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Summary

Dendrochronogical analysis of samples from the roof of the medieval farmhouse South Yarde resulted in the production of a felling date for the timbers of AD1447/8, and a tree-ring chronology spanning the period AD1309-1447. The timbers from the later inserted ceiling were unsuitable for dating purposes.

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## TREE-RING ANALYSIS OF OAK TIMBERS FROM SOUTH YARDE, ROSE ASH, DEVON, 1992

### Introduction

The Grade I listed medieval farmhouse South Yarde (NGR: SS771212), Rose Ash, has recently undergone restoration during which a survey commissioned by English Heritage and Devon County Council was carried out by Keystone Historic Buildings Consultants. Although documentary evidence suggests that a dwelling has been present on the site since Doomsday, the surviving medieval hall house is thought to be that of a major rebuilding, for which the architectural style suggests a mid-late 15th century date (Cox & Thorp 1993). A later inserted floor, thought to be of 17th century date, is present in what was originally the open hall (Cox & Thorp 1993). Tree-ring analysis was undertaken during the renovation work in late 1992 to determine precise dates for the timbers, and hence provide more precise dating evidence for the major rebuild (phase 1) and the insertion of the floor.

### Method

All timbers were briefly assessed and those which looked most suitable for dendrochronological analysis were selected for study and sampled. Unsuitable timbers are usually those with less than 50 growth rings. Ring patterns with fewer than 50 rings are generally unsuitable for absolute dating as they may not be unique (Hillam *et al* 1987). The samples were obtained by use of a corer attached to an electric drill which leaves a hole of approximately 15mm diameter. The location of each sample is recorded according to the plans produced by Cox & Thorp (1993). Each core was polished with an electric sander and then by hand using fine silicon carbide paper so that the annual growth rings were clearly defined.

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 1992). 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 of crossmatching is aided by the use of programs on the Atari microcomputer. The crossdating routines are based on versions of CROS (Baillie & 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 & 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 achieved by crossmatching ring sequences within a phase or building and combining the matching patterns to produce a site master curve. All previously unmatched ring sequences from the site are compared with this master curve and if any additional patterns are found to crossmatch these are incorporated into the 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. If the outermost ring has both early and latewood present and therefore appears to be complete, the timber was felled during late summer-early spring (ie out of the growing season) and is referred to as winter felled. If only the earlywood is present then the timber was probably felled during late spring-early summer (Baillie 1982, fig 2.1) which is referred to as summer felled.

In the absence of bark surface the felling date is calculated using the sapwood estimate of 10-55 rings. This represents 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 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. The possibility of a timber structure having undergone repair work should also be taken into account. 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 archaeological and documentary evidence.

**Results**

During the initial assessment it was noted that the major structural timbers were probably all oak. Those from the 17th century inserted floor were wide ringed and contained less than the minimum 50 rings required for dating purposes (ie derived from fast grown, young trees). These were therefore rejected prior to sampling, as were all the secondary rafters which were small and unlikely to contain sufficient growth rings and may also be of a later date (Cox pers comm).

The timbers thought to be associated with phase 1 were generally shaped from halved trunks (Figure 1). Bark edge was noted on several timbers and sapwood was present on many, although this was sometimes too friable to survive coring. The phase 1 timbers

appear to have been derived from trees over 50 years but under approximately 150 years old when felled.

Full details of the tree-ring samples are given in Table 1. Cores were removed only from the roof trusses as it was considered unnecessary, at this stage, to obtain samples from moulded and decorated timbers that are clearly visible at first floor level. Samples 02-05 are from the undecorated roof section west of truss 1; 01 and 06 are from truss 1 which divides the undecorated west section from the moulded and decorated open hall; 07 and 08 are from truss 2 in the open hall. No samples were obtained from the undecorated roof section to the east of the open hall, as this was inaccessible throughout sampling.

The ring patterns of four samples (03, 04, 05, 08) crossmatched and were combined to form a site master curve, SYARDE/T4 (Figure 2). This was dated to the period AD1309-1447 by comparison with numerous reference chronologies from the British Isles (Table 2).

Samples 01, 06 and 07 also crossmatched (Figure 2). Sample 01, the north rafter of truss 1, gave a *t* value of 11.3 with sample 06, the south rafter of truss 1. Although there is no precisely defined limit, studies on modern samples suggest that those samples which match with *t* values greater than 10 are likely to have originated from the same tree. The ring width data from 01 and 06 were averaged to produce a single sequence before being combined with the data from sample 07 to produce a second site master curve, SYARDE/T2. This gave a tentative match with SYARDE/T4 when it spanned AD1365-1446. This was confirmed by comparison with reference chronologies (Table 2). SYARDE/T4 and SYARDE/T2 were combined to produce a 139-year site master curve, SYARDE/T6 (Table 3). No consistent results were obtained for sample 02, so this timber remains undated.

Two of the dated timbers, 04 and 08, had bark edge. Timber 08 was winter felled in AD1447/8 but the outermost rings of sample 04 were too narrow for accurate measurement so these were counted. Its outermost measured ring dates to AD1426 but when allowance is made for the unmeasured rings and also the loss of 1

or 2 rings during sampling a felling date of AD1447 or AD1448 is produced for timber 04. Felling date ranges were calculated for the five other dated timbers by applying the 10-55 sapwood range (Table 4). The results indicate that all seven dated timbers may be contemporary and were therefore all likely to have been felled in the winter of AD1447/8. Tree-ring analysis therefore indicates a construction date for the medieval roof shortly after felling in AD1447/8, assuming that all seven dated timbers are associated with the primary building phase.

## Conclusion

Analysis of the phase 1 roof timbers at South Yarde resulted in the production of a dated site chronology spanning the period AD1309-1447. The tree-ring analysis shows that the seven dated timbers were all probably contemporary and were felled in AD1447/8. This corresponds with the mid-late 15th century date indicated by the architectural style and coincides with a change of ownership *c*.AD1450 noted in the documentary evidence (Cox & Thorp 1993).

No tree-ring dates could be obtained for the later modifications to the medieval hall house as the timbers were unsuitable for dating purposes.

## Acknowledgements

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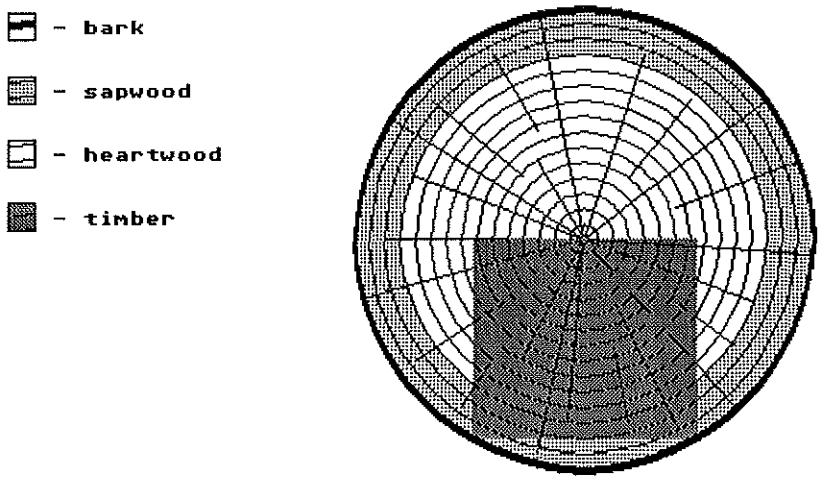


Figure 1: Diagram showing the method of conversion of the major roof timbers from phase 1 at South Yarde.

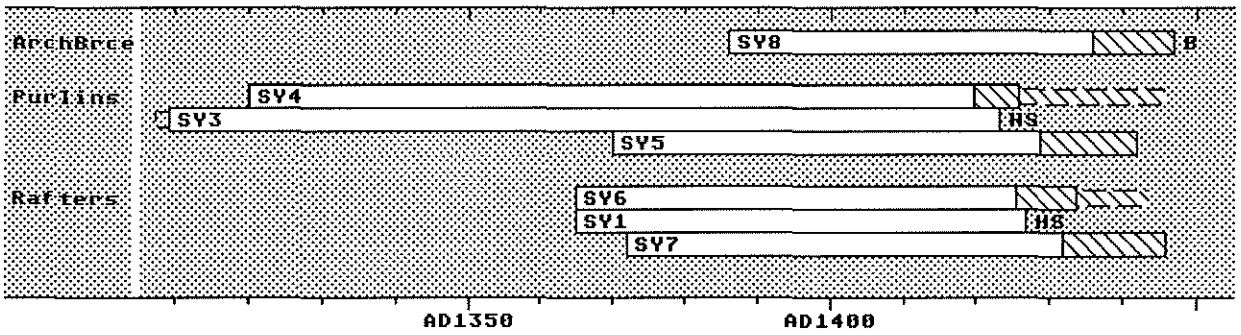


Figure 2: Bar diagram showing the relative positions of the dated ring sequences included in the site master chronology from South Yarde. White bars - heartwood rings; shaded bars - sapwood rings; broken lines - unmeasured rings; HS - heartwood-sapwood transition; B - bark edge.

Table 1: Details of the tree-ring samples from South Yarde, Rose Ash, Devon. + - number of unmeasured rings on core; hs - heartwood/sapwood boundary; G - more than 10 rings to the pith; F - 5-10 rings to the pith; V - less than 5 rings to the pith; AGR - average growth rate (mm/year).

| Sample | Location | Total no of rings | Sapwood rings | Pith | AGR | Comment |
|---|---|---|---|---|---|---|
| 01 | Truss 1 north rafter | 63(+10) | hs(+10) | G | 3.0 | - |
| 02 | West of truss 1 north upper purlin | 57 | 12 | F | 1.7 | - |
| 03 | West of truss 1 north lower purlin | 115 | hs | G | 1.1 | - |
| 04 | West of truss 1 south lower purlin | 107(+20) | 6(+20) | G | 1.1 | bark edge present on timber but outer 1-2 rings lost during coring |
| 05 | West of truss 1 south upper purlin | 73 | 13 | G | 1.7 | - |
| 06 | Truss 1 south rafter | 70(+10) | 8(+10) | G | 2.2 | - |
| 07 | Truss 2 south rafter | 75 | 14 | G | 3.0 | - |
| 08 | Truss 2 south arch brace | 62 | 11 | F | 1.6 | bark edge; felled winter |

Table 2: Dating the South Yarde site master chronology, SYARDE/T6, AD1309-1447. All reference chronologies are independent. SDL - Sheffield Dendrochronology Laboratory; *t* values of less than 3.0 are not given.

| reference chronology | *t* value SYARDE/T4 | SYARDE/T2 | SYARDE/T6 |
|---|---|---|---|
| France: Brittany-2 (Guibal pers comm) | - | 3.27 | - |
| Ireland: Belfast (Baillie 1977a) | 3.21 | 5.22 | 3.98 |
| Dublin-2 (Baillie 1977b) | - | 4.11 | 3.62 |
| Elland (Hillam 1984) | 4.81 | 4.98 | 5.75 |
| Exeter: Bowhill House (Hillam 1991) | 4.31 | 3.52 | 4.70 |
| Medieval-C8 (SDL unpubl) | 5.60 | 3.68 | 5.63 |
| Field Place Barn, West Sussex (Bridge pers comm) | 4.16 | 5.08 | 4.58 |
| Hafoty-1, Anglesey (SDL unpubl) | - | 5.44 | 4.87 |
| Kings Pyon barn, nr Leominster (Groves & Hillam 1993) | 4.20 | 3.74 | 3.90 |
| London: Southwark boats-3 (Tyers 1990) | 5.41 | 4.33 | 5.87 |
| Peel Hall-1, nr Manchester (Leggett 1980) | 3.20 | 5.32 | 5.13 |
| Southern England (Bridge 1988) | 5.08 | 3.35 | 5.15 |
| Wimborne Minster, Dorset (Miles 1993) | 4.94 | - | 5.10 |
| Yorkmed (Hillam unpubl) | 4.64 | - | 4.08 |

Table 3: Ring width data of the site master chronology, SYARDE/T6, from South Yarde, AD1309-1447.

| year | ring widths (0.01mm) | | | | | | | | | | numbers of trees per year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AD1309 | | | | | | | | | 138 | 168 | | | | | | | | | 1 | 1 |
| | 159 | 167 | 141 | 101 | 161 | 157 | 154 | 136 | 176 | 160 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| | 187 | 184 | 242 | 124 | 135 | 128 | 159 | 176 | 261 | 158 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | 75 | 119 | 130 | 156 | 137 | 108 | 112 | 185 | 170 | 175 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | 186 | 147 | 166 | 151 | 167 | 104 | 60 | 67 | 77 | 74 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| AD1351 | 107 | 160 | 184 | 141 | 174 | 152 | 147 | 138 | 73 | 55 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | 47 | 122 | 109 | 138 | 168 | 213 | 166 | 182 | 129 | 185 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 |
| | 149 | 298 | 198 | 325 | 225 | 274 | 164 | 226 | 275 | 225 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | 171 | 182 | 186 | 219 | 159 | 234 | 243 | 235 | 199 | 166 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 |
| | 180 | 149 | 162 | 162 | 207 | 221 | 164 | 174 | 211 | 242 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| AD1401 | 158 | 149 | 180 | 202 | 243 | 197 | 214 | 223 | 213 | 190 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | 169 | 166 | 192 | 163 | 166 | 131 | 153 | 156 | 121 | 178 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | 152 | 128 | 209 | 205 | 175 | 175 | 142 | 158 | 159 | 141 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 |
| | 148 | 170 | 133 | 139 | 180 | 160 | 158 | 119 | 82 | 104 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 |
| | 102 | 108 | 134 | 165 | 189 | 167 | 174 | | | | 3 | 3 | 2 | 2 | 2 | 2 | 1 | | | |

Table 4: Summary of the tree-ring dates. The date of the heartwood/sapwood transition is given in brackets.

| Sample | Date span of measured rings | Unmeasured rings | Felling date |
|---|---|---|---|
| 01 | 1365-1427 (1427) | - | 1444-1481 (same tree as 06) |
| 03 | 1309-1423 (1423) | - | 1433-1478 |
| 04 | 1320-1426 (1420) | 20+c1-2 | 1447-1448 |
| 05 | 1370-1442 (1429) | - | 1442-1484 |
| 06 | 1365-1434 (1426) | 10 | 1444-1481 (same tree as 01) |
| 07 | 1372-1446 (1432) | - | 1446-1487 |
| 08 | 1386-1447 (1436) | - | 1447/8 |