TREE-RING ANALYSIS OF OAK TIMBERS FROM BRANDON, SUFFOLK

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ABSTRACT

Twenty two oak timbers from Saxon structures excavated at Brandon, Suffolk during 1981-82 were sampled for tree-ring analysis with a view to providing more precise construction dates for the causeway and buildings. Three site chronologies were produced, one of which dated to the period AD 417-597. The exact date of felling cannot be determined as none of the samples had sapwood. However, the dated timbers cannot have been felled before AD 612. The other two chronologies remain undated, providing a further example of the difficulties encountered in the dating of timbers from East Anglia.

INTRODUCTION

The excavation at Brandon, Suffolk (site code - BRD018) in 1981-82 by the Suffolk Archaeological Unit revealed various timber structures. A variety of species of wood were present, of which all suitable oak (Quercus spp) timbers were sampled for dendrochronological analysis. Three principle contexts were represented. Ten of the samples were from planks of buildings of middle Saxon date. A further eight samples were from piles associated with a causeway running across the marsh. This was tentatively dated to the middle Saxon period but archaeological evidence for dating was poor. The remaining four samples were a group of piles from the same feature, also probably of middle Saxon date. An approximate archaeological date of AD 600-850 had been suggested for all timbers sampled. The aims of the study were firstly to provide dates for the structures and secondly to produce a tree-ring chronology for the Brandon area.

METHOD

The samples were prepared and measured following the method given by Hillam (1985a). Following preparation, six samples (739, 748, 749, 1935, 1936, 1942) were found to contain bands in which the individual growth rings could not be reliably distinguished. As five of these samples were associated with the same building (number 734) they were all allowed to dry out. These samples were sanded with several grades of emery paper in an attempt to clarify the narrow bands of rings. This proved successful with samples 739 and 748, leaving only four samples unmeasurable.

The sequence of ring widths of each sample is represented as a graph, known as a tree-ring curve, on transparent semi-logarithmic paper. The graphs were compared visually by superimposing two curves, sliding one curve past the other and searching for similarities in the patterns of wide and narrow rings which indicate that the timbers had some period of growth in common. This process known as crossmatching is also carried out on a microcomputer. The computer program (Baillie & Pilcher, 1973) measures the amount of similarity between two ring sequences by calculating the value of Student's t for each position of overlap. Generally a t-value of 3.5 or over represents a match provided that the visual match is acceptable. Computer matching must always be checked visually before it can be accepted, since spurious results occasionally occur.

A site master curve is produced from any matching curves by taking an average of their ring widths. A master curve is more likely to produce a date than the ring sequence of a single sample when compared with a dated reference chronology. This is because the master curve enhances the common climatic signal but reduces the "background noise" resulting from the local growth conditions of individual trees.

Following the completion of crossmatching and dating, it is possible to calculate the felling dates of the timbers. Sapwood, the outer part of the tree, is very important in the determination of felling dates. If the sapwood on a sample is complete the exact felling year can be given. The amount of sapwood in an oak tree remains relatively constant between 10-55 rings (Hillam et al, 1986). Consequently the felling year can be estimated even if only a small amount of sapwood has been preserved. If there is no sapwood, then the addition of the minimum sapwood allowance (10 rings) to the date of the last measured heartwood ring produces a terminus post quem for felling. As the number of missing heartwood rings is unknown, the actual felling date could be much later. The seasoning of timber is a relatively recent practice, so construction usually followed soon after felling. Whilst the production of dates is a completely independent process, the calculation of felling and construction dates can be refined by studying other archaeological evidence.

RESULTS

The samples had between 45-161 annual growth rings and seven had retained some sapwood. Samples with more than 50 rings are usually prefered as these can be more readily dated. Sample 1216 was double centred so two radii were measured. The two ring sequences crossmatched and were therefore combined and subsequently treated as a single ring sequence.

The first group consisted of eight samples associated with the causeway, all of which were measured. Six of the ring sequences crossmatched each other (Figure 1) of which three (1285, 1295, 1296) were from the east line, two (1236, 1271) from the central line and one (1216) from the west line. A master curve, BRANCAUSE, of 129 years (Table 2) was compiled from these matching curves.

The second group consisted of samples from four associated piles. Two of the ring sequences (1235, 1319) crossmatched. The ring widths of these matching curves were averaged

together to form a master curve, BRANAP, of 65 years (Table 3).

The third group consisted of eight samples, associated with building 734. Three samples were unmeasurable due to the presence of narrow bands in which the individual rings were not clearly defined. The ring sequences of samples 739, 740, 748 and 1938 crossmatched each other. A master curve, BRANBUILD, (Table 4) was constructed using the data from these four matching curves.

The three master curves were compared with each other but did not crossmatch. Sample 1942 from building 1391 was unmeasurable. The tree-ring curve of sample 1037 from building 1094 and all unmatched ring sequences were compared with the three master curves but no conclusive crossmatches were found.

The three site master curves were tested against various reference chronologies, or absolutely dated ring sequences, covering the Saxon period from Britain and Europe (see Appendix for details). High t-values and good visual matches were obtained when BRANBUILD covered the period AD 417-597 (Table 5). As no conclusive results were obtained for either BRANCAUSE or BRANAP, they were also tested against chronologies covering the periods before and after the Saxon chronologies. This also proved unsuccessful so these two master curves remain undated.

INTERPRETATION AND DISCUSSION

The dates of the outer rings of the samples from building 734 range from AD 501 to 602. In the absence of sapwood a terminus post quem was calculated for the felling dates of the timbers (Table 6). It is likely that all four samples are contemporary and were therefore probably felled after AD 612. The building cannot, therefore, have been constructed before AD 612.

Samples 1235 and 1319, both piles, are probably contemporary and as sample 1235 has retained some sapwood a relative felling date of 78-117 (arbitrary years) is produced.

Relative felling dates have also been calculated for the crossmatched timbers from the causeway (Table 6). The timbers from each line of the causeway are probably contemporary which results in relative felling dates of 115-149 for timbers associated with the central line, 136-172 for timbers associated with the eastern line and after 137 for timbers associated with the western line. If

the three causeway lines are contemporary a relative felling date for the timbers of 137-149 is obtained. (The relative timescales of the causeway timbers and the four associated piles are independent; they do not indicate relative dating.)

Absolute dating of BRANAP and BRANCAUSE has been unsuccessful. This is due to the lack of chronologies available for East Anglia and also the shortness of the ring sequence of BRANAP. Few tree-ring chronologies exist for East Anglia as timbers from this area have so far proved difficult to date (Hillam 1985b).

The average ring widths are mostly quite narrow. Generally trees with very narrow rings are from woodland where competition was severe, whereas trees with wide complacent rings usually originate from open contexts where little competition was experienced (Bartholin 1978, Hillam & Morgan 1981). The samples from the causeway and the four other associated piles appear to have been left virtually whole and unworked. In general these timbers appear to be from trees with diameters of at least 170mm and over 70 years old. It is difficult to estimate the size and age of trees used to provide the timber for the buildings with any accuracy due to them having been worked.

CONCLUSIONS

Tree-ring analysis has successfully provided dates for timbers associated with building 734. The felling dates of these timbers indicate that this building cannot have been constructed before AD 612. A more precise felling date cannot be estimated as the number of missing heartwood rings, if any, is unknown. Relative dating of the causeway and associated piles has also been achieved but these are not likely to be absolutely dated until further reference chronologies for East Anglia are available. The problems of dating timbers from East Anglia are once again highlighted. The results obtained from the Brandon timbers show that, whilst timbers can be dated, much more work is necessary on timbers from East Anglia.

ACKNOWLEDGEMENTS

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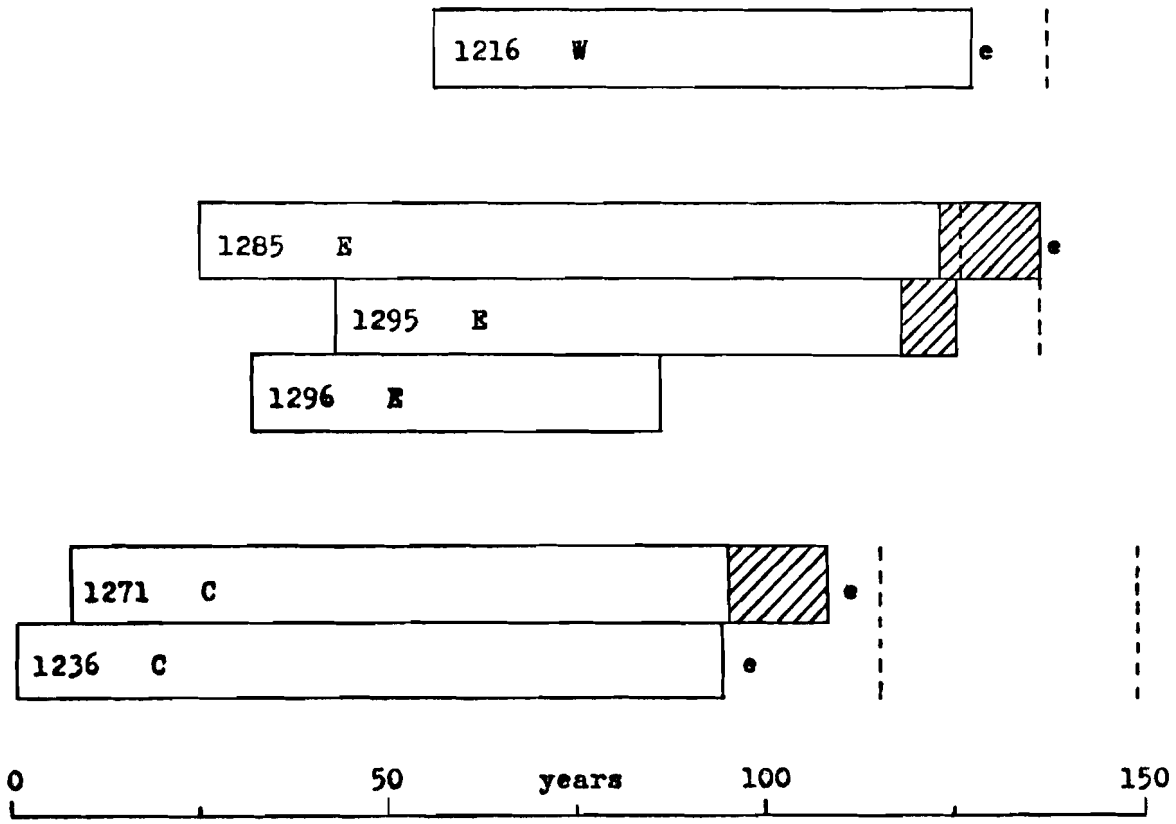
Figure 1: Relative positions of the matching ring sequences.
a) BRANCAUSE; timbers were felled between years 137-149 on the arbitrary scale. b) BRANAP; timbers were felled between years 78-117 on the arbitrary scale. c) BRANBUILD; timbers were felled after AD 612. Sapwood rings are shown by hatching; e - indicates outer rings were counted rather than measured.



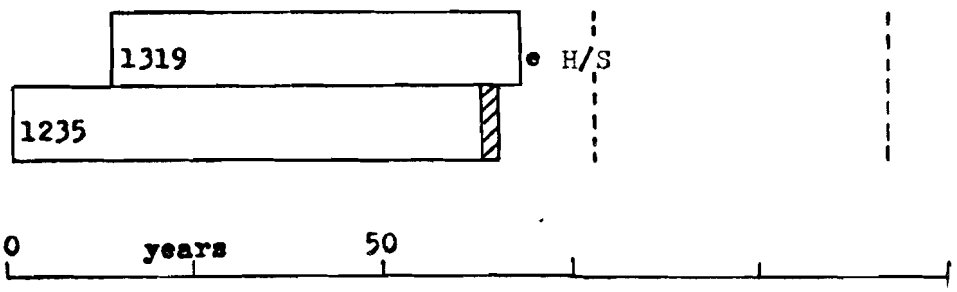


Figure 1c

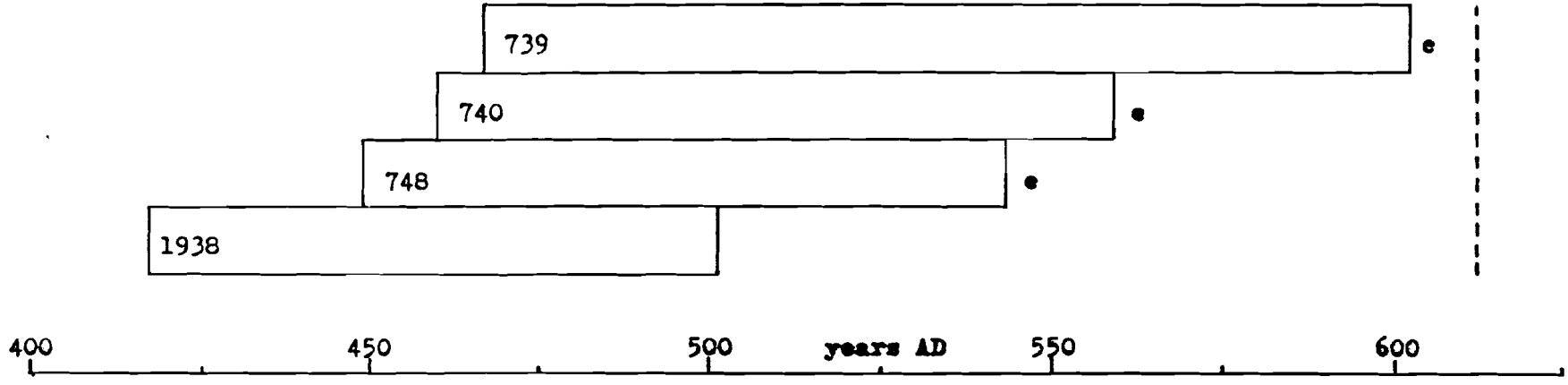


Table 1: Details of timbers. Sketches are not to scale; + - indicates the presence of rings which have not been measured; sapwood is represented by shading on the sketches.

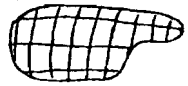
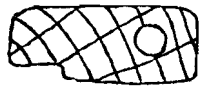
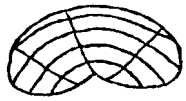
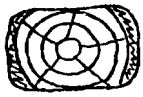
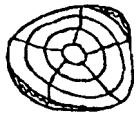
sample number	structure -function	total no of rings	sapwood rings	mean ring width (mm)	sketch	maximum dimensions (mm)
739	building 734	+131 +5	-	1.25		240x85
740	building 734	55 +45	-	0.93		95x35
748	building 734	55 +40	-	1.11		115x55
749	building 734	unmeasurable				200x65
750	building 734	75 +5	-	1.58		150x55
1037	building 1094	43	-	1.87		190x110
1152	pile	+64	10	1.85		200x190
1158	causeway pile, west	62 +5	-	1.54		210x190
1183	causeway pile, west	86 +17	12-17+	0.99		radius 105
1216	causeway pile, west	66 +6	-	1.40		radius 115
1235	pile	65	1-4	1.65		205x190
1236	causeway pile, central	74 +20	-	1.27		240x210
1271	causeway pile, central	91 +10	4+	1.03		200x155
1285	causeway pile, east	105 +6	4-7+	1.25		215x205
1295	causeway pile, east	83	8	0.88		radius 85
1296	causeway	55	-	1.68		200x175

Table 1 (cont)

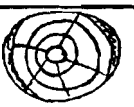
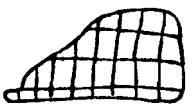
sample number	structure -function	total no of rings	sapwood rings	mean ring width (mm)	sketch	maximum dimensions (mm)
1307	pile	71	1	1.43		190x170
1319	pile	52 +3	-	1.95		radius 110
1935	building 734	unmeasurable				95x55
1936	building 734	unmeasurable				95x35 85x30
1938	building 734	85	-	1.68		200x45
1942	building 1391	unmeasurable				180x80

Table 2: Ring width data of the master BRANCAUSE.

years arbitrary	ring widths (0.02mm) 0	1	2	3	4	5	6	7	8	9	number of samples per decade
1		82	69	143	156	106	93	88	121	133	1
10	135	182	125	102	88	93	126	124	118	90	2
20	84	77	56	33	27	28	41	46	45	43	3
30	55	49	63	56	76	64	90	92	70	85	4
40	114	93	82	85	93	95	90	67	75	49	5
50	27	45	33	28	35	57	67	47	62	38	5
60	74	68	46	46	49	53	69	71	57	58	6
70	69	67	64	64	76	87	50	46	59	51	6
80	46	29	37	40	57	45	32	67	46	51	5
90	35	24	44	44	22	23	23	48	29	39	4
100	32	73	84	92	95	93	67	45	35	39	3
110	39	35	29	23	34	42	43	28	44	52	3
120	28	46	35	36	93	81	45	76	48	55	2

Table 3: Ring width data of the master BRANAP.

years arbitrary	ring widths (0.02mm) 0	1	2	3	4	5	6	7	8	9	number of samples per decade
1		100	63	65	68	49	73	80	85	41	1
10	58	75	43	52	37	50	42	68	113	89	2
20	88	115	100	75	80	73	62	91	66	78	2
30	118	135	128	114	100	130	91	51	45	71	2
40	106	107	113	106	75	81	56	78	103	113	2
50	128	135	97	68	148	103	142	101	114	71	2
60	75	53	80	110	106	89					2

Table 4: Ring width data of the master BRANBUILD, AD417-597.

years AD	ring widths (0.02mm) 0	1	2	3	4	5	6	7	8	9	number of samples per decade
417								81	80	80	1
420	75	95	117	119	106	112	81	82	122	59	1
430	90	80	50	76	154	91	139	137	98	64	1
440	90	96	147	63	144	56	74	91	75	72	1
450	110	79	58	95	94	142	94	122	96	91	2
460	78	51	36	44	33	33	55	51	50	67	3
470	56	39	35	51	69	91	70	66	85	100	4
480	66	45	65	67	73	72	44	45	48	41	4
490	37	39	36	49	79	60	62	39	27	51	4
500	80	55	60	53	48	37	39	40	41	44	3
510	44	45	32	33	31	30	37	57	39	36	2
520	24	39	47	30	25	33	24	42	63	37	1
530	34	61	41	48	80	55	68	95	63	38	1
540	31	47	50	70	62	85	68	91	66	66	1
550	79	49	49	68	126	79	59	43	54	63	1
560	79	100	114	110	88	75	86	83	97	91	1
570	121	103	87	51	48	28	38	52	61	93	1
580	64	75	84	41	67	87	151	111	91	90	1
590	96	70	67	108	84	52	59	65			1

Table 5: Dating the master BRANBUILD, AD417-597. (see Appendix for details of reference chronologies)

reference chronology	t-value
England	6.1
Ref8	5.8
Mersea Strood	5.4
Odell	2.8
Carlisle Saxon	3.5
Tamworth	4.0
Hamwic	3.1
Germany, Munich area	2.5
Germany, Trier area	2.1

Table 6: Summary of tree-ring dates. Dates of heartwood-sapwood transitions, if present, are given in brackets. Dates are arbitrary unless otherwise indicated; the relative dates of the samples from the causeway and the piles are independent.

structure - function	sample	date span	felling date
building 734	739	AD467-602	after AD612
	740	AD460-559	after AD569
	748	AD449-543	after AD553
	1938	AD417-501	after AD511
causeway - west line	1216	56-127	after 137
causeway - east line	1285	25-136 (123-126)	136-177
	1295	43-125 (118)	127-172
	1296	32-86	after 96
causeway - central line	1236	1-94	after 104
	1271	8-108 (95-106)	115-149
pile	1235	1-65 (63)	72-117
pile	1319	14-68	after 78

Appendix

List of the dated reference chronologies used in this study.

chronology	date span	reference
Carlisle Roman	247BC-AD90	Baillie pers comm
Carlisle Saxon	AD441-770	Baillie & Pilcher pers comm
City Southwark (CS88)	252BC-AD255	Tyers, Hillam, Morgan & Fletcher unpublished
City Medieval	AD682-1159	Hillam unpublished
East Midlands	AD882-1976	Laxton et al unpublished
England	AD404-1981	Baillie & Pilcher pers comm
Germany, Munich area	370BC-AD1405	Becker 1981
Germany, Trier area	400BC-AD1400	Hollstein 1980
Hamwic	AD458	Hillam 1984
Mersea Strood	AD445-661	Hillam 1981a
Odell	AD473-623	Hillam 1981b
Ref6	AD780-1193	Fletcher 1977
Ref8	AD416-737	Fletcher 1977
Tamworth	AD404-825	Baillie pers comm
Teeorry	AD1-894	Belfast Tree Ring Laboratory unpublished