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TREE-RING ANALYSIS OF OAK TIMBERS FROM BERRY POMEROY CASTLE, NEAR TOTNES, DEVON, 1992

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Summary

The dendrochronological analysis of timbers from the north range of Berry Pomeroy Castle is described. A felling date of circa AD 1591 -1601 was obtained for one of the timbers but the other four remain undated.

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Introduction

Berry Pomeroy Castle (NGR: SX839623) lies 3 miles north-east of Totnes. Although owned by the Duke of Somerset, it is currently in the care of English Heritage. The castle ruins include the remains of a 15th century fortified mansion, constructed by the Pomeroy family, and the unfinished shell of a far larger stately dwelling, built in two principal phases, associated with the Seymours. In AD1547, after over four centuries of ownership, the Pomeroys sold the castle and estate to Edward Seymour, Protector Somerset, but during the late-17th century the castle was abandoned (Slade 1990). Tree-ring analysis was undertaken during the conservation work in late 1992 to determine precise dates for the few remaining timbers in the unfinished north range associated with a closet in the kitchen block. It was hoped that the results would provide more precise dating evidence for the initiation of construction of this planned major extension.

Method

The samples were obtained by use of a corer attached to an electric drill which leaves a hole of approximately 15mm diameter. Duplicate samples were taken from several timbers in an attempt to obtain intact sections of sapwood. 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.

Any samples unsuitable for dating purposes were rejected before measurement but a note was made of the number of rings and the average growth rate. Unsuitable samples are usually those with unclear ring sequences or less than 50 rings. Ring patterns with fewer than 50 rings are generally unsuitable for dating purposes as they 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 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 generally 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. 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

The seven timbers thought to be associated with the primary construction of the north range kitchen block were all oak (*Quercus* spp). The single timber beneath the closet was a tangential plank (Figure 1). Although it contained sufficient rings for dating purposes it was not possible to remove a core as the timber was mostly embedded in a stone wall. *In situ* measurement could not be carried out either as the exposed cross-section was extremely badly weathered, and therefore this timber was rejected. The six timbers over the closet were roughly hewn whole trunks. Bark edge was noted on several timbers and sapwood was apparent on all six but this proved too friable to survive coring. These timbers probably originated from trees over 50 years but under approximately 150 year old when felled. Their twisted and branched appearance suggests that they may have been derived from the top section of the tree-trunk or that the tree may have grown in a relatively open environment rather than dense woodland. This type of environment would allow the trunk to branch and curve naturally.

Cores were removed from five of the trunks. The sixth timber was rejected as it was extremely knotty and therefore unlikely to provide a ring pattern suitable for dating purposes. Full details of the tree-ring samples are given in Table 1. Sample 5 was rejected before measurement as it did not contain enough rings for dating purposes but a note was made of the number of rings and average growth rate. Where duplicate samples had been taken, their data was combined to produce a single ring sequence for each timber.

The ring patterns from the four measured timbers did not crossmatch and so all were compared with numerous dated reference chronologies from the British Isles, Ireland and France, spanning the medieval period to present day. Timber 2 dated to the period AD1474-1571 (Figure 2; Tables 2 & 3) but no reliable results were obtained for any of the other three sequences. A tentative mid-late 16th century date was found for timber 4 but this cannot be proved.

During sampling the outer 30-35mm of timber 2 had disintegrated. This appeared to be mostly sapwood. Therefore the outermost measured ring of timber 2 is probably the heartwood-sapwood boundary or within a few rings of it. This timber was therefore felled after AD1580 but before *circa* AD1630. Timber 2, the front lintel, had retained bark surface in places so an attempt at refining the felling date range was considered worthwhile. Wedges of sapwood complete from the heartwood to bark surface were removed by Stewart Brown, the archaeologist, and a site workman. The number of sapwood rings varied from 20-25. Thus, allowing for some variation in the position of the heartwood-sapwood boundary around the trunk, it is likely that timber 2 was felled after AD1590 but probably no later than AD1601.

Discussion

The lack of intra-site crossmatching is probably due, at least in part, to the distortion of the ring patterns, which will mask the climatic signal, caused by the close proximity of branches and natural twisting of the trunk. This clearly affects the dating potential as the production of a site/phase master curve from a

number of individual timbers enhances the prospects of obtaining a date (see above). A master sequence of as little as 60 rings may be datable, assuming that there are appropriate reference chronologies available, whereas a single sequence of 80 or even 100 rings may not (see for example Hillam *et al* 1987).

The lack of local reference material may also be a problem with this site. Although a tentative date was obtained for a second timber (4), the absence of much local reference material may be a contributory factor in not obtaining confirmation of this possible date. The successful dating of structures such as Berry Pomeroy Castle, where there are so few timbers available for analysis, may well be reliant on the availability of well replicated local reference chronologies. Very few dendrochronological studies have been carried out on standing buildings in Devon, or the south-west peninsula in general. Previous analyses have demonstrated the difficulties in obtaining dates for what are presumed to be local timbers (see for example Mills 1988). Consequently there are currently relatively few local reference chronologies available for an area whose very nature, with such varied topography, may well increase the need for local data. It is hoped that this situation will be, at least in part, remedied over the next few years by the concentrated analysis of a geographical and chronological range of buildings in Devon under the auspices of a proposed project funded by Devon County Council and English Heritage. Additionally a study of crossmatching between ring sequences from living trees across the peninsula may be useful in providing comparative material which would indicate the level of crossmatching expected. The dendrochronological analysis of standing buildings in the county may then be expected to become far more productive, not only in the producing independent dates, but also in providing information concerning medieval and post-medieval woodland cover, exploitation and management.

Conclusion

A tree-ring date has been obtained for timber 2 which, assuming that it is primary, indicates that the north-range building work probably took place during the last decade of the 16th century. This therefore implies that it was a descendant of the first Duke

of Somerset who carried out the work rather than Edward Seymour himself who was executed in AD1552. However it should be noted that this date rests on a single timber.

Acknowledgements

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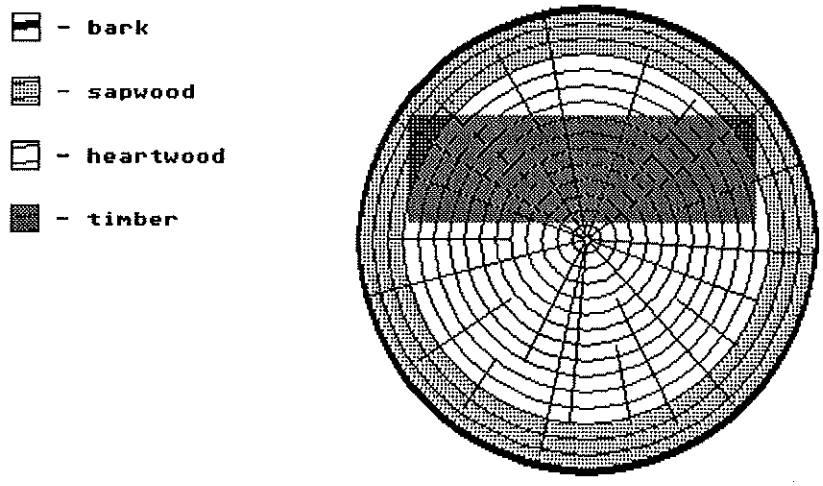

Figure 1: Diagram showing the method of conversion of the plank beneath the closet in the north range kitchen block at Berry Pomeroy Castle.

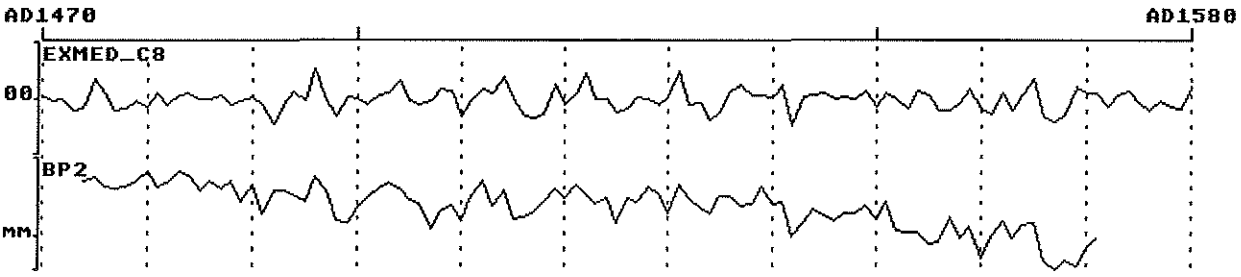

Figure 2: Diagram showing the match (t = 5.56) between Berry Pomeroy Castle timber 2 and the reference chronology Exeter medieval-C8 (SDL unpubl) which contains data from a number of sites in Exeter.

Table 1: Details of the tree-ring samples from Berry Pomeroy Castle, near Totnes, Devon. hs - heartwood/sapwood boundary; G - more than 10 rings to the pith; V - less than 5 rings to the pith; AGR - average growth rate (mm/year).

Timber	Location	Total no of rings	Sapwood rings	Pith	AGR	Comment
01	timber aligned N-S, west side beam	72	hs	G	2.6	+15-20mm of sapwood lost during coring
02	timber aligned E-W, north (front) lintel	98	?hs	V	1.9	+30-35mm of sapwood lost during coring
03	timber aligned N-S, east side beam	123	?hs	G	1.0	-
04	timber aligned E-W, southernmost beam	70	hs	G	1.6	-
05	timber aligned E-W, beam immediately south of 02	44	hs	G	1.2	+15-20mm of sapwood lost during coring

Table 2: Dating Berry Pomeroy Castle timber 02, AD1474-1571. All reference chronologies are independent. SDL - Sheffield Dendrochronology Laboratory; *t* values of less than 3.0 are not given.

reference chronology	*t* value
Beaulieu Domus-2, Hampshire (SDL unpubl)	4.01
Bewdley, Worcestershire (Giertz pers comm)	3.65
Droitwich, Upwich-3 (Groves & Hillam 1993)	5.47
East Midlands (Laxton & Litton 1988)	3.82
Elland, West Yorkshire (Hillam 1984)	3.99
Exeter: Medieval-C8 (SDL unpubl)	5.56
London: Southwark boats-3 (Tyers 1990)	4.19
Nuffield, Oxfordshire (Haddon-Reece *et al* 1989)	4.27
Peel Hall-1, nr Manchester (Leggett 1980)	3.78
Reigate, Surrey (Tyers pers comm)	3.86
Southern England (Bridge 1988)	3.73
Yorkmed (Hillam unpubl)	4.25

Table 3: Ring width data of the Berry Pomeroy Castle timber 02, AD1474-1571.

year	ring widths (0.01mm)									
AD1474				302	326	262	253	264	294	355
	264	291	358	341	250	301	253	295	198	273
	156	244	247	229	199	320	251	132	129	176
AD1501	213	261	287	256	201	186	115	160	178	135
	223	299	178	243	136	143	164	193	254	214
	276	231	186	213	128	213	196	268	226	154
	278	211	174	157	223	216	183	189	263	190
	197	99	129	165	152	133	156	156	182	141
AD1551	199	109	105	104	84	87	144	94	120	65
	97	131	93	124	128	61	51	62	56	78
	94									