Ancient Monuments Laboratory
Report 30/87

TREE-RING ANALYSIS OF TIMBERS FROM SWAN LANE, CITY OF LONDON, 1981.

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Summary

Over 100 oak timbers from structures associated with the construction and development of the waterfront at Swan Lane, City of London, were examined at the Sheffield Dendrochronology Laboratory. The study produced two master site curves covering the periods 56 BC - 169 AD and 938 - 1192 AD, plus two tree-ring sequences which span the fourteenth and early fifteenth centuries. Interpretation of the tree-ring dates was made difficult because of absence of sapwood.

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Tree-ring analysis of timbers from Swan Lane, City of London, 1981

Introduction

Excavations at Swan Lane (site code - SWA81) by the Museum of London's Department of Urban Archaeology, directed by Geoff Egan, revealed a series of Roman, Saxon and medieval structures. A complex sequence of approximately thirty timber revetments marked successive phases of land reclamation from the River Thames. A Roman quay, constructed of large beams, was replaced by two post and plank revetments and two further Roman waterfront structures. A series of mid 12th to mid 14th century post and plank revetments succeeded a late Saxon clay bank. This marked an intensive period of development on the waterfront during which an undercroft, thought to be early 13th century, and a large number of industrial hearths were also constructed. Towards the southern end of the site, 15th century revetments were revealed. These consisted of thick vertical beams and were braced on the landward side. The latest and most southerly waterfront structure was a later 15th century stone wall.

Oak timbers (*Quercus* spp) from some of these structures were sampled for dendrochronological analysis. It was hoped that the results of the analysis would clarify the chronology of the development of the waterfront.

Method

The samples were prepared, measured and crossdated following the method given in Hillam (1985). They were grouped according to their approximate archaeological date and then examined group by group. Any samples with insufficient rings (less than 30) or with unclear ring sequences, due to the presence of knots, narrow rings or attacks of modern fungus, were rejected.

The sequence of ring widths of each measured sample was represented as a graph. The tree-ring curves were compared visually, by superimposing two curves and sliding one past the other searching for similarities in the pattern of wide and narrow rings. They were also compared by computer which calculates the value of Student's t for each position of overlap (generally a value of 3.5 or over represents a match). The tree-ring sequences from each group were compared with each other and also with reference chronologies from southern England and Germany. The most commonly used reference chronologies for the medieval period were SOUTHWARK (Tyers unpublished), REF6 (Fletcher 1977) and ENGLAND (Baillie & Pilcher pers comm) and for the Roman period GERMANY TRIER AREA (Hollstein 1980) and various chronologies from London such as New Fresh Wharf/Seal House (Morgan & Schofield 1978) and City/Southwark (Tyers unpublished).

The results only date the rings present in the timber and therefore the date of the outermost ring does not necessarily

represent the felling year. Sapwood, the outer part of a tree, is important in the determination of felling dates. If it is complete, indicated by the presence of bark or the bark edge, the exact felling year can be determined. A recent study of oak sapwood data showed that 19 out of 20 samples from British trees had 10-55 sapwood rings (Hillam et al 1986). These 95% confidence limits are used throughout the report to estimate felling dates in the absence of complete sapwood. In the total absence of sapwood, the addition of 10 rings to the date of the last measured heartwood ring produces a probable terminus post quem for felling. As the number of missing heartwood rings is unknown the actual felling date could be much later.

Results

Details of all samples are given in Appendices 1 and 2. The ring widths of 74 samples were measured. Initially 32 samples were successfully dated but following further information about the site's stratigraphy another two samples, originally assumed to be from Roman structures, were successfully dated to the medieval period. Neither of the two samples tentatively placed in the Saxon period by other archaeological evidence were dated.

Two site master chronologies were produced: SWAN LANE ROMAN (Table 1a) which covers the period 56BC-AD169 and SWAN LANE MEDIEVAL (Table 1b) spaning the period AD938-1192. They both crossmatched well with other London chronologies whilst Swan

Lane medieval also showed a high correlation with Germany (Table 2a). Additionally two sequences (3451 and 3454) spaning the 14th and early 15th centuries were also dated by comparison with various regional chronologies (Table 2b). The results are given in full in Appendix 3.

Interpretation of the results is made difficult because of the lack of sapwood. In addition, detailed information about the stratigraphy and phasing of the site is not yet available, so that the following discussion is based mostly on the tree-ring evidence alone.

Roman

Eleven samples from several different Roman structures, revetment R2 being the earliest and revetment R5 the latest, were dated (Table 3a; Figure 1a). Only one of these, 1925B from the drain associated with revetment R2/3, had retained any sapwood and was felled during AD135-180. The felling dates of the other samples range from after AD133 to after 179, apart from sample 1887 which was felled after AD61. This sample may be re-used but it seems more probable that a number of heartwood rings are absent.

If the three timbers from R2/3 and R2/3 drain are contemporary a felling date of AD138-180 is obtained. This would suggest that plank 1877A from R2 was also felled before AD180. The timbers from revetment R4 have a probable terminus post quem of AD144.

However, sample 1341, which archaeological evidence indicates is associated with R3, was felled after AD159. This suggests that the R4 timbers could have a number of missing heartwood rings or that 1341 may in fact be associated with either R4 of even revetment R5.

Medieval

Twenty three samples from various medieval structures were dated (Table 3b; Figure 1b). Once again only one of these samples, 368, had retained some sapwood and unfortunately this was a re-used timber robbed from an earlier building. The felling dates of the other samples range from after AD1133 to after 1202, apart from samples 3018, 1195 and 1191, which were felled after AD1042, 1394 and 1462 respectively.

A terminus post quem of AD1192 is obtained from the four dated timbers from the main medieval structure. The timbers from the undercroft support produce a felling date of after AD1154, although sample 368, felled in AD1147-1189, was re-used from a late 12th century building. Two 12th century structures are represented by timbers 1579 and 1502H which give a terminus post quem of AD1123 and 1155 respectively. If 368 is contemporary with these then a felling date of AD1155-1189 is indicated.

It appears possible that some timbers were either re-used or have a number of heartwood rings missing. Timber 1596, given a

tentative archaeological date in the 15th century, produced a terminus post quem of AD1202. However, the appearance and way in which this timber had been worked suggest that few hearwood rings are missing and that it was probably felled and initially used during the 13th century.

The Timbers

The number of rings on the samples ranged from circa 25 to 180 plus. This variation was apparent on both Roman and medieval samples. However the bulk of the timbers appear to originated from trunks of approximately 40-100 years old. The dimensions of the timbers and the way in which they have been worked are variable, presumably according to the function of the timber. The diameter of the parent trunk of both the medieval and Roman timbers must have ranged from approximately 0.1 to 0.7 metres. The average ring width varies between 0.85 to 4.41 millimetres. This indicates that some of the trees must have grown under conditions that were limiting, possibly in dense woodland, whilst others had more favourable conditions and perhaps experienced less competition.

Discussion

The results from the Roman timbers indicate that an almost continuous period of construction took place during the mid to late 2nd century. No dendrochronological dates were obtained

for the Saxon period as the only two available oak samples were unsuitable for analysis. The felling dates of the medieval samples suggest intensive development on the waterfront thoroughout the 12th and early 13th centuries. However, during the 14th and 15th centuries development of the waterfront appears to have decreased.

It is not possible to estimate the life span of the various Roman and medieval structures with any accuracy. This is due to the absence of sapwood on almost all the timbers, which causes the felling ranges, and therefore the construction dates, to be less precise. Additionally many of the structures are represented by only one dated timber. However, the Swan Lane results are useful in that they augment the growing body of tree-ring dates from other sites in the City of London (eg Hillam & Groves 1985).

During the examination of the timbers in terms of the size and age of their parent tree, and the average width of their rings, it becomes apparent that there is a great variety of material. This is to be expected in a region such as London as it is likely to be the result of the exploitation of a large area of woodland.

Conclusion

Development of the waterfront took place throughout the latter half of the 2nd, 12th and early 13th centuries and to a lesser extent during the 14th and 15th centuries. Due to lack of suitable samples dendrochronological dates could not be obtained for the Saxon period.

The results of the dendrochronological analysis generally support the dates suggested by other archaeological evidence. However the absence of sapwood and in some instances the lack of available information makes interpretation of the felling dates difficult. The precision of the felling dates may have been improved if more samples per structure had been available and dated.

Acknowledgements

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Figure 1a

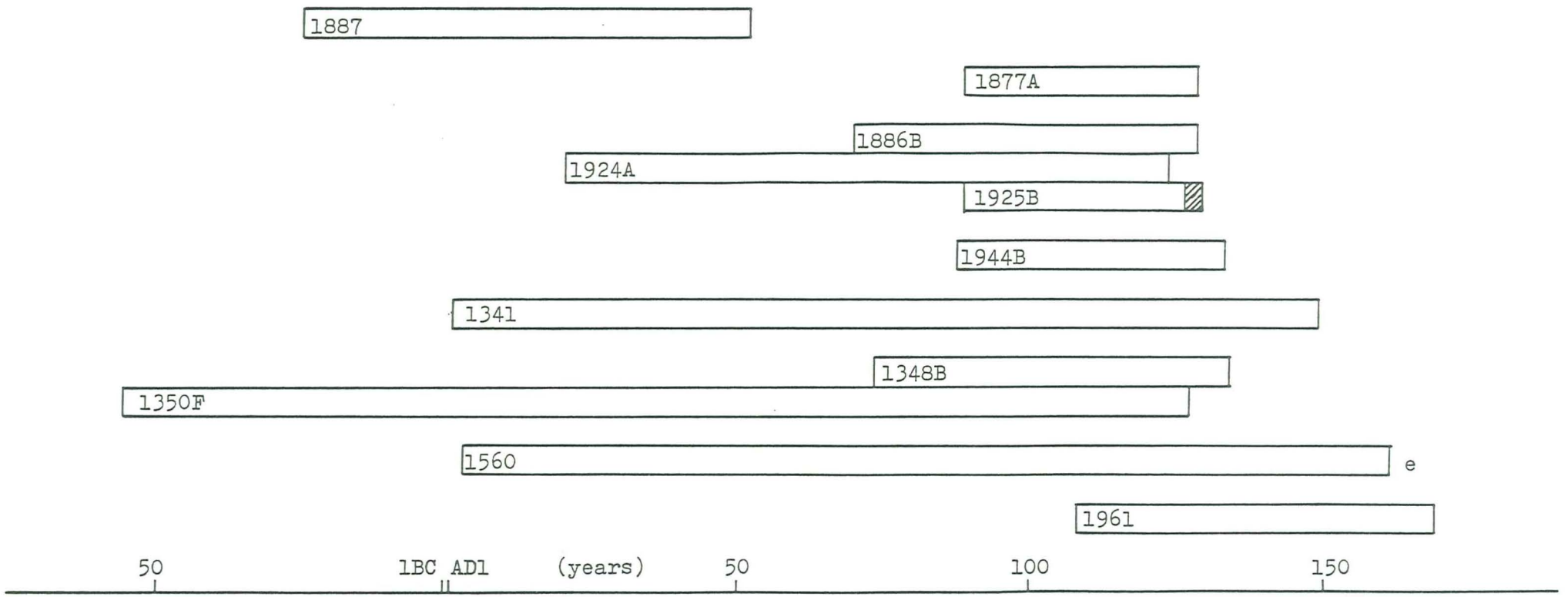


Figure 1: Bar diagram showing the relative positions of the dated ring sequences from a) Roman period and b) Medieval period. The accession numbers are given in brackets where there is more than one sample with the same context number. Shading indicates sapwood; e - indicates the presence of unmeasured rings.

Figure 1b

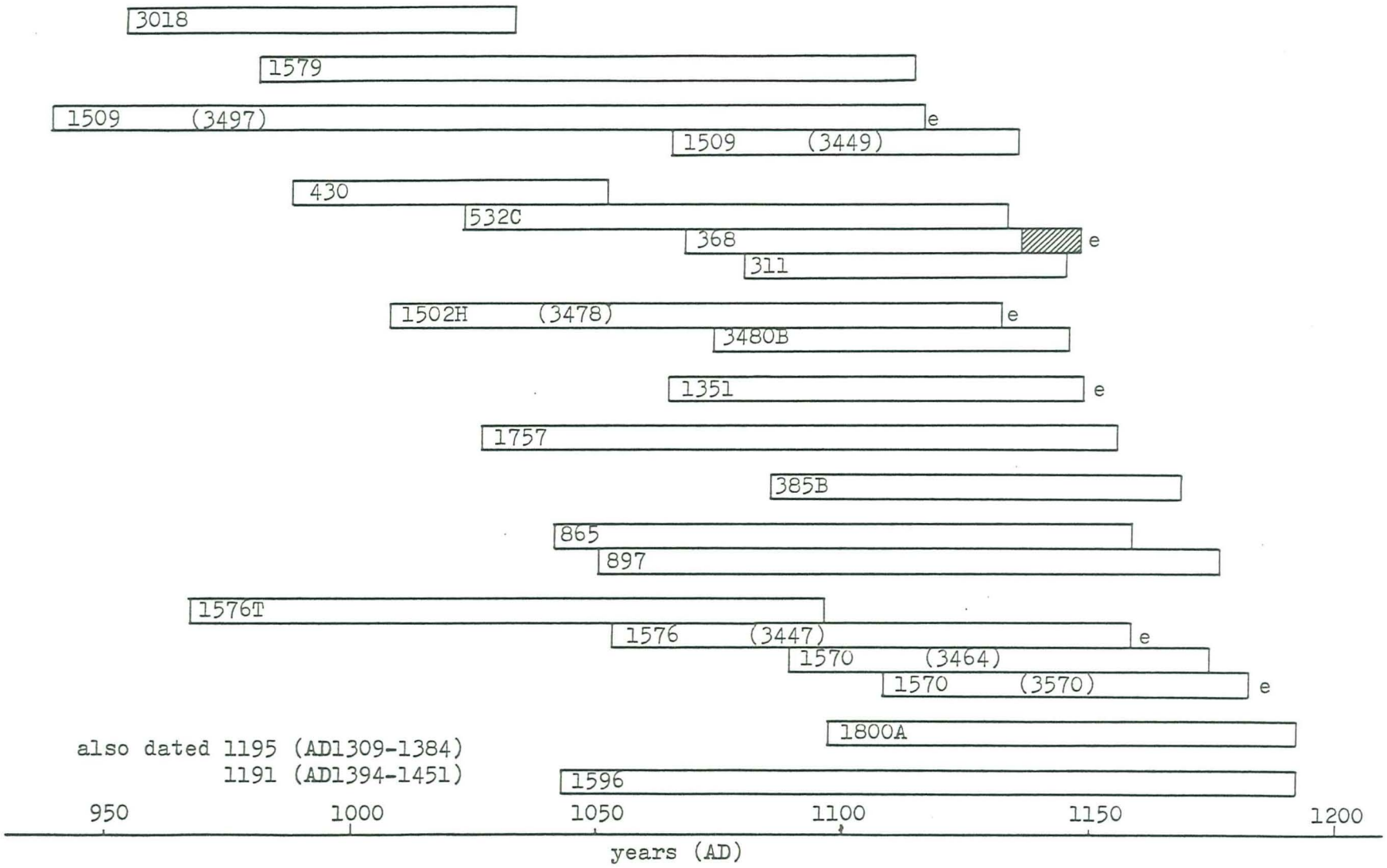

3018
1579
1509 (3497) e
1509 (3449)
430
532C
368 e
311
1502H (3478) e
3480B
1351 e
1757
385B
865
897
1576T
1576 (3447) e
1570 (3464)
1570 (3570) e
1800A
also dated 1195 (AD1309-1384)
1191 (AD1394-1451)
1596
950
1000
1050
1100
1150
1200
years (AD)

Table 1a: Ring width data, in units of 0.02mm, of SWAN ROMAN MEAN, 56BC-AD169.

SWAN LANE LONDON
SWAN ROMAN MEAN
225

1	-	353	339	298	283	370	310	299	320	266	281
11	-	334	195	176	149	177	193	118	148	229	97
21	-	95	74	106	80	75	54	85	56	52	58
31	-	110	68	63	68	60	51	38	56	75	61
41	-	81	71	71	68	49	44	67	74	66	77
51	-	83	51	62	86	64	51	74	115	99	111
61	-	105	140	136	98	138	99	85	65	73	77
71	-	97	87	109	110	100	99	71	62	60	91
81	-	100	76	104	108	122	86	84	95	75	84
91	-	102	80	93	131	108	79	89	75	69	76
101	-	78	70	65	67	62	48	57	69	59	54
111	-	74	65	45	53	53	58	80	50	56	48
121	-	49	59	71	72	51	56	57	40	104	140
131	-	88	69	64	76	83	83	87	88	81	67
141	-	53	76	112	127	141	110	128	139	100	74
151	-	117	124	137	97	91	100	118	115	81	135
161	-	123	103	118	109	102	96	118	108	72	91
171	-	62	85	113	91	92	114	73	101	80	103
181	-	92	115	118	129	105	131	96	99	100	89
191	-	89	124	125	124	90	85	98	97	110	105
201	-	109	81	141	88	83	121	96	86	87	64
211	-	99	68	77	83	77	68	82	51	57	44
221	-	58	50	84	83	62					

Table 1b: Ring width data, in units of 0.02mm, of SWAN LANE MED, AD938-1192.

SWAN LANE LONDON
SWAN LANE MED
255

1	-	110	97	62	69	62	35	39	70	50	62
11	-	55	20	45	27	47	53	49	70	64	94
21	-	68	38	53	49	41	44	42	36	56	122
31	-	89	77	63	102	75	60	65	70	67	102
41	-	74	98	105	104	107	89	78	106	83	91
51	-	87	116	94	99	112	113	113	110	81	85
61	-	104	116	99	84	97	130	107	84	82	79
71	-	111	92	82	75	90	90	58	70	74	77
81	-	88	68	75	92	80	99	84	75	88	87
91	-	67	58	86	58	57	66	66	68	74	103
101	-	69	58	89	96	101	79	62	81	85	93
111	-	60	69	66	74	58	55	47	83	81	67
121	-	86	81	76	68	62	80	94	76	97	116
131	-	116	104	101	93	96	96	96	108	113	102
141	-	101	92	96	91	103	116	98	97	98	71
151	-	67	85	68	69	88	100	81	71	71	79
161	-	91	84	95	66	64	97	82	82	80	90
171	-	93	89	71	73	77	87	91	108	86	75
181	-	77	74	78	62	82	93	101	77	68	69
191	-	78	59	77	72	82	77	75	78	59	50
201	-	75	57	91	88	72	77	76	89	64	64
211	-	79	81	90	80	61	95	74	69	77	80
221	-	81	76	101	79	79	62	75	78	70	74
231	-	93	121	98	92	82	100	83	69	84	69
241	-	82	71	62	36	87	96	64	87	92	85
251	-	64	67	86	75	93					

Table 2: Dating the tree-ring sequences a) the master curves and b) sequences 3451 and 3454.

Table 2a

reference chronology / date	t-value Swan Lane Roman	Swan Lane Medieval
England (AD404-1981)	-	9.9
Ref6 (AD780-1193)	-	10.7
Southwark medieval (AD779-1227)	-	9.6
Germany Trier area (400BC-AD1965)	3.8	7.2
City/Southwark (252BC-AD255)	9.2	-
New Fresh Wharf/Seal House (73BC-AD209)	10.5	-

Table 2b

reference chronology / date	t-value 3451	3454
Germany Munich area (370BC-AD1969)	4.3	-
Germany Trier area (400BC-AD1965)	3.8	-
Droitwich (AD1178-1415)	4.6	-
England (AD404-1981)	3.3	4.0
English/Welsh border (AD1341-1636)	-	3.9
Reading (AD1160-1407)	3.2	-
St Cuthberts (AD1255-1496)	3.4	-
Tower, London (AD1383-1534)	-	3.8
York medieval (AD1320-1696)	-	6.2

Table 3a: Felling dates of Roman timbers. 'e' indicates the presence of rings that have been counted rather than measured; sapwood transition is given in brackets.

structure	timber	years spanned	felling date (AD)
R2	1877A	88-128	after 138
R2/3	1886B	69-128	after 138
R2/3 drain	1924A	20-123	after 133
	1925B	88-129(126)	135-180
isolated drain	1944B	87-133	after 143
associated with R3	1341	1-149	after 159
R4	1348B	73-134	after 144
associated with R4	1350F	56BC-AD127	after 137
R5	1560	3-161 e	after 171
isolated timber	1961	108-169	after 179
?	1887	26BC-AD51	after 61

Table 3b: Felling dates of medieval timbers. 'e' indicates the presence of rings that have been counted rather than measured; sapwood transition is given in brackets; accession numbers have been given where necessary.

structure	timber	years spanned (AD)	felling date (AD)
?	1351	1064-1148 e	after 1158
?	1757	1027-1155	after 1165
?	1596	1043-1192	after 1202
removed revetment	3018	953-1032	after 1042
late C12 structure	1579	980-1113	after 1123
late C12 structure	1502H - 3478	1007-1131 e	after 1141
	1502H - 3480B	1073-1145	after 1155
undercroft support	311	1079-1144	after 1154
	368	1067-1147(1135) e	1145-89
	430	987-1051	after 1061
	532C	1022-1132	after 1142
frame - hearth 1	385B	1085-1168	after 1178
late C12 structure	865	1041-1158	after 1168
or 'deep hole'	897	1050-1176	after 1186
early C13 structure	1570 - 3464	1089-1174	after 1184
- main medieval	1570 - 3570	1108-1182 e	after 1192
feature	1576 - 3447	1053-1158 e	after 1168
	1576T	967-1096	after 1106
?early C13 structure	1509 - 3449	1064-1134	after 1144
	1509 - 3497	938-1115 e	after 1125
isloated structure	1800A	1097-1192	after 1202
early C15 structure	1195	1309-1384	after 1394
C15 drain	1191	1394-1451 e	after 1461

Appendix 1

Details of samples

Context - context number

Accn - accession number

Rings - total number of rings

Sapwood - number of sapwood rings

Av. width - average ring width in mm

Dimensions - maximum dimensions of the cross-section in mm

Exres - expected date from other archaeological evidence

\+ - rings present but not measured

APPENDIX 1 - DETAILS OF SAMPLES

CONTEXT	ACCN	RINGS	SAPWOOD	AV.WIDTH	DIMENSIONS	EXRES	COMMENT
311	76	66	–	0.89	195x160	medieval	–
366	78	83	8–9	2.08	195x150	13th	–
368	100	75+	7	1.80	200x200	13th	+6 outer rings
369	75	31	17	3.21	135x120	13th	–
385B	88	84	–	0.66	140x55	13th	–
385C	90	58	24	2.36	180x85	13th	–
385A	91	55	13	2.87	175x100	13th	–
409	80	31	14	2.31	155x115	?Saxon	knotty
430	83	65	–	4.41	310x55	13th	–
527A	81	c35	–	–	135x65	13th	decayed
527B	82	–	–	–	125x100	13th	decayed
527Z	101	–	–	–	110x100	13th	decayed
530	79	94	32	0.95	150x140	12th?	–
531C	86	35	9	–	155x70	13th	–
532C	84	111	–	1.04	140x65	13th	–
532A	85	–	–	–	160x130	13th	decayed
532D	89	133	–	1.02	150x45	13th	–
535D	87	c45	–	–	210x110	13th	decayed
600A	232	39	–	1.79	75x60	?Saxon	–
602	66	–	–	–	225x150	13th	decayed
620	77	–	–	–	210x160	13th	decayed
865	3484	118	–	3.32	420x50	13th	–
875	3488A	56+	–	1.68	185x45	13th	+5 outer rings
875	3488B	42	–	3.04	150x45	13th	–
897	3491	127	–	1.37	285x45	13th	–
965	4394	63	–	2.61	325x40	14–15th	–
1016A	3470	49	–	2.56	145x120	13th	–
1017	3458	40	9	1.33	115x105	13–14th	–
1025	3499	62	?	2.86	285x195	14th	–
1033	3466	c35	y	–	160x105	13th	rings unclear
1100	3471	25	–	–	175x130	–	knotty
1145C	3455	28	–	–	120x40	14th	–
1146	3459	55	25	2.03	230x120	13–14th	–
1156	3468	25	–	–	195x165	13–14th	–
1157	3477	26	5	–	195x190	13–14th	–
1158	3568	27	7	–	155x130	13–14th	–
1191	3454	56+	–	2.68	250x190	14th	+2 outer rings
1195	3451	77	–	1.91	290x230	15th	–
1216	3450	84	1	1.76	215x155	15th	–
1218	3472	20	–	–	215x50	–	rings distorted
1282	3567	c35	–	–	235x165	13–14th	rings unclear
1291	3575	25	–	–	140x50	13–14th	–
1314	3453	40	–	3.60	165x135	13–14th	–
1314	3457	21	–	–	140x135	13–14th	–
1316	3483	76	23–25	2.11	185x115	13–14th	knotty
1341	3580	149	–	1.38	410x355	L.Roman	–
1348B	3496	62	–	2.71	340x40	L.Roman	–
1350D	3576	65	–	1.96	145x40	L.Roman	–
1350F	3578	183	–	1.51	530x360	L.Roman	knotty

APPENDIX 1 - DETAILS OF SAMPLES

CONTEXT	ACCN	RINGS	SAPWOOD	AV.WIDTH	DIMENSIONS	EXRES	COMMENT
1351	3474	75+	-	2.59	240x150	L.Roman	+10 outer rings
1502H	3478	122+	-	1.24	225x45	13th	+3 outer rings
1502H	3479	69	-	3.94	300x35	13th	-
1502H	3480A	80	-	0.85	155x30	13th	-
1502H	3480B	73	-	1.33	140x35	13th	-
1502H	3481	119	-	1.50	290x45	13th	-
1502H	3482	c40	-	-	325x40	13th	unclear rings
1502	3489	+84	-	1.29	260x105	13th	-
1508	3473	48	-	1.90	170x135	-	-
1509	3449	71	-	4.06	325x60	13th	-
1509	3497	172+	-	1.06	300x45	13th	+5 outer rings
1560	3485	144+	-	1.61	325x85	L.Roman	+15 outer rings
1562	3492	60	-	3.60	220x165	13th	-
1563B	3476	25	-	-	125x125	13th	-
1563C	3581A	45	-	2.04	100x25	13th	-
1563C	3581B	58	-	1.42	110x25	13th	-
1570	3464	86	-	2.53	240x35	13th	-
1570	3570	+73+	-	2.15	195x35	13th	+2 outer rings
1570	3571	25	-	-	145x140	13th	-
1576P	3446	116	-	1.03	335x60	13th	-
1576	3447	+99+	-	1.07	245x95	13th	+7 outer rings
1576	3467	25	-	-	250x50	13th	-
1576T	3493	130	-	1.45	205x155	13th	-
1576	3582	27	-	-	255x50	13th	-
1579	3579	134	-	0.91	325x295	12-13th	-
1581	3463	75+	4+	1.52	205x155	13th	knotty
1596	3577	150	-	1.84	500x490	15th	-
1757	3494	129	-	0.94	280x35	Roman	-
1800D	3456	52	-	4.21	260x20	14th	-
1800M	3486	35	-	4.11	210x195	14th	-
1800	3490	29	-	-	135x120	14th	-
1800O	3573	c42	-	-	335x40	14th	decayed
1800A	3574	96	-	1.21	400x41	14th	-
1877A	4417	41	-	4.34	190x30	Roman	-
1880A	4409	29	8	-	155x110	14th	-
1882D	4413	29	-	-	175x60	Roman	-
1886J	4403	64	-	1.87	205x25	Roman	-
1886B	4404	60	-	1.16	335x65	Roman	-
1886	4410	30	-	2.29	155x110	Roman	-
1887	4406	77	-	1.20	115x75	Roman	-
1909	4407	34	-	3.88	155x135	Roman	-
1924A	4400	104	-	1.77	205x60	Roman	-
1924B	4412	15	-	-	130x105	Roman	-
1925B	4401	42	4	2.89	165x115	Roman	-
1944B	4415	47	-	3.44	190x20	Roman	-
1953	4405	35	-	3.84	130x105	Roman	-
1955	4408	100	-	1.55	195x65	Roman	-
1955	4414	35	-	1.62	65x55	Roman	-
1961	4398	62	-	2.61	250x240	Roman	-

APPENDIX 1 - DETAILS OF SAMPLES

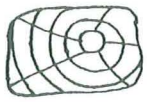
CONTEXT	ACCN	RINGS	SAPWOOD	AV.WIDTH	DIMENSIONS	EXRES	COMMENT
2195	3462	-	-	-	-	-	broken
2198	3495	-	-	-	170x45	13th	rings unclear
2276E	3572	69	-	2.53	295x50	13th	-
3007	4418	35	-	2.87	135x30	Roman	-
3008	4419	20	-	-	145x20	Roman	-
3018	4411	80	-	1.25	140x110	12-13th	-
3044B	4402	29	-	-	170x50	Roman	-

Appendix 2

Cross-sectional sketches

Sapwood indicated by shading; sketches are not drawn to scale and are intended as a rough guide to the way in which the timbers were cut or split.

APPENDIX 2

311 

366 

368 

369 

385A 

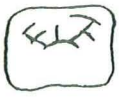
385B 

385C 

409 

430 

527A 

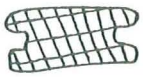
527B 

527Z 

530 

531C 

532A 

532C 

532D 

535D 

600A 

602 

620 

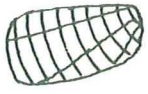
865 

875
(3488A) 

875
(3488B) 

897 

965 

1016A 

1017 

1025 

1033 

1100 

1145C 

1146 

1156 

1157 

1158 

1191 

1195 

1216 

1218 

1282 

1291 

1314
(3453) 

1314
(3457) 

1316 

1341 

1348B 

1350D 

1350F 

1351 

1502 

1502H
(3478) 

1502H
(3479) 

1502H
(3480A) 

1502H
(3480B) 

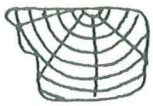
1502H
(3481) 

1502H
(3482) 

1508 

1509
(3449) 

1509
(3497) 

1560 

1562 

1563B 

1563C (3581A) 

1563C (3581B) 

1570 (3464) 

1570 (3570) 

1570 (3571) 

1576 (3447) 

1576 (3467) 

1576 (3582) 

1576P 

1576T 

1579 

1581 

1596 

1757 

1800 

1800A 

1800D 

1800M 

1800O 

1877A 

1880A 

1882D 

1886 

1886B 

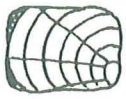
1886J 

1887 

1909 

1924A 

1924B 

1925B 

1944B 

1953 

1955
(4408) 

1955
(4414) 

1961 

2195 fragmented

2198 

2276E 

3007 

3008 

3018 

3044B 

Appendix 3

Results

Context - context number

Accn - accession number

+ - rings present but not measured

Dates of the heartwood-sapwood transitions, where present, are given in brackets.

APPENDIX 3 - RESULTS

CONTEXT	ACCN	RESULT1	RESULT2	COMMENT
311	76	dated	1079-1144	-
366	78	undated	-	-
368	100	dated	1067-1141 (1135)	+6 outer rings
369	75	undated	-	-
385B	88	dated	1085-1168	-
385C	90	undated	-	-
385A	91	undated	-	-
409	80	undated	-	knotty
430	83	dated	987-1051	-
527A	81	rejected	-	decayed
527B	82	rejected	-	decayed
527Z	101	rejected	-	decayed
530	79	undated	-	-
531C	86	undated	-	-
532C	84	dated	1022-1132	-
532A	85	rejected	-	decayed
532D	89	undated	-	-
535D	87	rejected	-	decayed
600A	232	undated	-	-
602	66	rejected	-	decayed
620	77	rejected	-	decayed
865	3484	dated	1041-1158	-
875	3488A	undated	-	+5 outer rings
875	3488B	undated	-	-
897	3491	dated	1050-1176	-
965	4394	undated	-	-
1016A	3470	undated	-	-
1017	3458	undated	-	-
1025	3499	undated	-	-
1033	3466	rejected	-	rings unclear
1100	3471	rejected	-	knotty
1145C	3455	rejected	-	-
1146	3459	undated	-	-
1156	3468	rejected	-	-
1157	3477	rejected	-	-
1158	3568	rejected	-	-
1191	3454	dated	1394-1449	+2 outer rings
1195	3451	dated	1309-1384	-
1216	3450	undated	-	-
1218	3472	rejected	-	rings distorted
1282	3567	rejected	-	rings unclear
1291	3575	rejected	-	-
1314	3453	undated	-	-
1314	3457	rejected	-	-
1316	3483	undated	-	knotty
1341	3580	dated	1-149	-
1348B	3496	dated	73-134	-
1350D	3576	undated	-	-
1350F	3578	dated	56BC-AD127	knotty

CONTEXT	ACCN	RESULT1	RESULT2	COMMENT
1351	3474	dated	1064-1138	+10 outer rings
1502H	3478	dated	1007-1128	+3 outer rings
1502H	3479	undated	-	-
1502H	3480A	undated	-	-
1502H	3480B	dated	1073-1145	-
1502H	3481	undated	-	-
1502H	3482	rejected	-	unclear rings
1502	3489	undated	-	-
1508	3473	undated	-	-
1509	3449	dated	1064-1134	-
1509	3497	dated	938-1110	+5 outer rings
1560	3485	dated	3-146	+15 outer rings
1562	3492	undated	-	-
1563B	3476	rejected	-	-
1563C	3581A	undated	-	-
1563C	3581B	undated	-	-
1570	3464	dated	1089-1174	-
1570	3570	dated	1108-1180	+2 outer rings
1570	3571	rejected	-	-
1576P	3446	undated	-	-
1576	3447	dated	1053-1151	+7 outer rings
1576	3467	rejected	-	-
1576T	3493	dated	967-1096	-
1576	3582	rejected	-	-
1579	3579	dated	980-1113	-
1581	3463	undated	-	knotty
1596	3577	dated	1043-1192	-
1757	3494	dated	1027-1155	-
1800D	3456	undated	-	-
1800M	3486	undated	-	-
1800	3490	rejected	-	-
1800O	3573	rejected	-	decayed
1800A	3574	dated	1097-1192	-
1877A	4417	dated	88-128	-
1880A	4409	rejected	-	-
1882D	4413	rejected	-	-
1886J	4403	undated	-	-
1886B	4404	dated	69-128	-
1886	4410	undated	-	-
1887	4406	dated	26BC-AD51	-
1909	4407	undated	-	-
1924A	4400	dated	20-123	-
1924B	4412	rejected	-	-
1925B	4401	dated	88-129 (126)	-
1944B	4415	dated	87-133	-
1953	4405	undated	-	-
1955	4408	undated	-	-
1955	4414	undated	-	-
1961	4398	dated	108-169	-

APPENDIX 3 - RESULTS

CONTEXT	ACCN	RESULT1	RESULT2	COMMENT
2195	3462	rejected	-	broken
2198	3495	rejected	-	rings unclear
2276E	3572	undated	-	-
3007	4418	undated	-	-
3008	4419	rejected	-	-
3018	4411	dated	953-1032	-
3044B	4402	rejected	-	-