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Summary

The analysis of the structural timbers from Upwich have been reported elsewhere (Groves 1988). This report describes the analysis and dating of oak timbers from the remains of six barrels. Five of the barrels were dated, although precise felling dates were not obtained because none of the timbers had sapwood. A timber from one of the barrels was probably felled in the 13th century, but the remainder were probalbly 17th century in date.

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Tree-ring analysis of barrel timbers from Upwich, Droitwich, 1983-84

Introduction

Excavations at Upwich (site code, HWCM 4575), thought to be the heart of Droitwich's medieval salt-making industry, by the Hereford and Worcester Archaeological Unit produced large quantities of wood and timber, much of which has been subjected to tree-ring analysis. In 1985, cores from the medieval brine shaft and pump support were examined and dated (Hillam 1985a), and in 1987/8, slices from most of the remaining oak and elm timbers were examined (Groves 1988). This latter study produced a Roman tree-ring chronology spanning the period 256BC-AD61, and three medieval/post-medieval oak chronologies for the period 955-1415, 1454-1620, and 1685-1742.

The remains of oak barrels were also found, and the analysis and dating of six of these form the subject of this report. A total of eleven timbers were examined from phases 6-8, which are provisionally dated to mid 13th-14th century, 15th-17th century and post 17th century respectively. Although most of the timbers were from phase 7, there were three end timbers from phase 6 (2364), one end timber from phase 8 (734), and the end of an unphased timber (3218). Phase 7 was represented by the two bottom boards from 669, three end boards from 809, and one end from 1053. Four unlabelled timbers, two staves and two ends, were also examined to provide more tree-ring data, since a secondary aim of the study was to try to extend or bridge one or more of the chronologies produced by Groves (1988).

Methods

The preparation and measurement of tree-ring samples from archaeological contexts is now standard and will not be described here (see instead Groves 1988; Hillam 1985b). Crossmatching was carried out using an Atari 1040ST microcomputer with software written and developed by Ian Tyers of the Museum

of London, although visual matching was still used to check the computer results. The crossdating programs are based on versions of CROS (Baillie & Pilcher 1973; Munro 1984), and all t-values quoted in this report are identical to those produced by the original CROS program (Baillie & Pilcher 1973). (For more details of the use of the Student *t* test in tree-ring dating, see Baillie 1982 82-5.)

Estimations of the *termini post quem* for felling are based on the sapwood estimate of 10-55 rings (Hillam *et al* 1987). Since it is assumed that a minimum of 10 sapwood rings are probably missing from those timbers without sapwood, the *terminus post quem* for felling is calculated by adding 10 to the date of the last measured ring. Of course, the actual felling date could be much later depending on how many heartwood rings were removed when the timber was shaped into a board.

Results

The samples had between 52-143 annual growth rings, with the exception of 3218 which had 273 rings. The average ring width was generally between 0.8mm and 1.5mm, except for 809.28 which had very wide rings with an average width of 4.6 mm. None of the samples had sapwood.

The two ring sequences from 669 were almost identical, the match between them giving a t value of 10.2. The two boards themselves were also very similar, and it is likely that they were cut from the same tree. The two sets of ring widths were therefore averaged and treated as a single sequence of 143 years for dating purposes.

There was some similarity between the other ring sequences. 669, for example, matched 2364.2 and 734, both matches giving t values of 5.5, whilst 809.25 matched 734 with a *t* of 4.6. However higher *t* values were obtained for some

of the sequences when they were tested against dated reference chronologies, and dating was achieved in this way rather than first constructing a site chronology and dating that. Five of the labelled timbers and three unlabelled ones were dated. 2364.2, 669, 809.25 and 734 had end dates of 1611, 1642, 1559 and 1602 respectively (Table 2), and matched particularly well with chronologies from Droitwich (Groves 1988), East Midlands (Laxton & Litton 1988), Oxford (Haddon-Reece pers comm) and the English-Welsh border (Siebenlist-Kerner 1978). The three unlabelled samples also matched these chronologies, their end rings dating to 1563, 1596 and 1619.

The only ring sequence which differed significantly in date was that of 3218. This covered the period 946-1218, and matched well with sequences from Beverley, London, Nantwich and Stafford (Table 3).

Discussion

Interpretation of the tree-ring dates is made difficult because of lack of sapwood. The unphased 3218 ends in 1218 and was therefore felled after 1228. Assuming that the timber was seasoned for a few years, the barrel is unlikely to have been in use before the mid 13th century.

The remainder of the timbers are similar to each other in date (Fig 1). The phase 6 timber, 2364.2, ends in 1611 and was felled some time after 1621 (Table 2). Two phase 7 timbers, 809.25 and 669, were felled after 1569 and 1652 respectively, whilst the phase 8 timber, 734.27, was felled after 1612. The unlabelled timbers (X1, X3, X4) were felled after 1573, 1606 and 1629 respectively. Also of similar date are the two structural timbers, 220 and 709, which were dated by Groves (1988). These two timbers which were used to repair the medieval pump support were felled after 1610 and 1630. Most of these post-medieval timbers are likely to be 17th century in date. 809.25 and X3 could be late 15th century, but their slightly earlier date may be due to

the fact that more heartwood rings were removed, ie the timbers could be from the inside of a tree trunk. For the same reason, an early 18th century date for 669 cannot be ruled out.

All the post-medieval ring sequences crossmatch chronologies from Droitwich or nearby areas. Many of them match the sequences from the pump support repairs better than they do each other, which suggests a local origin for these barrel timbers.

The medieval 3218 on the other hand matches less well with timbers from Droitwich but gives relatively high correlations with chronologies from Beverley, London, Nantwich and Stafford (Table 3). It is less likely than the post-medieval timbers to be of local origin, although it is impossible to source the timber with any detail. (This is made more difficult because the regional distribution of English tree-ring chronologies is different in the medieval and post-medieval periods.)

The study has not produced any new chronologies for Droitwich, nor has it noticeably extended or bridged any of the existing chronologies. However the seven post-medieval barrel sequences have been combined with those from the pump support repairs, which had formed the existing 1454-1620 chronology (Groves 1988), to produce a 189-year chronology for the period 1454-1642 (Table 4). The data for 3218 is also presented (Table 5). Although it is only a single sequence, its length makes it potentially useful for dating other tree-ring sequences.

Conclusion

Eight barrel timbers from Upwich were dated. Seven were of a similar date and were probably mostly used in the 17th cenutry; the eighth was felled after 1228. A local origin is suggested for the post-medieval timbers on the basis

of a strong similarity in ring pattern with repair timbers from the pump support structure. 3218 was less likely to have been local.

Acknowledgements

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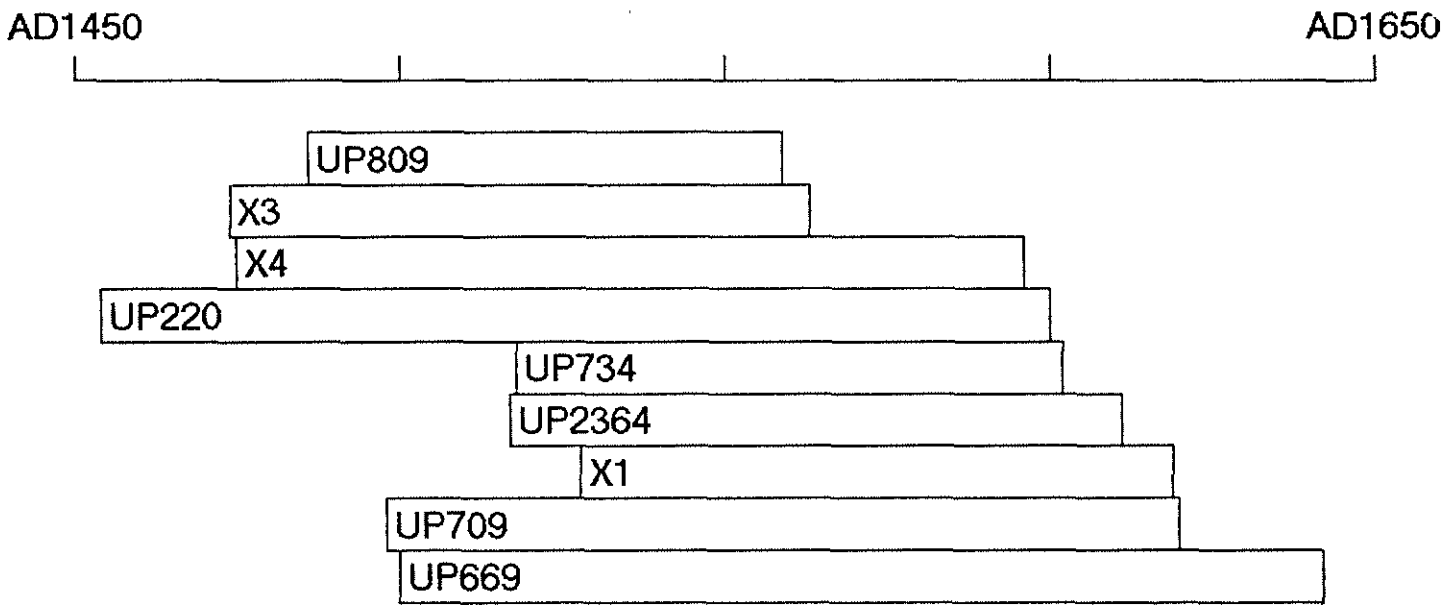


Fig 1: Bar diagram showing the relative positions of the dated ring sequences. X1, 3 and 4 are from the unlabelled timbers; 220 and 709 are from repairs to the pump support structure.

Table 1: Details of the tree-ring samples. Sketches are not to scale; "+" - unmeasured rings present. X1-4 are the unlabelled timbers.

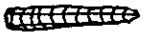
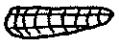
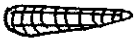
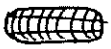
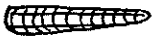
wood no.	phase	total no. of rings	average ring width (mm)	sketch	maximum dimensions (mm)
2364.1	6	99	1.06		120 x 15
2364.2	6	+95	0.95		105 x 25
2364.3	6	79	0.98		80 x 15
669.2	7	115	1.49		185 x 20
669.4	7	143	1.52		235 x 25
809.25	7	74	1.38		110 x 35
809.26	7	124	1.49		210 x 30
809.28	7	52	4.57		245 x 35
1053	7	80	1.79		155 x 25
734.27	8	85	1.21		110 x 20
3218	-	273	0.78		225 x 20
X1	-	92	1.15		115 x 20
X2	-	102	1.07		120 x 25
X3	-	90+	1.10		110 x 20
X4	-	122	0.94		125 x 25

Table 2: Dating the 16th/17th century timbers - t values with dated reference chronologies.

wood no.	phase	date span	felled	t values with: Droitwich	E. Midlands	Oxford	Wales
2364.2	6	1517-1611	1612+	6.5	5.2	6.2	4.8
669	7	1500-1642	1652+	4.7	7.1	6.9	6.0
809.25	7	1486-1559	1569+	7.3	5.5	6.2	6.9
734	8	1518-1602	1612+	4.4	3.2	6.0	4.0
X1	-	1528-1619	1629+	2.5	5.2	3.8	3.3
X3	-	1474-1563	1573+	3.5	4.4	4.3	3.7
X4	-	1475-1596	1606+	2.6	3.4	4.9	5.1

Table 3: Dating 3218 to AD946-1218.

chronology	t value
Beverley, Eastgate (Groves 1987)	4.9
Droitwich, Upwich (Groves 1988)	3.3
East Midlands (Laxton & Litton 1988)	3.8
London, Billingsgate 11 (Hillam unpubl)	4.7
Fennings Wharf (Tyers pers comm)	4.4
Merton Priory (Tyers pers comm)	3.5
Seal House (Hillam unpubl)	5.0
Nantwich (Leggett 1980)	4.3
Stafford (Groves unpubl)	5.8

Table 4: The tree-ring chronology, 1454-1642, for Droitwich, Upwich.

year	ring widths (0.02mm)										no. of samples									
AD1454				74	85	115	78	73	88	87				1	1	1	1	1	1	1
	100	77	82	59	88	97	112	99	108	97	1	1	1	1	1	1	1	1	1	1
	87	91	97	104	102	81	70	62	77	79	1	1	1	2	3	3	3	3	3	3
	83	62	86	104	81	94	88	63	65	86	3	3	3	3	3	4	4	4	4	4
	67	53	69	82	76	98	63	56	68	64	4	4	4	4	4	4	4	5	5	6
AD1501	53	59	56	62	58	55	57	51	71	53	6	6	6	6	6	6	6	6	6	6
	58	68	69	73	58	54	44	54	73	50	6	6	6	6	6	6	7	8	8	8
	60	76	61	54	36	51	53	60	54	46	8	8	8	8	8	8	8	9	9	9
	65	47	53	45	55	57	51	48	47	54	9	9	9	9	9	9	9	9	9	9
	62	36	50	51	48	44	38	50	54	51	9	9	9	9	9	9	9	9	9	9
AD1551	60	40	47	51	56	49	40	43	47	45	9	9	9	9	9	9	9	9	9	8
	51	51	41	59	60	40	33	48	56	52	8	8	8	7	7	7	7	7	7	7
	51	50	46	47	51	44	50	39	48	55	7	7	7	7	7	7	7	7	7	7
	48	46	43	60	59	64	66	53	62	48	7	7	7	7	7	7	7	7	7	7
	62	53	53	55	59	54	48	54	55	44	7	7	7	7	7	7	6	6	6	6
AD1601	70	63	78	69	45	65	64	70	57	57	5	5	4	4	4	4	4	4	4	4
	53	46	81	63	80	60	77	78	59	71	4	3	3	3	3	3	3	3	3	2
	96	117	125	79	96	86	102	178	217	86	1	1	1	1	1	1	1	1	1	1
	83	132	109	106	164	131	138	199	121	170	1	1	1	1	1	1	1	1	1	1
	170	130									1	1								

Table 5: Ring widths of the individual ring sequence, 3218.

year	ring widths (0.02mm)									
AD946						33	30	29	34	37
AD951	24	30	41	33	35	34	25	54	54	51
	54	46	40	54	41	41	47	59	46	51
	62	77	63	70	66	64	70	65	66	56
	55	35	44	44	40	54	57	52	58	39
	35	42	50	54	42	39	56	58	58	45
AD1001	60	44	63	53	48	42	31	68	50	40
	40	50	40	36	41	36	39	49	38	31
	39	43	34	44	35	44	37	36	43	44
	39	36	36	29	36	39	35	51	49	45
	43	61	43	31	69	56	44	35	36	28
AD1051	25	24	29	32	46	34	36	40	37	35
	36	40	32	33	43	51	36	50	33	39
	38	36	34	42	44	47	41	46	30	50
	36	40	42	34	52	41	32	37	40	23
	30	29	36	29	30	29	27	24	22	21
AD1101	22	21	22	26	26	25	31	27	24	25
	20	21	20	20	24	27	30	26	25	29
	27	37	29	43	38	32	37	27	29	32
	39	36	38	45	57	30	25	26	38	40
	43	35	33	38	46	63	40	47	54	41
AD1151	50	35	61	36	57	58	41	32	34	32
	35	32	32	35	40	36	41	32	35	47
	34	38	47	35	56	50	37	42	56	45
	49	44	56	40	46	49	44	34	45	43
	27	35	39	37	39	40	38	31	20	22
AD1201	24	26	35	46	34	34	25	27	37	45
	33	33	36	38	51	57	37	41		