

Ancient Monuments Laboratory
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TREE-RING ANALYSIS OF THE
MEDIEVAL HALL ROOF OF MARWELL
HALL, HAMPSHIRE, 1993

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Summary

Dendrochronological analysis of samples from the medieval roof of Marwell Hall resulted in the production of a probable felling date range for the timbers of AD 1291-1333, and a tree-ring chronology spanning the period AD 1138-1281.

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Introduction

Marwell Hall lies in the middle of Marwell Zoological Park, two miles south-east of Twyford (NGR: SU508217). It has undergone extensive alterations throughout its history but at the core of the building, concealed above a nineteenth century vaulted plaster ceiling, a medieval timber roof is extant (Crook 1993). This base-cruck structure, consisting of four trusses, originally covered a three-bay hall which lay between stone cross-wings. The architectural style suggests a construction date in the first half of the fourteenth century (Crook 1993). Dendrochronological analysis was undertaken in late 1993 to determine precise dates for the timbers, and hence provide more precise dating evidence for the construction of the medieval hall.

Method

All accessible timbers thought to be associated with the original erection of the medieval hall roof were briefly assessed. Those which looked most suitable for dendrochronological analysis were selected for study and sampled. Cores were taken from the timbers using a 15mm diameter hollow borer attached to an electric drill. Each core was first polished using a sander with paper of medium grit and then finished by hand using fine silicon carbide paper so that the annual growth rings were clearly defined.

Any samples unsuitable for dating purposes were rejected before measurement but where possible a note was made of the number of rings and the average ring width estimated. Unsuitable samples are usually those with unclear ring sequences or fewer than 50 rings. Samples with fewer than 50 rings are generally unsuitable for dating purposes as the sequence may not be unique (Hillam *et al* 1987).

The growth rings of the samples selected for dating purposes were measured to an accuracy of 0.01mm on a travelling stage. This is connected to an Atari microcomputer which uses a suite of dendrochronology programs written by Ian Tyers (pers comm 1993). The ring sequences were plotted as graphs using an HI-80 Epson plotter attached to the Atari. The graphs were then compared with each other to check for any similarities between the ring patterns which might indicate contemporaneity. This process is aided by the use of programs on the Atari microcomputer. The crossmatching routines are based on the Belfast CROS program (Baillie and Pilcher 1973; Munro 1984) and measure the amount of correlation between two ring sequences. The Student's *t* test is then used as a significance test on the correlation coefficient. All *t* values quoted in this report are identical to those produced by the original CROS program (Baillie and Pilcher 1973). Generally a *t* value of 3.5 or over represents a match, provided that the visual match between the tree-ring graphs is acceptable (Baillie 1982, 82-5).

Dating is usually achieved by crossmatching ring sequences within a phase or building and combining the matching patterns to produce a site master curve. This master curve and any unmatched ring sequences are then tested against reference chronologies to obtain absolute dates. A master curve is used for absolute dating purposes whenever possible as it enhances the common climatic signal and reduces the background noise resulting from the local growth conditions of individual trees.

The results only date the rings present in the timber and therefore do not necessarily represent the felling date. If the bark or bark edge is present on a sample, the exact felling year can be determined. In the absence of bark surface the felling date is calculated using the sapwood estimate of 10-55 rings. This is the range of the 95% confidence limits for the number of sapwood rings on British oak trees over 30 years old (Hillam *et al* 1987). Where sapwood is absent, the addition of 10 rings (the minimum number of sapwood rings expected) to the date of the last measured heartwood ring produces a probable *terminus post quem* for felling. During timber conversion a large number of outer rings could be removed but as this is unquantifiable the actual felling date could be much later.

Once the felling date range or *terminus post quem* for felling has been calculated, factors such as stockpiling, re-use, repairs, and seasoning of timber must be considered since they might affect the interpretation of the tree-ring dates. Seasoning of timber is thought to have been a fairly rare occurrence until relatively recent times. Evidence indicates that timber was generally felled as required and used whilst green (eg Rackham 1990, 69). Construction which utilises primary, rather than re-used, timber is therefore likely to have occurred shortly after felling. Thus, whilst the date obtained for the measured tree-ring sequence is precise and has been achieved by a completely independent process, the interpretation of tree-ring dates can be refined by studying other architectural and documentary evidence.

Results

The timbers thought to be associated with the primary construction phase of the medieval hall roof were all oak. The major structural elements appeared to be shaped from either complete or halved trunks. Traces of sapwood were present on only a few timbers, although the method of conversion suggests that many of the timbers may only have sapwood and a few heartwood rings missing. The pith was probably present in the majority of timbers, although it was not necessarily sampled. Most of the major structural timbers used in the construction of the medieval hall roof appear to have been derived from trees over 50 years old but under approximately 150 years old when felled.

Full details of the tree-ring samples are given in Table 1. The trusses and bays were numbered from the south end of the hall roof as in Crook (1993). Cores were only removed from the east side of the roof as access for coring on the west side was impossible because of nineteenth-century alterations. The major structural elements of truss I were unsuitable for sampling. Very little survives of truss IV, apart from the tiebeam which was inaccessible.

The ring patterns of all five measured samples crossmatched and were combined to form a 144-year site master curve, MARWELL (Figure 1, Table 2). This was dated to the period AD 1136-1281 by comparison with numerous reference chronologies from the British Isles (Table 3).

Felling date ranges for samples 01, 04, and 05 and a *terminus post quem* for felling for samples 06 and 07 were calculated (Table 4). The results indicate that these five timbers are broadly contemporary and were therefore all likely to have been felled after AD 1290 but probably before AD 1334. The tree-ring analysis therefore indicates a construction date for the medieval hall roof shortly after felling in AD 1291-1333.

Conclusion

Analysis of the medieval roof timbers at Marwell Hall resulted in the production of a dated site chronology spanning the period AD 1138-1281, which will prove useful in future dendrochronological studies in this locality. The tree-ring analysis shows that the five dated timbers, thought to be associated with the primary construction phase, were probably contemporary and were felled during the period AD 1291-1333. This corresponds with the fourteenth-century construction date indicated by the architectural style. However the results can neither confirm nor refute the possibility of a construction date in or soon after AD 1316 which has been inferred from the limited documentary evidence available (Crook 1993).

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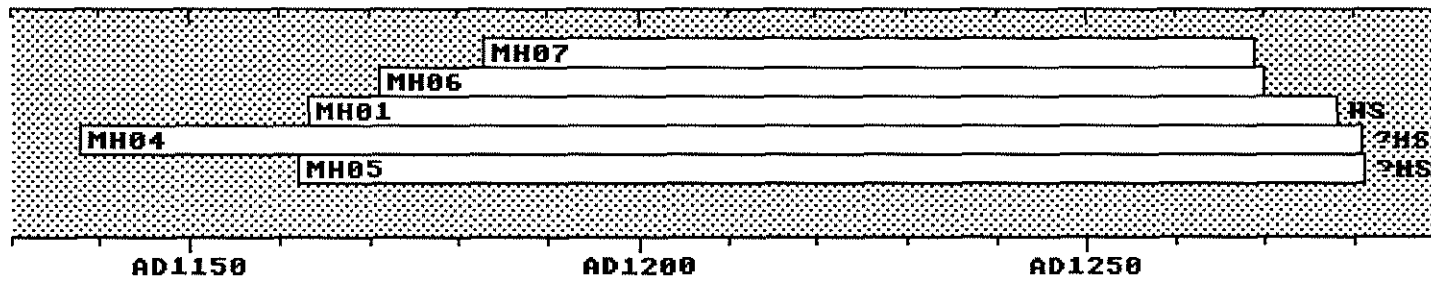


Figure 1: Bar diagram showing the relative positions of the dated ring sequences from Marwell Hall. White bars - heartwood rings; HS - heartwood/sapwood transition.

Table 3: Results of comparisons between the site master curve, MARWELL (AD 1138-1281) and reference chronologies spanning the medieval period. All chronologies are independent.

<u>Reference chronology</u>	<u>t value</u>
Baylolls Manor, Harwell, Oxon (Haddon-Reece and Miles 1992)	6.13
Droitwich: Upwich2 (Groves and Hillam 1994)	5.71
Glastonbury: Abbey Barn (Bridge 1988)	6.43
Gloucester: Blackfriars (Hillam and Groves 1993)	5.31
Great Oxenbold, Salop (Miles and Haddon-Reece 1993)	6.06
Lewknor, Oxon (Haddon-Reece <i>et al</i> 1990)	6.56
London: Fennings Wharf (Tyers 1993)	5.05
Reading, Berks (Groves <i>et al</i> 1994)	7.46
Siddington Barn, Gloucs (Groves and Hillam 1992)	5.38
Sompting Church, West Sussex (Tyers 1988)	5.88
Winterbourne, Avon (Hillam 1991)	5.05

Table 4: Details of the tree-ring dates.

<u>Sample</u>	<u>Date span of measured rings</u>	<u>Felling date range</u>
01	AD 1163-1278	AD 1288-1333
04	AD 1138-1281	AD 1291- <i>c.</i> 1340
05	AD 1162-1281	AD 1291- <i>c.</i> 1340
06	AD 1171-1270	after AD 1280
07	AD 1183-1269	after AD 1279