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Summary

Tree-ring analysis was carried out on timbers associated with later medieval structures of monastic origin in the former precincts of Shrewsbury Abbey. The majority of the primary timbers were alder and seven of these were sampled. Three oak timbers were also sampled, one of which dated and produced a felling date range of AD 1268 - 1310.

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Introduction

An excavation carried out during 1985-87 in the former precincts of Shrewsbury Abbey revealed several structures of monastic origin (Figure 1). The earliest structure, a sandstone rubble wall thought to be part of an early precinct wall, was probably built before circa AD 1300 (Birmingham University Field Archaeology Unit, nd). As the precinct expanded during the 14th-15th centuries, a large stone building was constructed over the remains of the old precinct wall. Wooden piles were used beneath these new stone walls to provide stability as this was a low lying area subject to flooding from the nearby Rea Brook.

The original aim of tree-ring analysis was to indicate the construction dates of the structures and provide a more precise dating framework for the site, particularly as there was a lack of dating evidence from other archaeological sources. It was also hoped that the study of timbers from areas A and B would determine whether the 14/15th century building incorporated part of a slightly earlier structure toward the south-east edge of the excavation (area A).

During a site visit, timbers were examined in areas A, B and C (Figure 1), but it became apparent from the softness of the wood that the exposed primary timbers were not oak. The only structural timbers of oak (Quercus spp) had been re-used and therefore were of little value to the dating of this site. However, it is possible to construct a relative chronology for some non-oak species (eg Morgan 1987) and a precise relative dating framework may be obtained if sufficient material is available. Consequently the analysis of both non-oak and some oak timbers from Shrewsbury was undertaken. Samples were obtained from ten timbers; five from area A, two from area B and two from area C. The remaining sample was from a timber structure (A858 1619) known as the 'cradle' whose function and date were uncertain. A photograph/diagram of A858 1619 was not available.

In the laboratory, the non-oak samples were identified as alder (Alnus glutinosa Gaertn). Since alder is the second most common wood species

found on archaeological sites (Groves & Hillam 1988), a secondary aim of the analysis was to explore the usefulness of alder for tree-ring dating.

Method

The samples were prepared and measured following the method given by Hillam (1985a). A note was made of the size of the cross-section, plus the number of rings and their orientation, of all the samples (Appendix A; B). It is usual to measure only one radius on oak samples. However three radii of each alder sample were measured and then averaged together to form a single sequence so as to minimise the problems associated with the measurement of alder ring patterns, such as faint ring boundaries and missing rings (eg Elling 1966; Crone 1988).

The ring sequences were represented as graphs, known as tree-ring curves. The curves were compared visually by superimposing two curves and sliding one past the other searching for similarities in the ring patterns. A computer program (Baillie & Pilcher 1973) is also used as an aid to crossmatching. This measures the amount of correlation between two ring sequences at each position of overlap. The Student's *t*-test is then used as a significance test on the correlation coefficient and generally a *t*-value of 3.5 or over represents a match provided that the visual match is acceptable (Baillie 1982: 82-5). The program was also used to compare the tree-ring sequences from the oak samples with dated reference chronologies from Britain and Europe.

Following the completion of crossmatching and dating it is necessary to calculate the felling date. If the bark or bark edge is present on a sample the exact felling year can be given. In its absence, the amount of missing wood must be estimated. The presence of sapwood on oak samples makes this process more precise since the number of sapwood rings is relatively constant. A recent study on oak sapwood data showed that 19 out of every 20 samples from British trees over 30 years old had 10-55 sapwood rings (Hillam *et al* 1987). These 95% confidence limits are used to estimate felling dates in the absence of complete sapwood.

Results

The five samples from area A were alder and all had either bark or bark edge. They contained 24-45 rings and despite the shortness of their ring sequences all were included for measurement. A high t-value (6.9) and a very good visual match was found between two sequences (SH3, SH4) and their ring widths were averaged to form a master, SHALDER. No other conclusive matches were obtained.

The two alder samples from area B, SH6 and SH7, contained 34 and 28 rings respectively. The bark edge was present on both samples but although a tentative visual match was found this could not be confirmed by statistical techniques. Consequently the two samples remain unmatched. SH6 and SH7 were tested against the sequences from area A but the ring patterns did not appear to crossmatch. This does not however necessarily indicate the non-contemporaneity of these samples.

Two oak samples were obtained from area C. SH9, was unsuitable for measurement as it contained insufficient annual growth rings. SH8 had 53 rings and the resultant ring sequence was tested against reference chronologies spanning the 14th and 15th centuries, but no conclusive crossdating was obtained.

The oak sample, SH10, from the cradle (A585 1619) had 95 rings and the heartwood-sapwood transition was present. It was compared with SH8 and dated reference chronologies. Good visual matches and relatively high t-values were obtained when its rings spanned AD 1174-1268 (Table 1). The ring sequence matched best with chronologies from Bredon in Hereford and Worcestershire (4.3), East Midlands (4.0), Beverley in North Humberside (4.0) and Reading (4.7). The date of the heartwood-sapwood transition is AD 1256, thus using the sapwood estimate of 10-55 rings, a probable felling date range of AD 1268-1310 is obtained.

Conclusion

There was no evidence for re-use of SH10 and therefore, assuming that it is a primary timber, the cradle (A585 1619) was probably constructed after AD 1268 but before AD 1310, shortly after the timber was felled. No dating was obtained for areas A, B or C. It was not possible to determine from the tree-ring results whether or not the timbers from

area A represent a slightly earlier structure which was later incorporated into the stone structure represented by area B.

The need to explore the potential of dating non-oak species is clearly demonstrated. Dendrochronology could then offer a precise dating framework for sites such as Shrewsbury where non-oak timber predominates and where there is a lack of dating evidence available from other sources.

Acknowledgements

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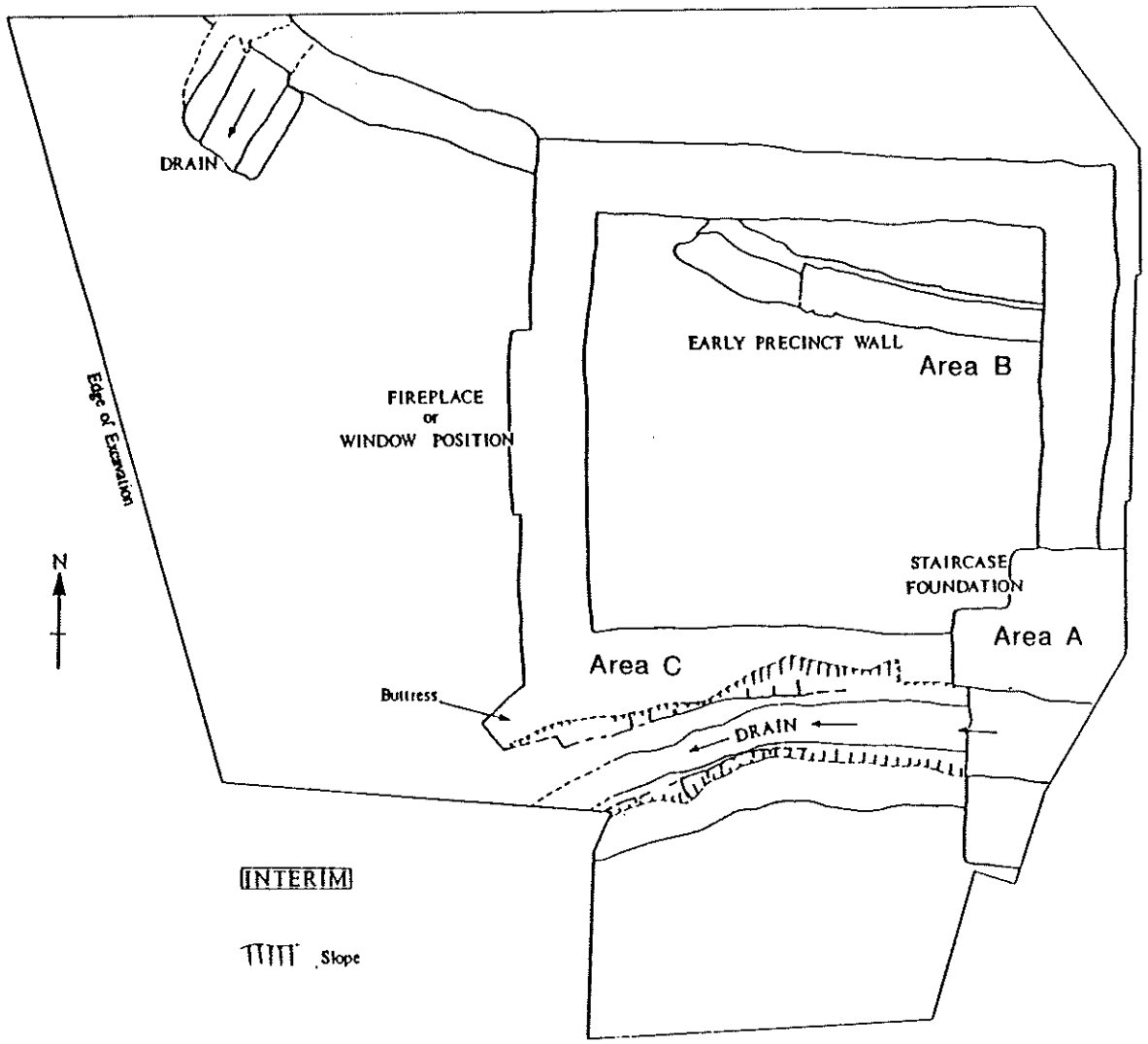


Figure 1: The Abbey excavation. Interim site plan indicating the position of areas A, B and C (reproduced from Birmingham University Field Archaeology Unit, nd).

Table 1: Dating SH10 (AD 1174-1268). Results of comparisons with dated reference chronologies.

chronology	t-values
Abbey Barn (Bridge 1983)	3.5
Bredon (Giertz unpublished)	4.3
Coxwell (Fletcher unpublished)	3.7
Droitwich (Hillam 1985b)	3.8
East Midlands (Laxton, Litton & Simpson pers comm)	4.0
Hall Garth (Hillam 1981)	4.0
Hull (Hillam 1979)	3.4
Reading (Groves, Hillam & Pelling-Fulford 1985)	4.7
Stafford (Sheffield Dendrochronology Laboratory unpublished)	3.1
Trier area, Germany (Hollstein 1980)	3.3

APPENDIX A

Details of the samples

Sample - sample number
Rings - total number of rings
Sapwood - number of sapwood rings
Av width - average ring width in millimetres

Sample	Species	Rings	Sapwood	Av width	Result
SH1	alder	24	-	2.02	undated
SH2	alder	28	-	2.47	undated
SH3	alder	45	-	2.03	undated
SH4	alder	39	-	1.91	undated
SH5	alder	26	-	1.89	undated
SH6 (F275 1653)	alder	34	-	1.44	undated
SH7 (F275 1651)	alder	28	-	1.99	undated
SH8 (A585 1726)	oak	53	15	3.96	undated
SH9 (A585 1730)	oak	19	-	-	rejected
SH10 (A585 1619)	oak	95	13	1.66	dated

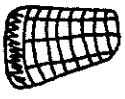
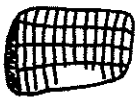
APPENDIX B

Cross-sectional sketches

Sample - sample number
Dimensions - dimensions of the cross-sectional surface in millimetres

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

Sapwood is indicated by shading.

Sample	Sketch	Dimensions
SH1		110x110
SH2		140x75
SH3		185x125
SH4		165x115
SH5		110x110
SH6		100x100
SH7		130x115
SH8		205x95
SH9		140x125
SH10		155x100