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Tree-Ring Analysis of Oak Timbers from Conduit House, Cowdray, Easebourne Lane, Midhurst, West Sussex

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Summary

Seven timbers from the roof and three other structural timbers were sampled. Matching was found between four roof timbers that all had a similar sensitive growth pattern, possibly resulting from management of a single parent tree. Two other samples, from beams supporting the first floor, also matched. No dates were found for any of the timbers.

Keywords

Dendrochronology

Standing Building

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Introduction

Conduit House (NGR SU 89119 21801; Fig 1), also referred to as The Round Tower, is a two-storey octagonal building with a tiled pyramidal roof. It is located within the grounds of the grade 1 listed Cowdray House, a Scheduled Ancient Monument. It is situated approximately 100 metres north of Cowdray House. Its dating and function are not certain (Oxford Archaeology 2006), though it is often assumed to have had a role in supplying water to the main house. The roof is not thought to be original, but may contain reused timbers from the original construction, and there are some internal structural timbers that may confirm the date of construction. Dendrochronological dating was requested by the local English Heritage Inspector of Ancient Monuments (Judith Roebuck), in order to inform grant-aided repairs on this Building at Risk by providing dating evidence for the initial construction and the anticipated later re-roofing.

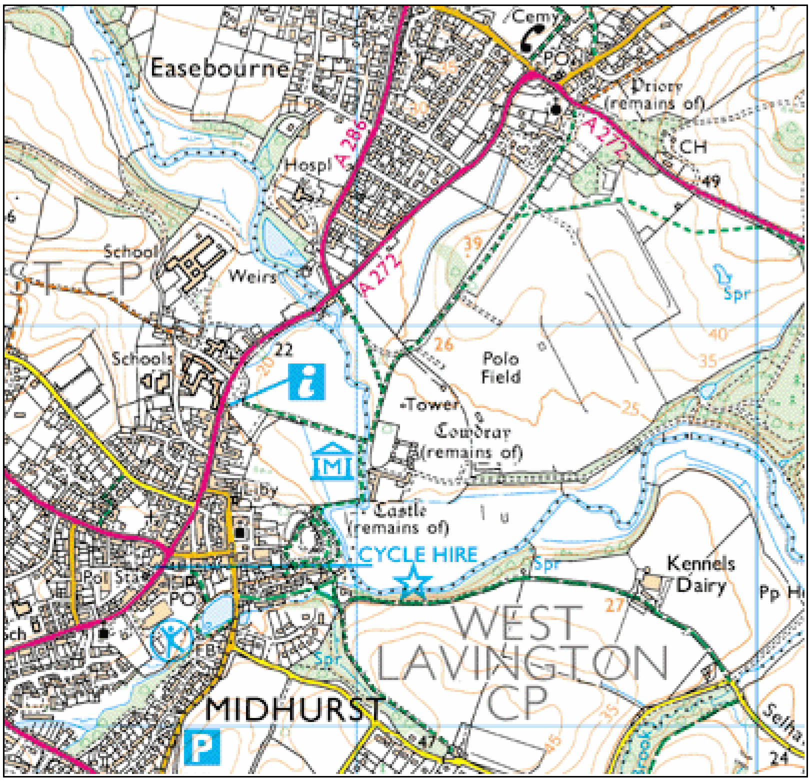

Figure 1: Map showing the location of Conduit House, Cowdray ('Tower', centre).

Methodology

The site was visited in February 2006. In the initial assessment, accessible oak timbers with more than 50 rings and traces of sapwood were sought. Those building timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, and stored for subsequent analysis.

The cores were prepared for measuring by sanding, using an electric belt-sander with progressively finer grit papers down to 400 grit. Any further preparation necessary, eg where bands of narrow rings occurred, was done manually. Suitable samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (1999). Cross-matching and dating was accomplished by a combination of visual matching and a process of qualified statistical comparison by computer. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted to allow visual comparisons to be made between sequences on a light table. This method provides a measure of quality control in identifying any errors in the measurements when the samples cross-match.

In comparing one sequence or site sequence against another, *t*-values over 3.5 are considered significant, although in reality it is common to find *t*-values of 4 and 5 which are demonstrably spurious because more than one matching position is indicated. For this reason, it is necessary to obtain some *t*-values of 5, 6, and higher, and for these to be well replicated from different, independent chronologies and with local and regional chronologies well represented, unless the timber is imported. Where two individual sequences match with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they most likely came from the same parent tree.

When cross-matching between samples is found, their ring-width sequences are averaged to form an internal 'working' site mean sequence. Other samples may then be incorporated after comparison with this 'working' master until a final site sequence is established. This is then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date it. Individual long series which are not included in the site mean(s) are also compared with the database to see if they can be dated.

The dates thus obtained represent the time of formation of the measured rings in each sample. These dates require interpretation for the construction date of the phase under investigation to be determined. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. The sapwood estimates used here are based on those proposed for this area by Miles (1997), in which 95% of oaks contain 9–41 rings. Where complete sapwood or bark is present, the exact date of tree felling may be determined.

The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the building. However, evidence suggests that, except in the reuse of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

Results and Discussion

All timbers sampled were of oak (*Quercus* spp). The locations of the samples are shown in Table 1, along with other information about the cores, and illustrated in Figures 2–4, except **COW06** which cannot be readily illustrated on the available drawings. Whilst there was no immediate evidence that the roof timbers were reused, as had been suggested in the brief, any timbers that looked as if they may have had sufficient rings for dating were sampled. In fact, many cores revealed that few timbers had sufficient rings, though this was difficult to determine prior to coring. Although timbers with 50 or more rings were sought, two with less than this number were actually measured as these sometimes can match other longer series from the same site. Timber **COW08** was sampled twice in order to get the complete sapwood present on the timber, the outer rings of which broke off from the first core.

Table 1: Details of oak (*Quercus* spp.) samples from Conduit House, Cowdray

Sample Number	Timber and position	No of rings	Mean width (mm)	Mean sens	Sapwood complement
COW01	Purlin in bay 4	<40	NM	-	H/S
COW02	Purlin in bay 5	52 + 10NM	2.43	0.34	H/S
COW03	Purlin in bay 6	56	2.40	0.34	3
COW04	Principal rafter 7	44	2.64	0.18	H/S
COW05	Main beam	66	1.58	0.19	H/S
COW06	West beam of roof base	87	2.10	0.18	2
COW07	Purlin in bay 1	74	2.54	0.36	H/S
cow08a		*55*	*2.01*	*0.27*	*13*
cow08b		*42*	*2.12*	*0.20*	*14?C*
COW08	Rafter nailed to east side of principal rafter 6	56	2.08	0.24	14?C
COW09	Beam at first floor level	77 + 22NM	1.77	0.15	H/S
COW10	Lintel over window in kitchen	<40	NM	-	-

H/S = heartwood/sapwood boundary
NM = not measured

Four samples from roof timbers match each other quite well (Table 2, Fig 5) and could be from the same tree. This is based on their plots rather than the statistical results. These series have a number of sudden growth changes and are very sensitive (ie have high year-to-year variation in ring width). It is likely that all four actually come from the same tree, and that this tree may well have been managed during its lifetime. These four series were combined into a single 89-year series, **COW2738**.

Two other series, **COW05** and **COW09**, from first-floor beams, matched each other (t = 8.6 with 66 years overlap), and these too were combined to make a single series, **COW59m**. None of the other series cross-matched, and **COW2738** and **COW59m** did not cross-match each other.

Each series was then compared to reference chronologies, but none could be dated. No relative or absolute dating evidence was produced for either construction or re-roofing, but given the nature of the material this is perhaps not surprising. Dating potential was probably adversely affected by a combination of factors: all the material was fairly marginal with respect to the number of rings present; there were some very sensitive erratic growth patterns; and potentially more than one phase was represented by the very few timbers suitable for sampling.

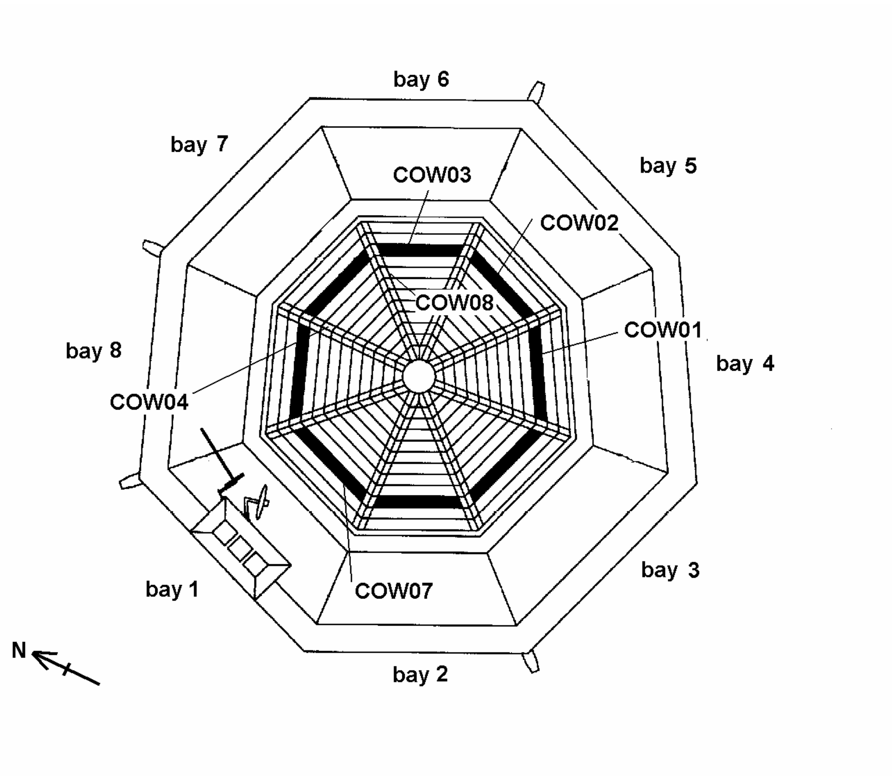

Figure 2: Plan of the roof showing the approximate positions of the samples taken for dendrochronology. Based on a drawing by Martin Ashley Associates

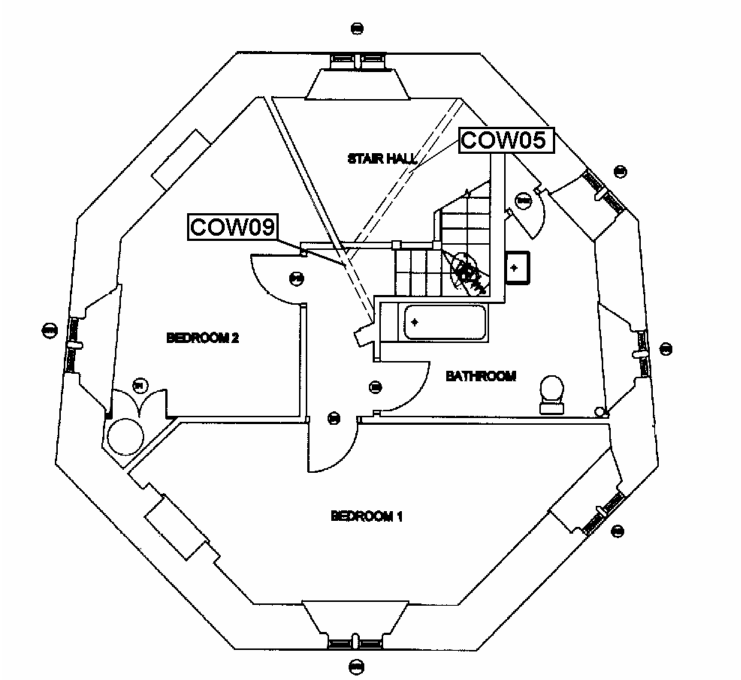

Figure 3: First floor plan showing two timbers sampled for dendrochronology. Based on a drawing by Martin Ashley Associates

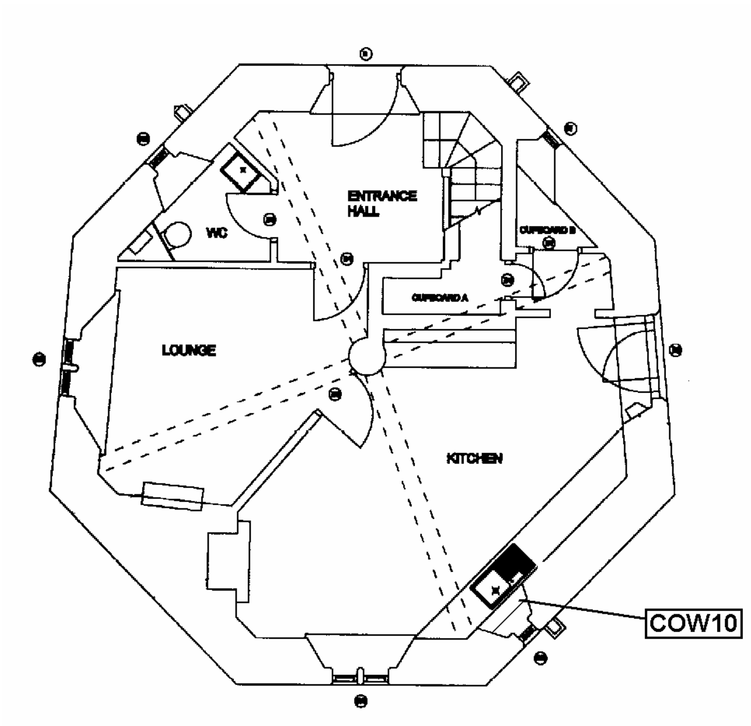

Figure 4: Ground floor plan showing the location of sample COW10. Based on a drawing by Martin Ashley Associates

Table 2: Cross-matching between series from Conduit House, Cowdray

	***t* - value**		
	COW03	**COW07**	**COW08**
COW02	8.3	12.0	6.6
COW03		8.5	6.2
COW07			5.6

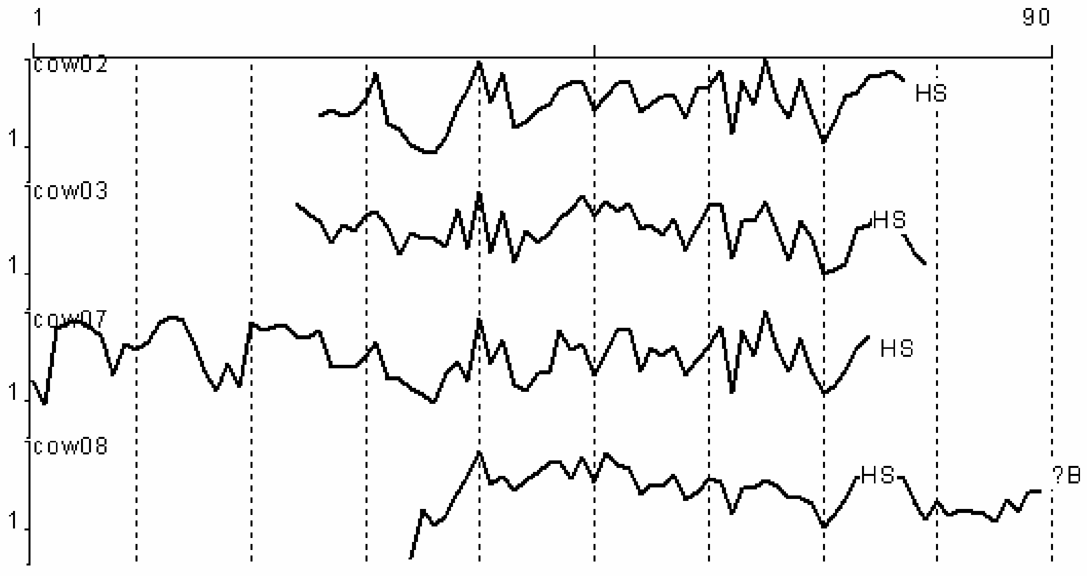

Figure 5: Plot of the four cross-matched series **COW 02, 03, 07,** and **08** showing their similarities in growth change. Ring-width is plotted on the y-axis, using a logarithmic scale. The 1 on the scale is 1mm. The vertical dotted lines are decadal and merely used to make visual assessment of the similarities easier

Acknowledgements

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