Ancient Monuments Laboratory
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TREE-RING ANALYSIS OF A TIMBER FROM PORTLAND CASTLE, CASTLETON, DORSET

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Summary

This investigation was somewhat unusual in that the request was to date a single timber. The beam in the Great Hall was thought to date to the original construction of the castle, known to have taken place during the reign of Henry VIII, around AD 1538 - 40. Two cores were taken from the beam. The heartwood-sapwood boundary was evident on both cores, and the most likely felling date range for the timber was found to be AD 1503 - 35. This shows that the beam in the Great Hall is almost certainly original, and that it may possibly have been cut a few years before being used. Analysis of further timbers from this site may allow clarification of this interpretation.

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Introduction

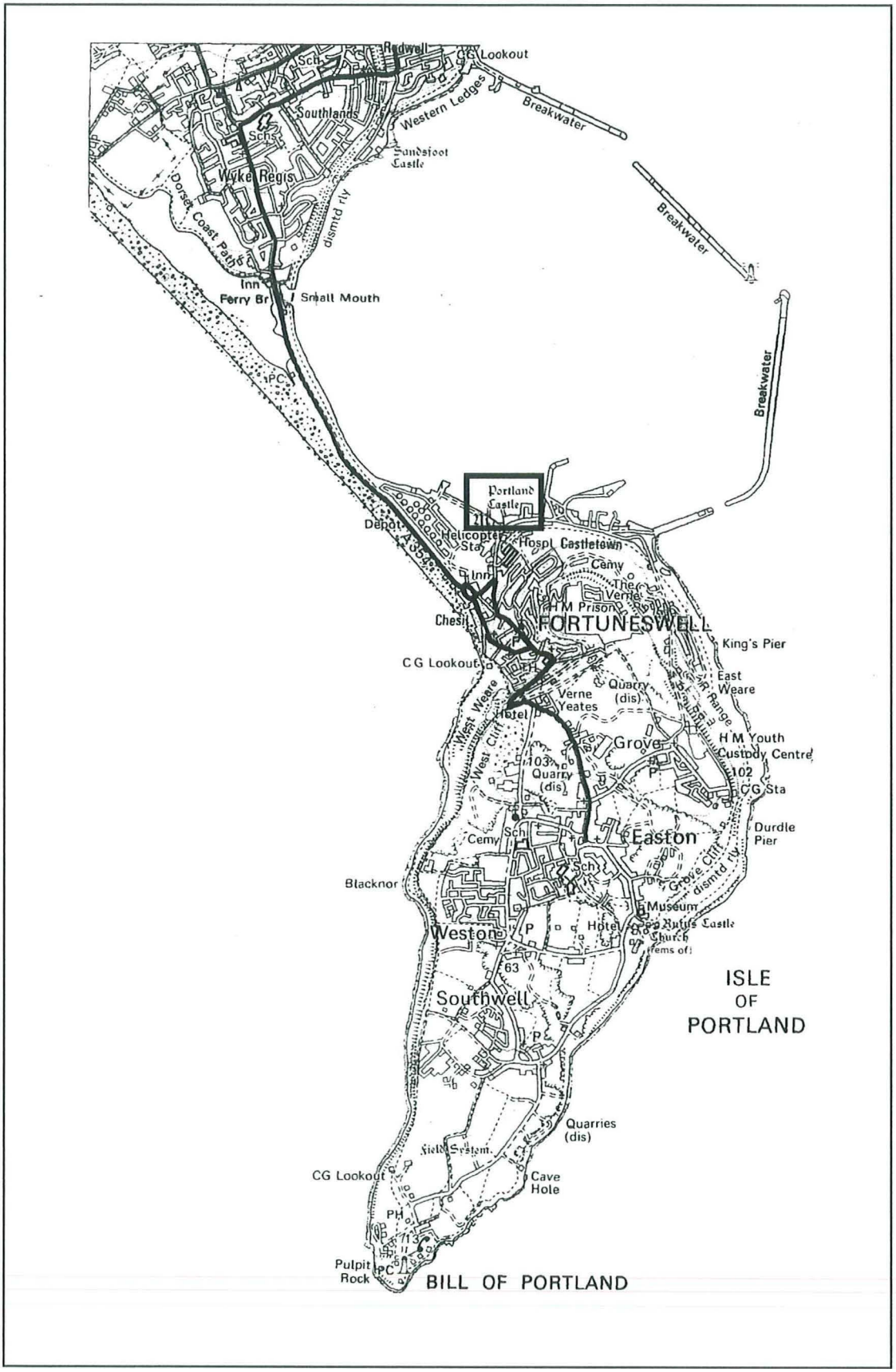
Portland Castle (NGR SY684743; Fig 1) was built as a coastal fort in the reign of Henry VIII, around AD 1538-40. It has a circular keep enclosing an octagonal hall to which access is gained via cornered passageways. The upper floor of the hall is carried on heavy joists and beams, but there is some confusion as to whether or not these are original. There are also a number of sub-divisions of the hall, separated by timber and plaster partitions. The building is a scheduled monument in the care of English Heritage and dating of the main beam supporting the upper floor of the hall was requested as part of a wider study of the site being undertaken during extensive repair work. The brief for this study was specific, sampling being restricted to the main beam only.

Methodology

The site was visited in March AD 2000, when the timber under consideration was assessed for its potential use in dendrochronological study. The beam was thought to contain sufficient rings to be of use, and traces of sapwood could be seen along parts of its length. It was therefore cored using a 15mm auger attached to an electric drill. Cores were taken from two places along the beam, both on the heartwood-sapwood boundary. The cores were glued to a wooden lath, labelled, and stored for subsequent analysis. They were prepared for measuring by sanding using an electric belt-sander with progressively finer grit papers down to 400 grit. The tree-ring sequences were measured to an accuracy of 0.01 mm using a specially constructed system utilizing a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC. The software used in measuring and subsequent analysis was written by Ian Tyers (1999).

The ring sequences were plotted to allow visual comparisons to be made between them and with other sequences on a light table. This activity also acts as a measure of quality control in identifying possible errors in the measurements. Statistical comparisons were made using Student's *t*-test (Baillie and Pilcher 1973; Munro 1984). The *t*-values quoted below were derived from the original CROS program (Baillie and Pilcher 1973). Those *t*-values in excess of 3.5 are taken to be indicative of acceptable matching positions provided that they are supported by satisfactory visual matches, and give consistent matching positions. Crossmatching positions were found between the sample sequences which were then combined to form a single site sequence. Comparisons were made with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date the site sequence.

The dates thus obtained represent the time of formation of the rings available on the sample. Interpretation of these dates then has to be undertaken to relate these findings to the construction date of the phase under investigation. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. In this instance, the sapwood estimates are based on those proposed for this area by Miles (1997), in which 95% of samples are likely



to have from 9 to 41 sapwood rings. Where bark is present on the sample the exact date of felling of the tree used may be determined, although that was not the case here.

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

Results

The timber sampled was of oak (*Quercus* spp.). Details of the samples are given in Table 1. The first core had a break in it, and was measured in two sections (PORTLDa1 and PORTLDa2), the second core (PORTLDb1) had a continuous sequence to the heartwood-sapwood boundary. Sequences PORTLDb1 and PORTLDa1 overlap with a *t*-value of 5.6 (78 years) and sequence PORTLDa2 (29 years) was successfully visually matched (Figure 2) against PORTLDb1, showing that only a few years were lost in the break. The relative positions of overlap of all three sequences are represented in Figure 3, along with the interpreted felling date range.

The three sequences were combined into a single series (PORTLDMN) of 118 years, which was subsequently dated against a range of regional and site chronologies (Table 2). Those chronologies above the darker line in the table are composite regional chronologies, those below this division being site chronologies, some of which may be components of the regional chronologies. The ring-width data for this combined series is presented in Table 3.

Table 1: Oak (*Quercus* spp.) series from the beam in the Great Hall of Portland Castle.

h/s = heartwood-sapwood boundary

Sample number	Total no of years	Average growth rate (mm yr^{-1})	Sapwood details	Date of sequence AD	Felling date of timber AD
PORTLDa1	78	1.61	-	1386 – 1463	1503 - 35
PORTLDa2	29	0.93	h/s	1466 - 94	1503 - 35
PORTLDb1	118	1.50	h/s	1377 - 1494	1503 - 35

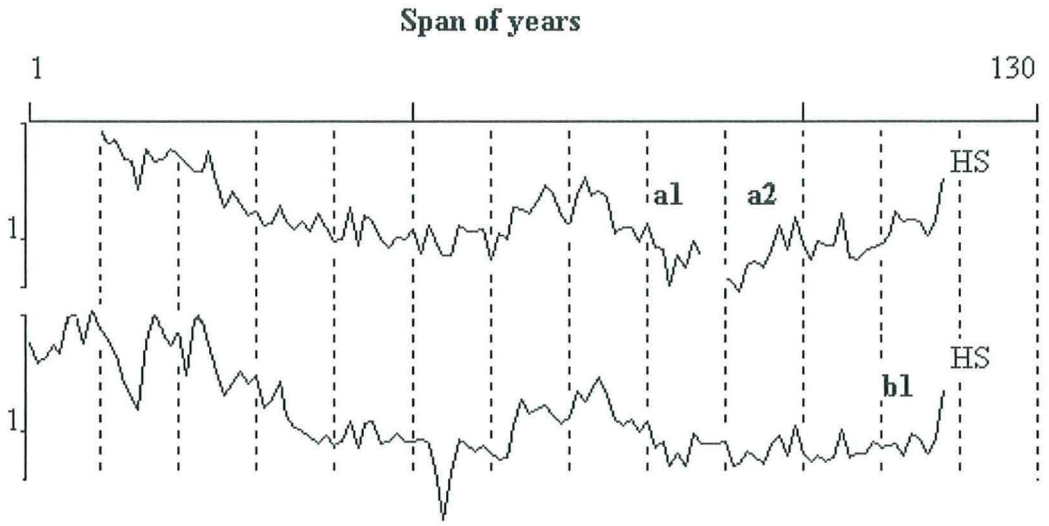


Figure 2: Plots of the ring-width against time for the three series from the two cores from Portland Castle, showing their relative positions of overlap

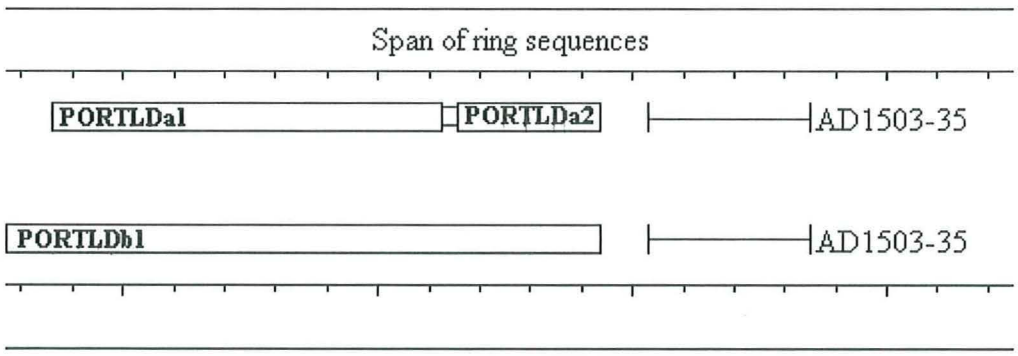


Figure 3: Bar diagram showing the relative positions of overlap of the two Portland Castle cores with the likely felling dates

Table 2: Dating of the oak sequence PORTLDMN

	PORTLDMN AD 1377 - 1494	
Dated reference or site master chronology	*t*-value	Overlap (yrs)
FEB2000 (Bridge unpubl)	6.1	118
London1175 (Tyers pers comm)	6.0	118
Hants97 (Miles pers comm)	5.3	118
Southern England (Bridge 1988)	4.0	118
Castlebridge, Hampshire (Miles and Worthington 1997)	6.1	118
Mary Rose 'original' (Bridge and Dobbs 1996)	6.1	118
Ford, West Sussex (Bridge forthcoming)	5.4	118
Mary Rose 'refit' (Bridge and Dobbs 1996)	5.2	118
Windsor Castle kitchen (Hillam and Groves 1996)	4.9	118
Sutton House, London (Tyers and Hibberd 1993)	4.9	118
Mottisfont Abbey, Hampshire (Miles 1996)	4.7	118
Acton, Somerset (Haddon-Reece and Miles 1994)	4.7	118
Eastbury, Essex (Tyers 1997)	4.6	118
George Hotel, Odiham, Hampshire (Miles and Haddon-Reece 1995)	4.6	111

Interpretation and Discussion

Although only a single timber was looked at, the series which resulted dated against a range of oak chronologies from across southern England. Adding the accepted normal sapwood number range for this region proposed by Miles (1997) to cover 95% of oaks gives a felling date range for this single tree of AD 1503-35. It is thought that the castle was built between AD 1538-40. The timber may have come from a tree that had a few more sapwood rings than 95% of oaks in the region, or it may have been felled some years before being used in the castle. Closer examination of the timber may reveal whether distortion of the timber on drying has taken place after it had been shaped and fitted into its present location, although this was not apparent at the time of sampling.

The main question behind the request for the dating reported here has been answered, ie that the timber supporting the floor in the octagonal hall is almost certainly original to the building. It should be noted that the floor is also composed of a number of joists and covered in wide floorboards, all of which may also be of mid sixteenth-century origin. The partition walls also contain pegged timber frames with carpenters' marks that are of uncertain age. These were

looked at briefly and were considered to be potentially useful for dendrochronological study in the future, but were beyond the specific brief for this study. There remains therefore the potential for more dendrochronological study of the timbers at this site, which may also assist in interpreting its complex building history, and clarifying the apparently slightly early date found for the single timber investigated.

Acknowledgements

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Table 3: Ring-width data for sequence PORTLDMN

Year	ring widths (0.01mm)										number of samples									
AD1377							324	247	271	322								1	1	1	1
	283	464	476	324	518	419	355	325	244	223	1	1	1	1	1	2	2	2	2	2
	166	339	385	335	329	348	244	349	346	326	2	2	2	2	2	2	2	2	2	2
AD1401	221	157	191	193	165	180	129	138	177	125	2	2	2	2	2	2	2	2	2	2
	109	114	102	113	105	88	93	134	86	124	2	2	2	2	2	2	2	2	2	2
	121	93	88	98	92	100	85	103	79	55	2	2	2	2	2	2	2	2	2	2
	68	106	95	93	97	75	87	85	130	150	2	2	2	2	2	2	2	2	2	2
	134	149	173	153	125	120	178	190	176	198	2	2	2	2	2	2	2	2	2	2
AD1451	168	113	111	116	97	118	84	86	58	76	2	2	2	2	2	2	2	2	2	2
	65	96	82	83	83	71	56	54	70	69	2	2	2	1	1	2	2	2	2	2
	63	82	102	75	115	80	68	79	75	76	2	2	2	2	2	2	2	2	2	2
	117	71	72	76	84	82	90	109	95	108	2	2	2	2	2	2	2	2	2	2
	104	86	105	194							2	2	2	2						