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TREE-RING ANALYSIS OF ROMAN PILES FROM PEVENSEY CASTLE, EAST SUSSEX

Ian Tyers

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Summary

Dendrochronological analysis of a group of waterlogged Roman piles excavated at Pevensey Castle, East Sussex, has resulted in the production of a chronology dating from AD 131-270 inclusive. The timbers appear to have been felled between *c* AD 280 and *c* AD 300, although precise felling dates are not obtainable due to the condition of the surviving timbers. The result illuminates aspects of the site phasing and provides the first tree-ring dated evidence relating to installations from the 'Saxon Shore'.

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Introduction

The purpose of the study was to carry out dendrochronological analyses of a group of waterlogged Roman piles excavated in 1994 from beneath the east wall of the Roman fort within Pevensey Castle. Eight piles were exposed, with a further 6 visible in the sections of the trench. The piles, *c* 0.6 - 0.8m in length, were in rows aligned at right angles to the line of the wall and set at intervals of *c* 0.25m (see section Figure1).

Pevensey Castle, near Eastbourne, East Sussex (TQ645048) is generally thought to be one of the fortresses described by the *Notitia Dignitatum* under the command of the *Comes Litoris Saxonici*. This group of installations covering the coastline of Hampshire, Sussex, Kent, Essex, Suffolk and Norfolk in England, as well as sites on the continental coast, is generally known as the 'Saxon Shore'. The surviving *Notitia* are copies, at several generations removed, from an early fifth century original (Hassall 1977). The documentary information therefore provides little evidence for the date of the instigation of this presumed defensive system. It is unknown whether new forts were built as part of the scheme or if older installations were placed under a different command structure. It has been thought that the forts were built at a number of different periods, mostly due to differences in layout. Pevensey, for example, does not have the standard layout of many Roman forts, but this may be due to topographical factors. Hitherto, the dating of the various fort sites has been reliant upon typological and finds evidence. The scanty recovery of datable finds and the lack of secure context for many of the earlier excavations have resulted in widely varying views. Modern opinion regards many of the forts as mid-third century in date, although some appear to be fourth century. The material reported here therefore represents the first dates independent of pottery typologies and coin evidence available from a 'Saxon Shore' fort.

The previously accepted date for the Pevensey shore fort has depended upon a coin, dated AD 330-5, found in a void formed by the rotting of a timber baulk (Bushe-Fox 1932, 67), although there is some dispute over the precise provenance of this coin. The fort is often regarded as typologically later than other shore forts due to its oval plan. The pottery assemblages from the earlier excavations have been used to suggest a variety of dates for occupation on the site (Johnson 1976; Fulford 1994).

Methodology

The eight available samples were placed in a deep-freeze until they were solid. Once frozen the surfaces were cleaned using surforms and scalpels. After the samples had thawed, the ring sequence from each sample was assessed for its suitability for dendrochronological analysis. Unsuitable samples are usually those with either unclear ring sequences or fewer than 50 rings, or timbers from non-oak trees (at least for the provision of routine dates).

The complete sequence of growth rings in the samples that were selected for dating purposes were measured to an accuracy of 0.01mm using a micro-computer based travelling stage. The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition cross-correlation algorithms (Baillie and Pilcher 1973; Munro 1984) were employed to search for positions where the ring sequences were highly correlated. These positions were checked using the graphs and, where these were satisfactory, new mean sequences were constructed from the synchronised sequences. The *t*-values reported below are derived from the original CROS algorithm (Baillie and Pilcher 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative or absolute position must be obtained from a range of independent sequences, and that these positions are supported by satisfactory visual matching.

All the measured sequences from this assemblage were compared with each other and those that were found to cross-match were combined to form a site master curve. This master curve and the remaining unmatched ring sequences were then tested against a range of reference chronologies, using the same matching criteria: high *t*-values, replicated values against a range of chronologies at the same position, and satisfactory visual matching. Where such positions are found these provide calendar dates for the ring-sequence.

These tree-ring dates can initially only date the rings present in the timber. Their interpretation relies upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem (tpq)* for the felling of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings that may be missing. This *tpq* may be many decades prior to the real felling date. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have been present. Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. The sapwood estimates applied through-out this report are a minimum of 10 and maximum of 55 annual rings, where these figures indicate the 95% confidence limits of the range. These figures are applicable to oaks from the British Isles (Hillam *et al* 1987). The dates obtained by the technique do not by themselves necessarily indicate the date of the structure from which they are derived. It is necessary to incorporate other specialist evidence concerning the re-use of timbers and the repairs of structures before the dendrochronological dates given here can be reliably interpreted as reflecting the construction date of phases within the structure.

Results

All the samples were oak (*Quercus* spp). Six of these timbers proved to be suitable for the technique. Sample **2** had too few rings, and sample **8**, although including enough rings, contained a highly compressed sequence within which individual rings could not be resolved (Table 1).

The six measured sequences were compared with each other and five of these were matched together to form a single sequence (Figure 2). All the material exhibited marked bands of slower growth. Hence, although the quality of matches between these samples is very good (Table 2), they do not necessarily indicate that they are derived from the same tree. It is likely however that they are derived from a single woodland area. This sequence was found to match to an extensive range of chronologies (Table 3), and is dated AD 131-270. The remaining measured sample has failed to produce a visually and statistically acceptable match and is thus undated by the technique. The site master chronology PEVENSEY, dating from AD 131-270 inclusive is listed in Table 4.

Interpretation

The absence of sapwood on any of the dated samples prevents the production of a precise felling date for the assemblage. Instead estimates of the number of sapwood rings likely to have been lost need to be added to the dates of the last surviving rings.

The last ring present on any dated timber is AD270 on sample 3. The addition of the minimum number of rings likely to have been present on the lost sapwood (10 rings) means that a *tpq* of AD280 can be calculated for the felling of this timber. In addition the outer edge of sample 7 (dated to AD261) is identified as the heartwood/sapwood boundary. This indicates that only sapwood is missing from this sample and thus the minimum and maximum estimated number of missing sapwood rings (10-55) can be added to the end-date of this timber. This indicates felling between AD271 and AD316. The felling date ranges of samples 3 and 7 can be combined since there is no evidence that the timbers are re-used (Allen 1994) and only one phase of construction is present (Fulford 1994). A date of felling for all the timbers between AD280 and AD316 is therefore indicated by samples 3 and 7.

This date range can be further refined because the other three dated samples are all recorded as ending at the possible heartwood/sapwood boundary. This type of record indicates that the last ring present survives around part of the sample circumference, as would be expected for the true boundary, but that it was impossible to eliminate other factors such as post-depositional decay that could have created the same type of outer edge although not at the true boundary. The clustering of the end-dates on these samples between AD245 and AD260 may indicate that these are reliable identifications. Applying the number of sapwood rings likely to have been lost (10-55) from these samples suggests a felling dated range of between AD 280 and *c* AD 300 for all samples.

If the material is used green, which appears to be normal Roman practise (Hanson 1982), this interpretation indicates construction on this part of the fortress site between *c* AD 280-300.

Discussion

There is considerable interest in the phasing of the 'Saxon Shore' installations. A full account of the implications of this result is clearly beyond the brief of this report. However, a number of chronologically related points are made below.

A late third century foundation date for Pevensey Castle would imply:

1. the coin evidence hitherto used to provide a date for the fort is suspect,
2. the non-standard layout is not indicative of a late construction,
3. the foundation post-dates the only other dendrochronologically dated defensive installation in southern Britain, the London 'riverside wall' dated to *c* AD 255-AD 270,
4. that although Pevensey is later than the currently accepted dates for many of the 'Saxon Shore' forts, it is not by as much as hitherto thought,
5. the foundation of the fort may relate to the Carausian period, rather than the later events with which it is often associated.

Conclusion

The dendrochronological analysis of waterlogged timbers from foundations at Pevensey Castle produced a tree-ring chronology dated AD 131-270. The timbers were probably felled in the period AD 280-300. This evidence is the first independent dating evidence, i.e. not derived from pottery typologies or coins, from a 'Saxon Shore' fortress for the commencement of construction activities on the site.

Acknowledgements

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Figure 1 South Section, Upper Trench from Pevensey 1994 excavation showing timber piles

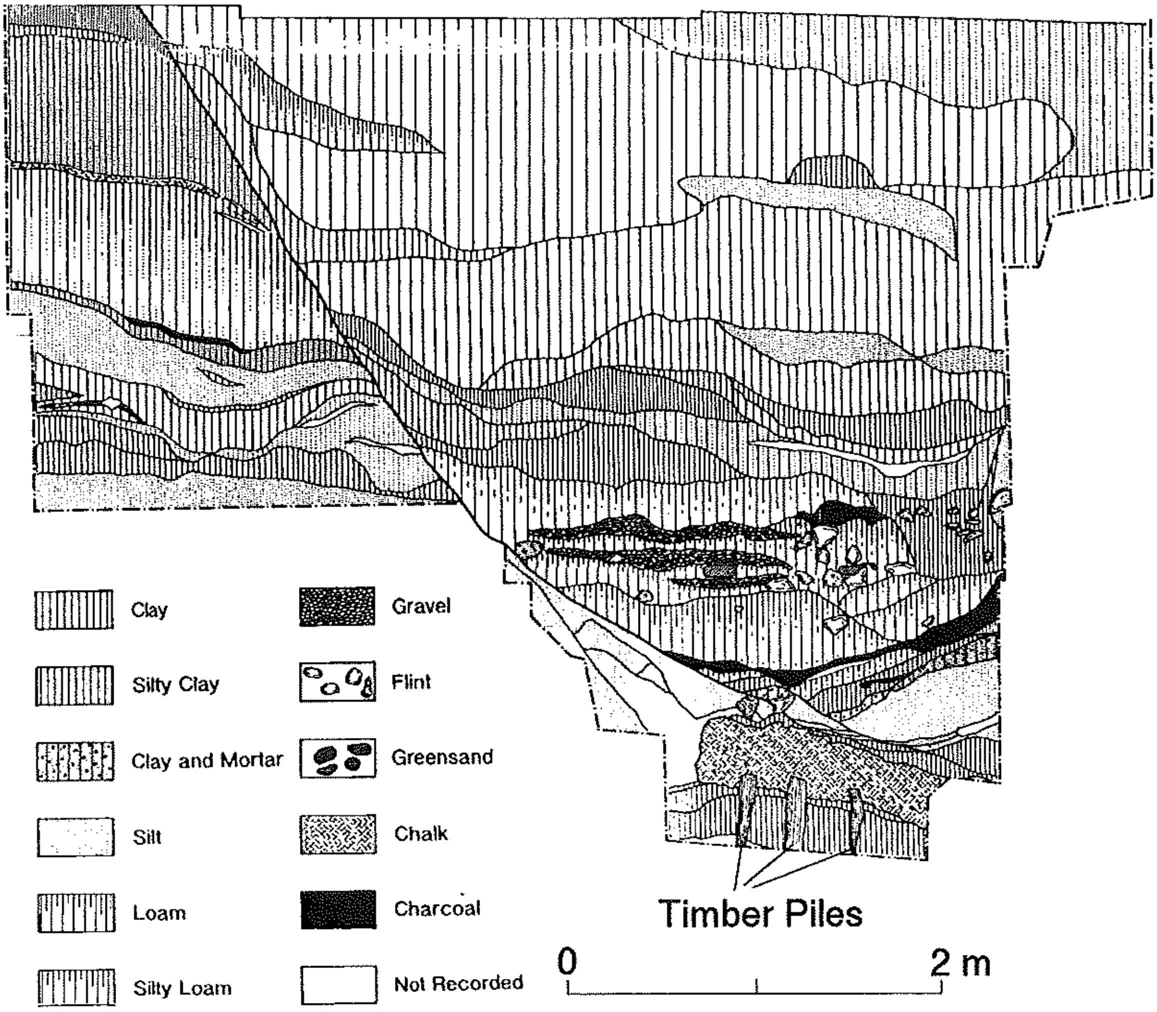


Figure 2. Bar diagram showing the relative positions of the dated ring sequences from Pevensey.

White bars - heartwood rings; HS - heartwood/sapwood boundary

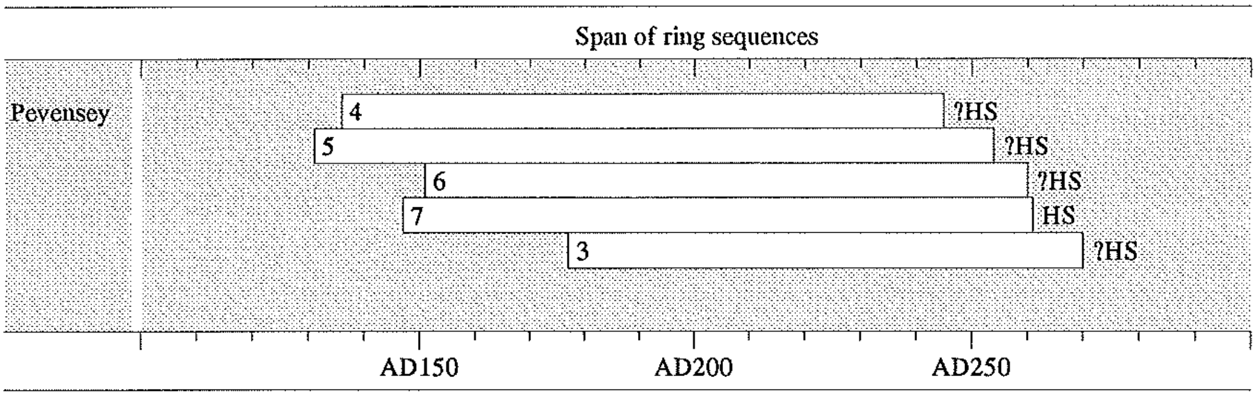


Table 1

Pevensey Castle **East Sussex** **TQ645048**

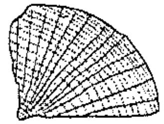
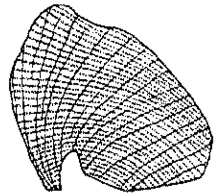
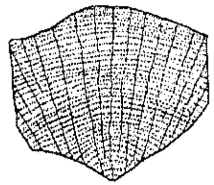
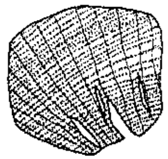
Sample number	Description	Sample type	Species	No of rings	No of sap rings	Dimensions (mm)	Growth-rate (mm/year)	Result	Date of Sequence	Cross-section
1	Pile	slice	*Quercus*	114	0	135 x 110	1.0	undated		
2	Pile	slice	*Quercus*	36	12	110 x 110	1.3	undated		
3	Pile	slice	*Quercus*	94	0	145 x 110	1.2	dated	AD 177-270	
4	Pile	slice	*Quercus*	110	0	140 x 110	0.9	dated	AD 136-245	
5	Pile	slice	*Quercus*	124	0	180 x 150	1.3	dated	AD 131-254	
6	Pile	slice	*Quercus*	110	0	170 x 150	1.3	dated	AD 151-260	
7	Pile	slice	*Quercus*	115	0	110 x 105	1.0	dated	AD 147-261	
8	Pile	slice	*Quercus*					rejected		

Table 2

Correlation between the dated material from Pevensey.

	***t*-values**			
sample	**samples**			
	4	*5*	*6*	*7*
3	5.4	8.4	7.4	6.0
4		11.0	10.2	8.1
5			10.3	9.0
6				6.4

Table 3

Dating of the master curve from Pevensey Castle, AD 131-270. *t*-values with dated reference chronologies. All the reference curves are independent.

Area	**Reference chronology**	***t*-values**
London	Baynards Castle, City of London (Morgan 1980)	5.6
	Billingsgate, City of London (Hillam 1990)	6.2
	County Hall Ship, Lambeth (Tyers 1994a)	4.4
	Guys Hospital, Southwark (Tyers unpubd)	5.7
	Guildhall Yard, City of London (Tyers 1994b)	4.0
	New Fresh Wharf, City of London (Hillam and Morgan 1986)	4.5
	St Peters Hill, City of London (Hillam 1992)	4.3
	Tower of London, Tower Hamlets (Hillam 1983)	4.7
Elsewhere	Magor, Wales (Nayling pers comm 1994)	5.8
	Ireland - Teeshan (Baillie pers comm 1982)	3.9
	Holland (Jansma pers comm 1994)	4.2
	S Germany (Becker 1981)	4.9
	NW Germany (Hollstein 1980)	5.0

Table 4

Ring-width data of the site master curve for oaks from Pevensey Castle, AD 131-270.

year	ring widths (0.01mm).										number of trees per year									
AD 131	242	426	408	393	518	274	275	249	389	301	1	1	1	1	1	2	2	2	2	2
	268	310	286	184	252	148	147	143	111	185	2	2	2	2	2	2	3	3	3	3
AD 151	254	262	274	186	246	179	137	123	127	116	4	4	4	4	4	4	4	4	4	4
	179	173	177	165	142	100	153	165	151	109	4	4	4	4	4	4	4	4	4	4
	182	139	132	173	153	174	118	155	113	87	4	4	4	4	4	4	5	5	5	5
	71	67	70	67	76	64	84	110	151	191	5	5	5	5	5	5	5	5	5	5
	140	70	69	71	86	118	121	75	68	66	5	5	5	5	5	5	5	5	5	5
AD 201	84	73	78	61	84	81	72	67	82	92	5	5	5	5	5	5	5	5	5	5
	58	75	67	59	92	62	65	85	92	93	5	5	5	5	5	5	5	5	5	5
	79	80	66	71	51	50	52	42	59	148	5	5	5	5	5	5	5	5	5	5
	116	82	87	104	95	61	48	67	79	82	5	5	5	5	5	5	5	5	5	5
	85	85	85	69	57	63	65	68	118	101	5	5	5	5	5	4	4	4	4	4
AD 251	64	76	99	104	120	106	105	94	104	121	4	4	4	4	3	3	3	3	3	3
	163	193	243	211	169	174	181	224	260	201	2	1	1	1	1	1	1	1	1	1