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TREE-RING ANALYSIS OF OAK TIMBERS FROM THE BEDERN FOUNDRY SITE, YORK.

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Summary

Tree-ring samples from Bedern Foundry were examined in 1978 without any firm dates being produced; the data were then re-examined in 1988. This report describes both studies, including the 1988 results which provide precise dating for two important contexts from the site.

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Tree-ring dating of oak timbers from the Bedern Foundry site, York

Introduction

In 1978, seven tree-ring samples from the Bedern Foundry site were examined in the Sheffield Dendrochronology Laboratory. Five came from oak piles (*Quercus* spp) from Area II of the 1976 excavation (site code 1976.13), and two from the 1978 excavation (code 1978.13). All the samples were taken by members of the York Archaeological Trust who carried out the excavations. They were thought to be 13th or 14th century in date.

The 1978 samples had less than 50 rings and were rejected. Of the 1976 samples, four (8061, 8073, 8111, 8169) were suitable for measurement. Lack of dated reference chronologies prevented them from being firmly dated, although tentative dates in the 13th-early 14th centuries were obtained for all of them. Re-examination of the ring width data in 1988 prior to publication of the excavation report has led to the dating of two of the samples.

Methods

The samples were measured using a travelling stage which was linked to a display panel. This showed the ring widths in units of 0.1mm after each ring had been traversed. When all the rings were measured, the widths were typed into a mainframe computer for crossmatching. (This equipment has now been replaced by a travelling stage which is linked directly to a microcomputer - Hillam 1985, Fig 4.) The ring widths were plotted as graphs which were compared against each other for similarity, and also against dated reference chronologies. Crossmatching was aided by a computer program (Baillie & Pilcher 1973), which calculates the degree of correlation between two ring sequences and then tests the significance of the correlations using the Student's *t* test. Values greater than 3.5 indicate a match provided that the visual match is acceptable (Baillie 1982, 82-5).

If bark or bark edge is not present on the sample, the tree-ring dates are related to the date of felling using the sapwood estimate of 10-55 rings. This figure represents the 95% confidence limits for the number of sapwood rings in British oak trees older than 30 years (Hillam *et al* 1987). If a sample retains some sapwood, the likely felling date range is obtained by adding 10 and 55 to the date of the heartwood-sapwood transition. In the complete absence of sapwood, a *terminus post quem* for felling is obtained by adding 10, the minimum sapwood number, to the date of the last measured ring. Unless a timber was reused, the date of construction is likely to be similar to the date of felling since it was unusual for timber, especially timber for piling, to be seasoned in the medieval period (eg Hollstein 1980).

Results

The piles from the 1976 excavation had between 40 and 96 rings (Table 1). 8168 with only 40 rings was rejected. There was no apparent similarity between the other four ring sequences. When they were compared with dated reference chronologies, 8073 and 8169 gave consistent results over the periods AD1188-1267 and AD1208-1303 respectively with a chronology from Hull (Hillam 1979) and a sequence from timber 8431 from Coppergate, York (Hillam unpubl). Whilst these matches looked good visually, there were few other dated chronologies against which the samples could be tested, and the dating remained tentative. Tentative end dates of 1252 and 1270 were also found for 8061 and 8111 when they were tested against Hull and Coppergate 8431, but the visual matches were less good.

There are now many chronologies for the medieval period from different regions of the British Isles. When the four Bedern samples were compared against a

selection of these, the tentative matches for 8073 and 8169 were confirmed (Table 2). 8073 matched well with local chronologies, such as those from Beverley and York, and also those from more distant areas such as East Midlands and Worthing. 8169 matched fewer chronologies but gave several *t* values over 3.5, all of which were acceptable visually. The tentative date for 8061 was rejected, but that of 1221-1270 for 8111 could be correct. However in view of the shortness of the ring pattern and the relatively poor *t* values, the date cannot be accepted with confidence.

Interpretation of the tree-ring results

The ring sequences of 8073 and 8169 span the years 1188-1267 and 1208-1303 respectively (Fig 1). 8169 had 37 sapwood rings plus bark edge indicating that the timber was felled in the winter of AD1303/4. 8073 had no sapwood giving a *terminus post quem* for felling of 1277. However the date of its outer measured ring is the same as the heartwood-sapwood tansition date of 8169. It is likely therefore that the two timbers were felled at the same time.

This provides dates for two contexts from the site: 8073 is from a pile used in the foundation of a wall which can be correlated with a major rebuilding phase across the site; 8169 is from a pile used in the construction of a timber-lined well (J Richards pers comm). The latter could not previously be assigned to a particular phase but could have belonged to several. It now seems likely that the start of the rebuilding phase and the construction of the well are contemporary and can both be dated to 1303/4 or very soon after.

Conclusion

Tree-ring samples from the site were examined in 1978 but no firm dating was

obtained. The data were reworked in 1988 when more dated reference chronologies were available, and dates were obtained for two of the timbers. One of them, 8169, was felled in 1303/4 thus providing a precise date for the construction of a timber-lined well. The other sample, 8073, has an outer ring dating to 1267, but is probably contemporary with 8169, thus dating a major rebuilding phase on the site.

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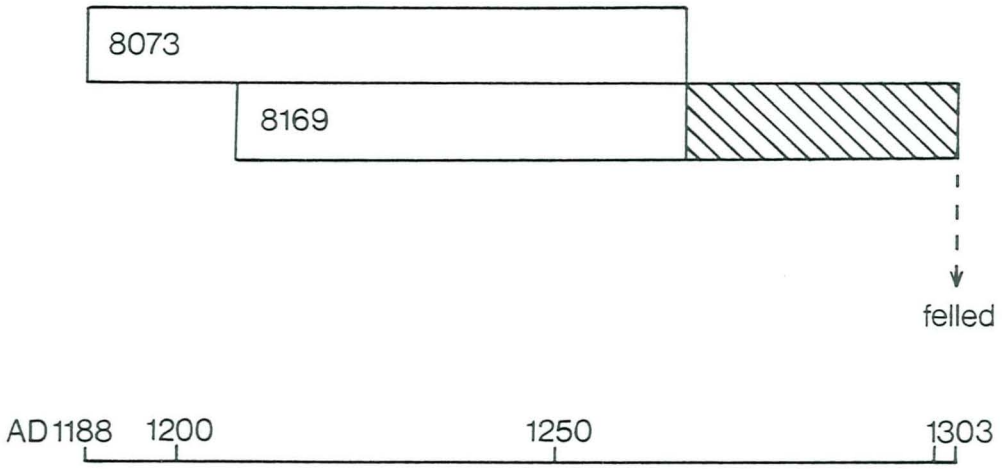

Fig 1: Bar diagram showing the relative positions of the Bedern Foundry ring sequences. White bars - heartwood rings; hatching - sapwood. The last ring of 8073 and the heartwood-sapwood transition of 8169 both date to AD1267.

Table 1: Details of the 1976 tree-ring samples. Sketches are not to scale; sapwood is represented by shading on the sketches.

timber	context	total rings	sapwood rings	average(mm) ring width	sketch	(mm) dimensions
8061	2571	60	-	0.88		60 x 80
8073	2999A	80	-	0.90		80 x 170
8111	-	50	-	2.20		80 x 100
8168	4231	40	3	3.75		160 x 170
8169	4231	96	37	0.82		150 x 200

Table 2: Dating samples 8073 and 8169 - *t* values with dated reference chronologies. Values of less than 2.5 are replaced by a dash.

chronology	(1188-1267) 8073	(1208-1303) 8169
Beverley, Eastgate (Groves 1987)	3.1	3.0
Beverley, Hall Garth (Hillam 1981)	4.3	4.0
Bristol Bridge (Hillam 1984a)	-	3.0
Coppergate medieval (Hillam unpubl)	3.5	-
Coxwell Barn (Haddon-Reece pers comm)	3.8	2.9
East Midlands (Laxton, Litton & Simpson pers comm)	5.1	3.0
Exeter Cathedral (Mills pers comm)	3.0	5.3
Droitwich (Groves & Hillam unpubl)	4.0	2.7
Hull (Hillam 1979)	4.2	3.6
Reading (Groves *et al* 1985)	4.3	4.0
Ship Street, Oxford (Haddon-Reece & Miles pers comm)	3.5	-
Shackerley (Hillam 1984b)	2.5	3.2
Sompting, Worthing (Tyers pers comm)	5.5	-
Southern England (Bridge pers comm)	4.7	3.1
Stafford (Groves unpubl)	-	3.5
Zachs, Oxford (Haddon-Reece & Miles 1988)	4.3	-

APPENDIX

Ring width data in units of 0.1mm.

8061

1	9	7	5	14	17	5	12	13	15	13
11	12	9	8	10	12	10	12	11	10	8
21	5	8	10	10	20	7	11	8	7	10
31	8	5	4	3	3	4	5	3	3	4
41	5	7	8	8	5	5	4	3	5	8
51	10	9	14	17	16	8	7	9	12	15

8073

AD1188								15	12	17
	15	11	23	10	10	17	11	9	6	8
AD1201	13	10	9	7	10	12	9	7	6	12
	6	7	7	10	8	9	10	7	12	8
	8	6	8	6	9	6	5	9	7	6
	6	8	6	10	10	8	9	10	14	9
	7	6	9	6	10	6	6	4	6	7
AD1251	9	6	9	7	9	9	10	5	8	8
	13	10	8	7	10	10	13			

8111

1	19	16	13	17	14	16	17	25	18	11
11	8	11	22	19	21	10	18	18	24	13
21	10	15	27	21	21	27	29	15	17	14
31	29	27	41	31	25	28	20	16	15	28
41	40	32	32	23	16	18	26	38	45	42

8169

AD1208								13	18	13
	13	9	7	10	6	10	12	9	11	14
	12	16	8	12	19	19	15	13	12	10
	7	5	5	8	6	3	6	4	3	4
	3	3	5	4	4	4	3	2	3	2
AD1251	3	3	5	3	4	5	7	9	6	10
	11	10	8	6	8	9	14	12	8	6
	12	11	9	7	6	11	17	9	13	9
	13	10	11	10	10	8	6	5	6	8
	8	10	6	9	6	5	8	6	6	4
AD1301	4	4	4							