AML Rpt 3752

NARROW QUAY, BRISTOL - TREE-RING ANALYSIS

SITE 1352

by Jennifer Hillam, May 1982

Tree-ring analysis was carried out on various groups of waterlogged timbers from the Narrow Quay excavation (Table 1). Several species of wood were represented (Table 2). The larger worked pieces, such as the re-used ship's timbers from layer AAT, were of oak (Quercus), with the exception of BBH 443, another re-used ship's timber, which was of elm (Ulmus). Elm was also used for some of the small roundwood stakes, e.g. ABK 354, ABR 435. Ash (Fraxinus) and one piece of alder (Alnus) were also found as stakes in layer ABR. Oak occurred as stakes in some layers, e.g. BAC 530.

The purpose of the study was to date as many timbers as possible. However tree-ring dating has certain limitations: first, absolute dating in the British Isles at the moment is restricted to oak timbers. Ring sequences from some other species such as hazel or ash can be crossmatched to give relative dating (e.g. Morgan, 1979), but there are no reference chronologies with which to date them absolutely. As oak has always been the chief building timber because of its hardness and durability, it is unlikely that other species of wood will be found in sufficient quantities to do this. In England little work has so far been done on crossmatching ring sequences from different species, but work on the Continent suggests that it is possible for at least some species (e.g. Huber & Giertz, 1970).

Second, a timber should contain at least 40-50 annual rings before it can be reliably dated. Ideally the timber should have over 50 rings to increase the chances of successful dating (e.g. Eckstein, 1981). This is not always possible but work at Sheffield has shown that short ring patterns can sometimes be crossmatched (e.g. Hillam & Morgan, 1979; Morgan, 1979). Morgan's work on the Somerset Levels timbers has also illustrated the information about woodland management etc. which can be extracted from tree-ring studies. The Narrow Quay samples therefore were examined with these two limitations in mind, and in the hope that the timbers would produce information other than dating.

Method

The samples were deep-frozen for 48 hours. The cross-sectional surfaces were cleaned, whilst still frozen, with a Surform plane. Those samples with less than 20 annual rings were rejected at this stage although their size and the season in which they were felled, if this were possible to determine, were noted. The oak timbers tended to be knotty and some of these were discarded, e.g. BAG 230, as was AAT 161 which contained a band of very narrow rings. Three further oak samples (AAT: 157, 160, 232) were set aside to dry because, as well as containing knots, they had very narrow rings. Accurate measurement of the ring widths was not possible in their waterlogged state, and it was hoped that once dry a better surface would be obtained. This was not the case and unfortunately, since these timbers had by far the longest ring sequences, they too had to be rejected.

The remaining samples (Table 2) were measured on the Sheffield tree-ring measuring apparatus. This consists of a travelling stage connected by a linear transducer to a display panel. The sample on the stage is observed through a binocular microscope (10x) and, as each ring is traversed, its width in 0.1mm can be recorded from the display panel. The recording of the data and the plotting of the tree-ring graph are done manually at present. The graphs, known as tree-ring cruves, are drawn on transparent semi-logarithmic recorder paper so that they can be compared visually by sliding one graph over and past another. When two graphs are synchronous they are said to crossmatch. (For further information on the techniques of tree-ring dating see Baillie, 1982.)

Results

The ring width data are set out in the Appendix. The alder and all but one of the ash samples (ADR 432) had been rejected because of insufficient rings, leaving only the elm and oak timbers.

Studies on modern and medieval elm from London (Brett, 1974) have demonstrated that elm can be successfully crossdated. The Bristol elm samples had between 22 and 43 rings (Table 2) but no similarities could be found between the ring sequences. It was noted that, unlike the oak samples, the ring widths were not uniform around the circumference of the stems; this may have prevented successful crossmatching.

The oak samples had between 28 and 76 rings.

The curves were compared visually with each other but there was no obvious crossmatching. A possible match was found between AAT 228 and BAC 530 but the overlap was only 26 years. It was felt that this match could not be accepted as completely reliable since it could easily have occurred by chance (Huber & Giertz, 1970). As expected there was no agreement between the oak and elm curves.

The longer oak sequences from the re-used ship's timbers (AAT 159, AAT 163, AAT 240, BAG 229, BAG 231, BBH 423) were compared using the Belfast computer program for crossdating (Baillie & Pilcher, 1973) with dated reference chronologies from the British Isles and Germany. No crossmatching was found. The lack of dating was disappointing, particularly in view of Baillie's study (1978) of a group of re-used ship's timbers from the Dublin excavations where the timbers were dated, and deduced to have originated from the Dublin area.

The wood/timber

The worked pieces of oak, i.e. the re-used ship's timbers, were usually quartered trunks. AAT 228 and BAG 231 were smaller whole trunks (though in the case of BAG 231 not necessarily younger) which had been slightly shaped. The latter still had some of their sapwood rings whereas the sapwood band had been removed from the quartered trunks. The timber was generally poor in quality.

No pattern emerged from the study of the round-wood samples (ABK, ABR, BAC). The age of the stems varied from 8 years (ABR 439) to 43 years (ABK 354) so the wood

was not selected for age as it would have been from a coppiced woodland. Nor was the wood selected for size since this also varied from stem to stem. It would appear therefore that the stakes represent a random selection of whatever wood was available at the time, although obviously a larger number of samples is needed for more exact deductions.

Most of the stakes were cut in winter or early spring because the outermost ring was completely formed, and sometimes bark was present. ABR 440, BAC 530 and BAC 531 had incomplete outer rings (i.e. only the spring wood was visible) so these were felled in late spring or summer, although the possibilities that the samples were damaged during or after excavation, or that the spring wood in fact represents a very narrow ring, cannot be rules out. Certainly the seven samples which had bark were all felled in winter or early spring.

Conclusion

The Narrow Quay samples proved disappointing for tree-ring analysis for several reasons. The larger timbers were poor in quality. Several had to be rejected because of the presence of knots or very narrow rings, or because they had insufficient rings. Of the few samples that were measured, none had more than 76 rings, which in this study proved to be too few for reliable tree-ring dating. The sample of roundwood stakes of various species on the other hand was too small to draw any firm conclusions other than that they were mostly felled in winter or early spring.

References

Baillie M.G.L. 1978, Dating of some ships' timbers from Woodquay, Dublin. In J.M. Fletcher (ed.) Dendrochronology in Europe, BAR S51, 259-62.

---------- 1982, Tree-Ring Dating and Archaeology. Croom Helm, London.

Baillie M.G.L. & Pilcher J.R. 1973, A simple crossdating program for tree-ring research. Tree-Ring Bulletin 33, 7-14.

Brett D.W. 1978, Medieval and Recent Elms in London. In J.M. Fletcher (ed.) Dendrochronology in Europe, BAR S51, 195-9.

Eckstein D. 1981, The medieval waterfront of Schleswig. In G. Milne & B. Hobley (eds) Waterfront Archaeology in Britain and Northern Europe, CBA Res. Rep. no.41, 96-101.

Hillam J. & Morgan R.A. 1979, The dating of the Roman riverside wall at three sites in London. London Archaeol. 3(11), 283-7.

Huber B. & Giertz V. 1970, Central European Dendrochronology for the Middle Ages. In R. Berger (ed.) Scientific Methods in Medieval Archaeology, University of California Press, Berkeley & London, pp 201-12.

Morgan R.A. 1979, Tree-ring studies in the Somerset Levels: the Drove site of the Sweet Track. Somerset Levels Papers 5, 65-75.

TABLE 1: Contexts of timbers.

layer	timbers	species
AAB	Probably associated with group AAT	oak
AAT	Group of ship's timbers re-used in a context dated to c.1660	oak
ABK	Probably associated with group AAT	elm
ABR	Group of stakes in situ in context dated to c.1660	alder/ash/ elm/oak
BAC	Stakes apparently of structural significance in a dock backfilled c.1590	oak
BAG	Probable ship's timbers deposited in context dated to c.1600	oak
BBH	Ship's timbers of uncertain date but probably pre-c.1590	elm/oak

TABLE 2

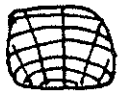
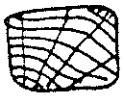
layer	no.	species	no.of rings	sapwood rings	season felled	average width(mm)	sketch	dimensions (cm)	comments
AAB	39	oak	47	-	-	-		14 x 10	knotty
AAT	157	oak	-	-	-	-		16 x 10	very narrow rings
	159*	oak	53	-	-	2.25		13 x 10	
	160	oak	-	-	-	-		13 x 13	very narrow rings
	161	oak	30+	-	-	-		14 x 9	narrow band of rings
	163*	oak	65	-	-	1.58		15 x 13	
	228*	oak	37	9	?	3.45		18 x 12 radius 13	
	232	oak	-	-	-	-		12 x 12	very narrow rings
	240*	oak	54	3	-	2.26		13 x 11	
	314	oak	28	-	-	-		13 x 10	

Table 2/cont

layer	no.	species	no.of rings	sapwood rings	season felled	average width(mm)	sketch	dimensions (cm)	comments
ABK	354*	elm	43		winter	1.58		radius 5-8	
ABR	430*	elm	40		winter	1.09		rad. 4-5	bark present
	431	alder	15		winter?	-		rad. 6-8	
	432*	ash	22		winter	2.18		rad. c.5	
	433	ash	14		winter	-		rad. 3-4	bark present
	434*	elm	22		winter	2.38		rad. 3-6	
	435*	elm	40		winter	1.49		rad. 5-6	bark present
	436	oak	14	14	winter	-		rad. 2-5	bark
	437*	elm	38		winter	0.89		rad. 4	bark
	438*	elm	33		winter	1.06		rad. 4	knotty

Table 2/cont

layer	no.	species	no.of rings	sapwood rings	season felled	average width(mm)	sketch	dimensions (cm)	comments
ABR (cont)	439	ash	8		winter	-		rad. 3-4	
	440*	elm	39		summer?	1.24		rad. 4-6	
	441*	elm	28		winter	2.13		rad. 5-7	bark present
	442*	elm	26		winter	2.19		rad. 5-6	bark
BAC	530*	oak	29	29	late spring	2.46		rad. 7-8	
	531*	oak	28	28	summer	2.94		rad. c.9	
BAG	229*	oak	61	3	-	4.62		33 x 14	
	230	oak	39	-	-	-		13 x 11	very knotty
	231*	oak	76	21	winter?	1.39		19 x 17 rad. 11	
BBH	423*	oak	55	-	-	3.52		26 x 22	
	443	elm	26		?	-		22 x 8	rings very wide

TABLE 2: Details of wood samples. Sketches not to scale; radial lengths do not include bark. Asterisks indicate those samples with measured ring widths.

APPENDIX

Listing of tree-ring data; ring widths in 0.1mm.

AAT 159 (53 rings) oak

24 22 24 25 30 30 30 31 31 26 25 20 23 25 19 21 21 31 19 31
17 18 26 26 27 25 28 19 24 19 26 23 24 28 25 25 32 23 18 25
14 17 17 8 13 18 19 15 19 22 20 15 18

AAT 163 (65 rings) oak

44 29 41 33 42 44 36 15 27 33 23 34 23 19 18 14 13 16 26 16
15 12 11 13 9 10 16 15 12 10 7 8 8 12 9 8 8 12 15 19
12 18 12 10 12 9 11 9 13 12 11 13 10 8 13 8 8 9 11 10
6 7 5 8 8

AAT 228 (37 rings) oak

21 17 16 13 20 23 28 22 21 24 19 27 23 21 24 47 49 26 45 52
48 43 45 47 37 42 42 37 47 55 48 45 41 31 48 39 48

AAT 240 (54 rings) oak

17 27 18 10 10 19 27 33 45 50 48 45 37 42 44 31 27 22 20 20
19 18 17 10 17 25 42 26 48 23 22 20 23 28 16 14 19 13 18 12
15 7 11 14 10 12 7 14 14 16 11 18 25 26

ABK 354 (43 rings) elm

19 17 25 17 18 12 12 13 16 14 18 13 20 20 26 15 19 36 23 18
20 17 30 16 19 17 18 15 12 12 7 4 9 5 7 11 9 9 6 18
18 18 15

ABR 430 (40 rings) elm

14 16 20 9 13 7 8 10 13 9 10 15 10 11 9 11 18 11 18 13
9 11 18 12 10 9 6 5 7 9 18 11 9 7 15 10 9 4 8 7

Appendix/cont

ABR 432 (22 rings) ash

10 3 9 7 28 43 40 18 23 35 29 18 35 27 32 19 18 15 14 23
14 20

ABR 434 (22 rings) elm

26 16 16 22 27 25 28 30 25 22 18 21 26 20 20 20 31 29 25 25
27 24

ABR 435 (40 rings) elm

12 15 10 7 9 13 14 13 7 10 10 15 11 12 13 13 10 12 9 7
5 7 7 17 24 15 22 19 12 19 31 24 24 22 27 26 19 14 18 20

ABR 437 (38 rings) elm

10 10 12 9 12 9 10 7 8 9 9 12 6 7 8 10 11 7 5 7
11 12 10 12 13 9 8 10 8 7 8 8 11 7 11 5 6 5

ABR 438 (33 rings) elm

10 11 15 7 5 7 15 10 5 6 10 16 23 12 6 12 6 11 13 6
12 11 9 14 4 6 6 9 19 20 12 14 8

ABR 440 (39 rings - 40th incomplete) elm

22 13 21 11 21 11 17 18 19 22 23 26 16 16 11 4 15 15 29 17
11 14 16 6 11 7 4 4 5 5 6 5 11 7 9 5 4 3 6

ABR 441 (28 rings) elm

10 11 14 9 10 22 21 19 16 23 24 25 21 19 23 24 22 30 33 22
22 20 26 27 29 26 28 29

ABR 442 (26 rings) elm

8 11 16 16 16 18 21 22 29 37 30 25 20 17 14 23 22 14 25 25
39 30 25 18 21 28

BAC 530 (29 rings - 30th incomplete) oak

25 19 16 19 12 9 5 17 17 19 17 22 28 16 28 31 23 48 56 47
47 47 23 33 28 23 14 9 15

BAC 531 (28 rings - 29th incomplete) oak

46 35 32 19 25 10 17 7 14 13 7 12 7 6 5 15 70 67 64 53
57 50 60 47 45 20 14 6

BAG 229 (61 rings) oak

50 28 38 50 75 70 76 65 70 72 63 56 42 31 35 38 41 50 44 44
52 35 43 51 41 29 29 27 44 62 50 45 43 48 39 42 39 46 45 38
51 65 50 63 43 52 36 51 62 29 29 33 27 32 40 58 53 50 38 34
37

BAG 231 (76 rings) oak

10 10 8 5 5 7 8 10 9 6 5 9 6 18 15 15 17 12 16 10
10 8 7 5 6 8 10 17 18 17 12 17 15 12 14 17 24 12 22 13
11 8 8 9 11 14 21 25 17 16 35 37 27 21 25 22 27 23 28 21
18 16 14 13 12 11 11 9 11 9 12 9 7 11 11 9

BBH 423 (55 rings) oak

23 26 23 41 37 24 40 42 50 58 51 48 60 52 44 55 35 40 49 48
40 37 26 30 43 27 36 28 33 37 35 35 32 26 37 40 26 35 24 25
28 26 30 27 32 34 37 24 24 47 43 36 31 29 26