

Ancient Monuments Laboratory Report  
42/87

TREE-RING ANALYSIS OF SAXON WELL  
TIMBERS FROM SMART STREET, IPSWICH,  
1984.

Cathy Groves

AML reports are interim reports which make available the results of specialist investigations in advance of full publication. They are not subject to external refereeing and their conclusions may sometimes have to be modified in the light of archaeological information that was not available at the time of the investigation. Readers are therefore asked to consult the author before citing the report in any publication and to consult the final excavation report when available.

© Opinions expressed in AML reports are those of the author and are not necessarily those of the Historic Buildings and Monuments Commission for England.

Ancient Monuments Laboratory Report 42/87

TREE-RING ANALYSIS OF SAXON WELL  
TIMBERS FROM SMART STREET, IPSWICH, 1984.

Cathy Groves  
February 1987

### Summary

Twenty-three wood samples of Saxon date were examined from two wells at Smart Street, Ipswich, with a view to providing a more precise indication of construction dates. All the timbers were oak except for a single non-oak timber from well 0053. No reliable dating was obtained for the samples from well 0053 but the timbers from well 0026 were felled after AD 712.

Author's address :-

Department of Archaeology and Prehistory University of  
Sheffield  
Sheffield S10 2TN

0742 768555× 6082

©

Historic Buildings and Monuments Commission for England

Tree-ring analysis of Saxon well timbers from Smart Streets  
Ipswich, 1984

Introduction

Twenty three wood samples were examined from the 1984 excavation at Smart Street, Ipswich (site code - 1AS5701). The samples were from two wells, both thought to be Saxon in date.

Well 0026

Eight samples (73, 74, 75, 76, 77, 78, 79, 81) were from the main ring of timbers forming the shaft (Figure 1a) and a further three samples (80.1, 80.2, 82) from timbers outside the main ring. Four timber fragments (69, 70, 71, 83) from within the shaft were also sampled.

Well 0053

Eight samples were collected from context 0053 of which three (92, 94B, 97) were from timbers forming the main ring of the shaft (Figure 1b), three (89, 91, 93) were from timbers inside the main ring and two (98, 116) were from small wood fragments within the shaft.

It was hoped that tree-ring analysis would provide felling dates for the timbers and hence indicate more precise construction dates for the two wells.

## Method

For dendrochronological purposes it is usual for slices of wood about 50-150 millimetres thick to be removed from a timber in order to produce a cross-section of maximum dimensions. However, as various timbers from well 0053 were required for conservation, attempts were made to remove cores from timbers 93, 94B and 97 so as to cause as little damage as possible to the timbers (for further discussion of conservation and tree-ring sampling, see Morgan et al 1981).

The remaining samples were prepared and measured following the method given by Hiram (1985). The non-oak sample was identified by taking thin sections of wood from the transverse, radial and tangential planes, and examining them under a microscope (see, for example, Schweingruber 1978). Any unsuitable samples were rejected before measurement. These were the non-oak and those oak samples with unclear ring sequences or sequences of less than 30 rings (short sequences are generally not unique and so cannot be dated reliably). The number of rings and their orientation and also the size of the cross section of every sample was noted (Appendices 1 and 2).

The ring widths of the measured samples were plotted as graphs, known as tree-ring curves, on transparent semi-logarithmic paper. The tree-ring curves were compared visually by superimposing two curves and sliding one past the other

searching for similarities in the ring patterns. This crossmatching process was 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. The computer program was also used to compare the tree-ring curves with all the dated reference chronologies for the Saxon period.

The results only date the rings present in the timber and therefore do not necessarily represent the felling date of the timber. If the sapwood on a sample is complete, indicated by the presence of bark or 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 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

### Well 0026

All the samples were oak (*Quercus* spp). Five samples, all tangentially split planks, were unsuitable for tree-ring dating as they had either insufficient rings (76, 80.1, 80.2, 83) or an unclear ring sequence (71). The ring sequences of seven of the remaining ten samples, none of which had retained any sapwood, were found to crossmatch (Figure 2). The ring width data of these seven samples, all radially split planks, was combined to form a master curve, SMART ST (Table 1).

The master curve and the unmatched ring sequences (75, 77, 82) were compared with various reference chronologies from the Saxon period. No conclusive results were obtained for samples 75, 77 and 82 but the master curve, SMART ST, was dated to the period AD 499-682 (Table 2). It is noticeable that the three unmatched ring sequences (75, 77, 82) from well 0026 were from samples on which the ring patterns were distorted by the presence of knots.

Five (73, 74, 78, 79, 81) of the dated timbers were from the main ring of the shaft and two were timber fragments from within the shaft. If the samples from the main ring of the shaft are contemporary a probable terminus post quem for felling of AD 712 is obtained. The two timber fragments, 69 and 70, were probably felled after AD 699 and AD 593 respectively and therefore could

be contemporary with the other dated timbers. The results are summarised in Appendix 3.

#### Well 0053

Sample 116 was apple/pear/hawthorn type (Pomoideae: *Pirus/Crataegus* spp); all remaining samples were oak. The sampling of timbers 93, 94B and 97 proved unsuccessful as the cores were fragmented and therefore ring sequences of suitable length could not be obtained. Only two samples (89, 91), from timbers inside the main ring of the well shaft, were suitable for measurement. They had 72 and 116 annual growth rings respectively, but there was no similarity between the ring sequences. No crossmatching was found between 89 and 91 and the sequences from well 0026 and no reliable dating was obtained when they were compared with the reference chronologies.

#### Discussion

It is not possible to determine the approximate size and age of the trees used to provide the timbers for either well. None of the oak samples had sapwood or pith and most of the timbers were planks split, either radially or tangentially, from larger trees. It is impossible to estimate the amount of missing wood.

Given a group of samples, not all comparisons will produce high t-values, but each ring sequence should match well with at least two others. This is true of the seven matching samples from

well 0026 (Table 3). However, when these individual sequences were compared with reference chronologies some of the known matches gave t-values less than 3.0 (Table 4). This shows that the replication of a ring pattern and the production of a master curve has enhanced the common climatic signal and reduced the background 'noise' produced by local growth conditions. A master curve is more likely to produce a date than an individual tree-ring sequence. It is possible that if additional suitable samples had been available from well 0053 the ring patterns of 89 and 91 may have been replicated thereby allowing a master curve to be produced.

### Conclusion

No reliable dates were obtained for the timbers from well 0053. The dates obtained for the timbers from well 0026 indicate that it was not constructed before AD 712. A more precise indication of the date of construction cannot be given due to the lack of sapwood on the samples.

### Acknowledgements

The Sheffield Dendrochronology Laboratory is financed by the Historic Buildings and Monuments Commission for England. I am also grateful to the Belfast tree-ring group for making available unpublished data.



## References

Baillie MGL & Pilcher JR 1973 A simple crossdating program for tree-ring research, *Tree-Ring Bulletin* 33, 7-14.

Becker B 1981 Pallungsdaten Romischer Bauholzer, *Fundberichte aus Baden-Wurttemberg* 6, 369-86.

Fletcher JM 1977 Tree-ring chronologies for the 6th to 16th centuries for oaks of Southern and Eastern England, *Journal of Archaeological Science* 4, 335-52.

Groves C & Hillam 1986 Tree-ring analysis of oak timbers from Brandon, Suffolk, *Ancient Monuments Laboratory report series number 4793*.

Hillam J 1981a The dating of the Mersea Strood timbers, *Ancient Monuments Laboratory report series number 3261*.

Hillam J 1981b Tree-Ring Analysis of the Odell Oak Timbers, *Ancient Monuments Laboratory report series number 3263*.

Hillam J 1984 Dendrochronology - Hamwic, Six Dials 1981, *Ancient Monuments Laboratory report series number 4167*.

Hillam J 1985 Theoretical and applied dendrochronology - how to make a date with a tree. In P Phillips (ed), *The Archaeologist and the Laboratory*, CBA Research Report number 58, 17-23.

Hillam J, Morgan RA & Tyers I 1986 Sapwood estimates and the dating of short ring sequences. In RGW Ward (ed), Applications of tree-ring studies - current research in dendrochronology and related areas, BAR forthcoming.

Hollstein E 1980 Mitteleuropäische Eichenchronologie. Zabern, Mainz am Rhein.

Morgan et al 1981 - conservation and sampling

Schweingruber FH 1978 Microscopic Wood Anatomy, Swiss Federal Institute of Forestry Research.

Table 1: Smart Street master curve, AD499-682; seven matching sequences are included.

year	ring widths (0.02mm)									
AD	0	1	2	3	4	5	6	7	8	9
499										175
500	122	84	81	86	62	58	68	60	79	112
510	82	89	72	55	49	89	69	66	53	42
520	37	41	49	56	78	46	49	73	73	46
530	43	70	54	82	67	58	55	62	61	55
540	37	50	56	62	66	56	56	63	45	57
550	69	68	71	60	59	51	44	62	80	96
560	69	58	56	48	68	67	78	100	94	96
570	82	78	78	54	63	46	51	61	50	61
580	50	37	39	56	68	54	63	52	43	48
590	38	34	64	74	58	61	85	47	32	30
600	38	61	70	67	66	55	62	65	50	62
610	66	62	75	71	85	64	60	69	78	38
620	44	67	58	85	62	65	58	56	57	52
630	41	49	56	69	57	30	30	34	36	38
640	36	38	42	42	32	35	36	37	43	29
650	59	37	38	33	39	29	24	25	30	28
660	29	33	33	37	26	29	26	34	30	43
670	27	23	30	27	28	26	19	29	29	29
680	28	28	37							

Table 2: Dating the Smart Street chronology. Results of comparisons with dated reference chronologies.

Reference chronology	t-value
England (Baillie & Pilcher pers comm)	4.4
Germany Munich area (Becker 1981)	3.7
Germany Trier area (Hollstein 1980)	2.3
Hamwic (Hillam 1984)	4.6
Ireland Nth Mills (Baillie pers comm)	3.1
Ireland Sth Mills (Baillie pers comm)	3.2
Mersea Strood (Hillam 1981a)	5.0
Odell (Hillam 1981b)	4.6
RefB (Fletcher 1977)	4.4

Table 3: Matrix of t-values; asterisks represent overlaps of less than 30 rings.

IAS	69	70	73	74	78	79	81
69	-	*	*	7.0	*	7.4	3.3
70		-	3.8	*	*	5.9	2.2
73			-	*	*	5.6	5.7
74				-	7.5	9.5	3.1
78					-	6.3	3.0
79						-	3.9
81							-

Table 4: Dating the individual timbers. Results of comparisons with reference chronologies; asterisks represent t-values less than 3.0.

reference	sample						
chronology	69	70	73	74	78	79	81
England	*	*	3.3	*	*	3.5	*
Ref8	*	*	3.1	*	*	3.6	*
Mersea Strood	*	*	3.7	*	*	3.3	3.6
Odell	*	*	4.3	3.5	3.7	3.2	3.7
Hamwic	*	*	3.0	*	3.0	3.2	*
Germany Munich area	*	*	*	3.0	*	3.2	*

## APPENDIX 1

### **Details of the samples and results**

Sample - sample number

Rings - total number of rings

Sapwood - sapwood rings present or not

Av.width - average ring width in mm

Dimensions - maximum dimensions of the cross-section in mm

+ - rings present but not measured

APPENDIX 1- DETAILS OF THE SAMPLES

CONTEXT	SAMPLE	RINGS	AV WIDTH	DIMENSIONS	COMMENT
0026	69	67+	0.91	75x25	+15 rings
0026	70	39	1.36	55x20	-
0026	71	c30	-	95x45	rings unclear
0026	73	66	1.16	90x20	-
0026	74	109+	0.94	115x30	+10 rings
0026	75	64+	1.16	125x35	+65 rings; knotty
0026	76	20	-	75x30	-
0026	77	52	1.34	170x55	knotty
0026	75	60+	1.49	110x30	+3 rings
0026	79	184	1.11	220x30	-
0026	80.1	27	-	80x45	-
0026	80.2	c25		170x40	rings unclear
0026	81	116+	1.14	190x25	+65 rings
0026	82	35+	1.48	120x55	+4 rings; knotty
0026	83	20	-	65x35	
0053	89	72	1.43	145x50	-
0053	91	116	1.04	125x20	-
0053	92	-	-	-	fragmented
0053	93	-	-	-	core
0053	94B	c20	-	-	core
0053	97	-	-	-	core
0053	98	-	-	-	fragmented
0053	116	-	-	100x75	non oak

## APPENDIX 2

### Cross-sectional sketches

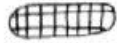
These are not drawn to scale, and are intended as a rough guide to the way in which the timbers were cut or split.



Appendix 2

Well 0026

69



70



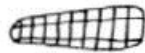
71



73



74



75



76



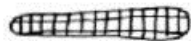
77



78



79



80.1



80.2



81



82



83

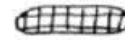


Well 0053

89



91



116 (non-o)



## APPENDIX 3

### Results

Sample - sample number

+ - rings present but not measured

APPENDIX 3 – RESULTS:

CONTEXT	SAMPLE	RESULT 1	RESULT 2	COMMENT
0026	69	dated	608-689	+15 rings
0026	70	dated	545-583	-
0026	71	ejected	-	rings unclear
0026	73	dated	519-584	-
0026	74	dated	564-682	+10 rings
0026	75	undated	-	+65 rings;
0026	76	rejected	-	-
0026	77	undated	-	knotty
0026	78	dated	569-631	+3 rings
0026	79	dated	499-682	-
0026	80.1	rejected	-	-
0026	80.2	rejected	-	rings unclear
0026	81	dated	522-704	+65 rings
0026	82	undated	-	+4 rings;
0026	83	rejected	-	-
0053	89	undated	-	-
0053	91	undated	-	-
0053	92	rejected	-	fragmented
0053	93	rejected	-	core
0053	94B	rejected	-	core
0053	97	rejected	-	core
0053	98	rejected	-	fragmented
0053	116	rejected	-	non oak

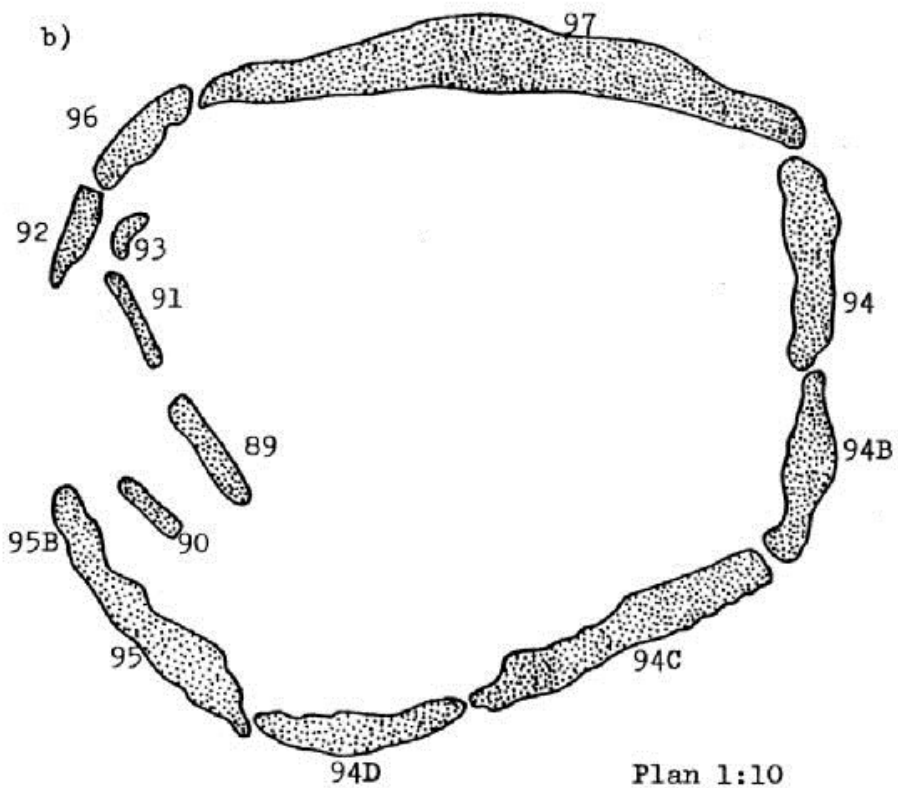
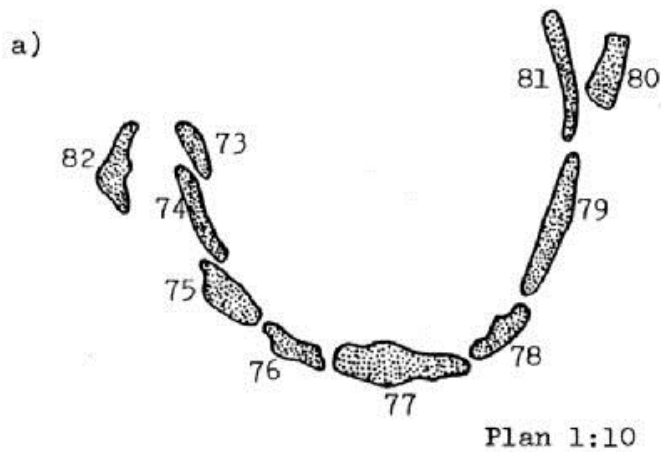


Figure 1: Diagrams indicating the positions of the timbers in a) well 0026 and b) well 0053.

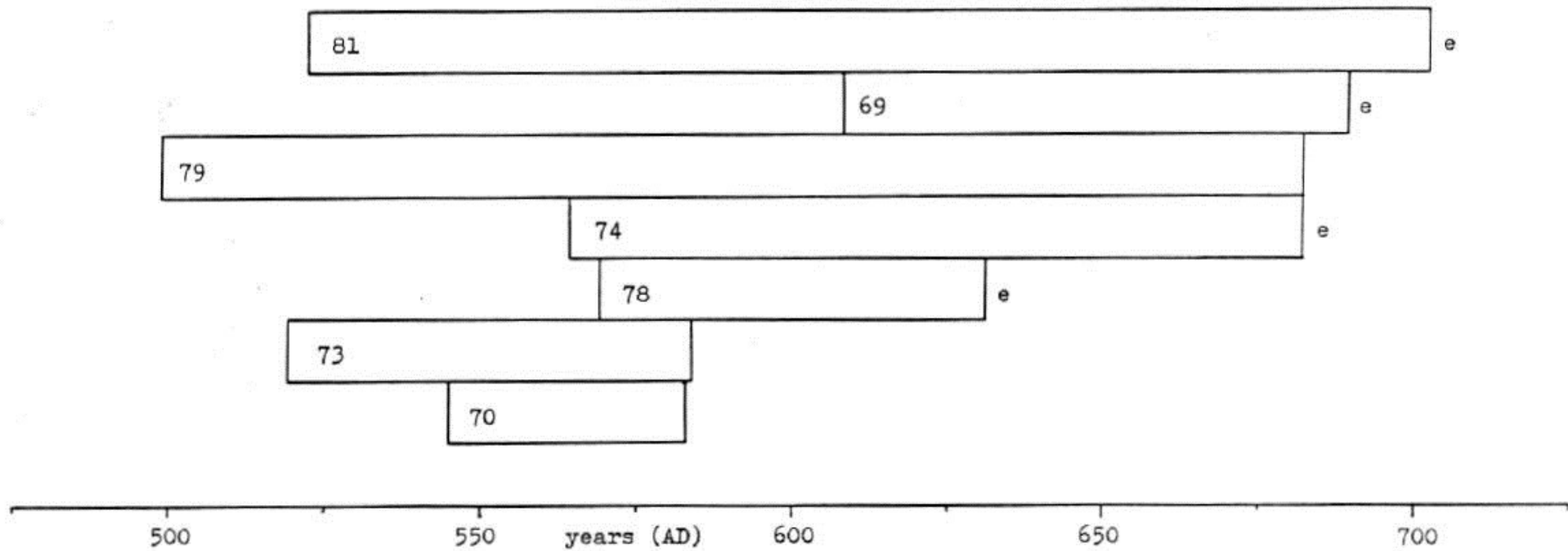


Figure 2: Bar diagram showing the relationship between the dated ring sequences from well 0026; e - indicates presence of unmeasured rings.