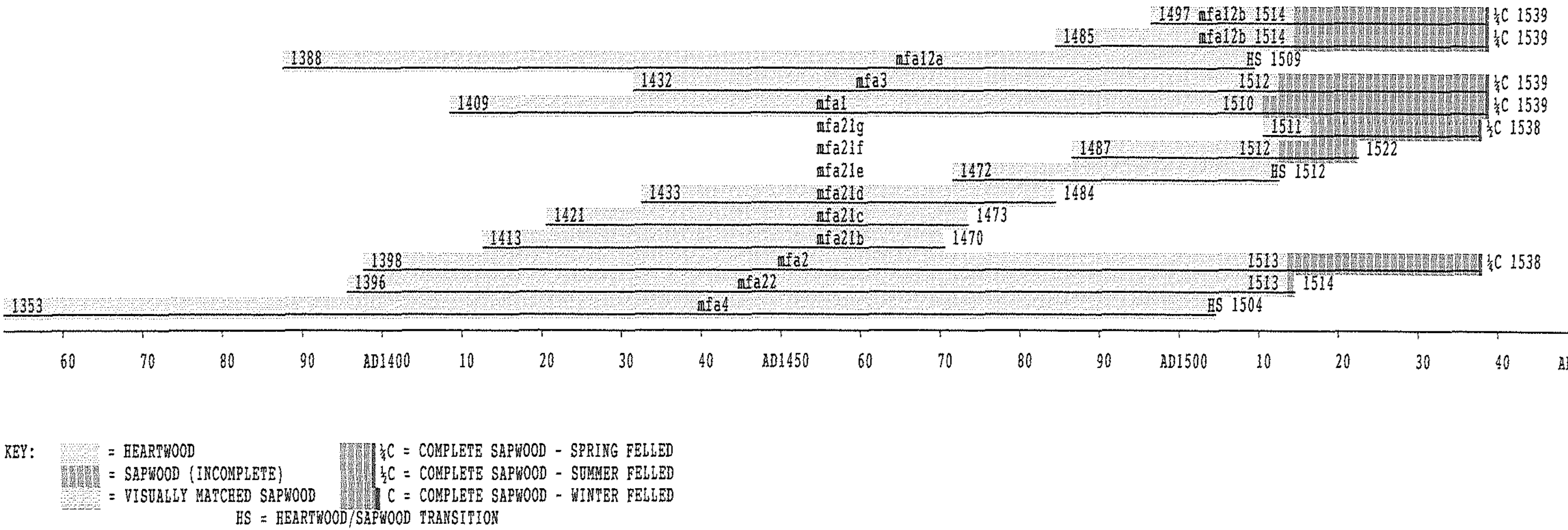


Figure 4: Bar diagram showing dated samples in chronological position