939

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Summary

The tree-ring analysis of ten oak timbers from two Roman wells are described. No date was obtained for the six timbers from well II, but those from well I were felled after AD100. A tree-ring chronology for the period 112BC-AD90 was produced, although this is probably based on only one tree.

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TREE-RING ANALYSIS OF WELL TIMBERS FROM SNETTISHAM BYPASS, NORFOLK

Excavations at Snettisham Bypass (TF 67703296) by Norfolk Archaeological Unit revealed the remains of two timber-lined wells. The oak timbers (*Quercus* spp) were sampled for tree-ring analysis with the aim of providing precise dates for the construction of the two wells.

Methods

The samples were prepared by freezing them for at least 48 hours and then cleaning their cross-sections with a surform plane. The ring widths of those samples with more than 50 rings were measured on a travelling stage connected to an Apple II microcomputer (Hillam 1985, Fig 4). (Ring patterns with less than 50 rings are unlikely to be unique and might not produce reliable dates - see Hillam et *al* 1987 for further details.) The ring sequences were plotted as graphs using a graphing program on the Prime mainframe (Okasha 1987). The graphs were then compared with each other on a light box to check for any similarities between the ring patterns which might indicate contemporaneity. For crossmatching purposes, the ring width data were also transferred to an Atari ST microcomputer with hard disk. The tree-ring software for the Atari was written and developed by Ian Tyers (pers comm 1990). The crossmatching routines are based on the Belfast CROS program (Baillie & Pilcher 1973; Munro 1984), and all the *t* values quoted in this report are identical to those produced by the first CROS program (Baillie & Pilcher 1973). Generally *t* values of 3.5 or above indicate 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 site or structure, combining the matching sequences into a site master, and then testing that master for similarity against dated reference chronologies. A site master is used for dating whenever possible because it enhances the general climatic signal at the expense of the background noise from the growth characteristics of the individual samples. Any unmatched sequences are tested individually against the reference chronologies.

If a sample has bark or bark edge, the date of the last measured ring is the year in which the tree was felled. A complete outer ring indicates that the tree was felled during its dormant period in winter or early spring. This is referred to as "winter felled". If the ring is incomplete, felling took place during the growing season in late spring or summer (referred to as "summer felled"). In the absence of bark edge, felling dates are calculated using the sapwood estimate of 10-55 rings. This is the range of the 95% confidence limits for the number of sapwood rings in British oak trees over 30 years old (Hillam *et al* 1987). Where sapwood is absent, felling dates are given as *termini post quem* by adding 10 years, the minimum number of missing sapwood rings, to the date of the last measured heartwood ring. The actual felling date could be much later depending on how many heartwood rings have been removed.

At this stage of the study, factors such as reuse, stockpiling, or repairs have also to be taken into account. Thus whilst the tree-ring dates for the measured rings are precise and independent, the interpretation of these dates often requires other archaeological evidence.

Results

Well I

The timbers from well I were radially split oak timbers (Table 1). <u>660</u> was very knotty and only the outer 63 rings could be measured; <u>661</u> contained 65 wide rings with an average ring width of 4.6mm, and <u>663</u> and <u>664</u> contained 202 and 159 rings respectively. None of the timbers had sapwood.

The ring patterns of 663 and 664 were almost identical (t = 12.8) suggesting that the timbers were split from the same tree. The tree must have been over 250 years old when felled with a diameter of at least 0.7m. The tree from which 661 was felled may have been similar in size but, because it was fast-grown, would have been much younger.

The ring widths of 663 and 664 were averaged to produce a master sequence of 202 years (Table 2). The master did not appear to match 660 or 661. When it was tested against dated reference chronologies, it gave several t values over 3.5 when it spanned the period 112BC-AD90 (Table 3). This matching position was confirmed by visual comparison of the graphs.

A precise felling date cannot be given because of the absence of sapwood. It is unlikely to have been felled before AD100 and, if no heartwood rings were lost when the sapwood was removed, the tree would probably have been felled before AD145.

Well II

The timbers from well II were completely different to those from well I. 702-705 were tangentially split timbers cut from the outside of the same oak tree (Table 1). (The same ring pattern could be traced from sample to sample even before the rings were measured). The samples had 21-34 rings which gave a single sequence of 43 rings when they were combined together in their matching positions. The 43-year sequence did not match that from well I, nor did it match with dated reference chronologies.

692 and 693 were planks shaped from very poor quality timber. 692 was rejected because its ring sequence was obscured by knots; 693 had only 30 rings and was also rejected.

Discussion

The results from the well I timbers give a *terminus post quem* of AD100 for the construction of the well, and the 202-year chronology provides a new reference curve for the Roman period. It is a useful addition, even if it is probably based on only one tree, because Roman dendrochronology is dominated by chronologies from London.

No dating was obtained for the timbers from well II nor is the 43-year ring sequence likely to date in the future. A ring sequence of 43 years is insufficiently unique for reliable dating.

The timbers from the two wells are very different to each other. Those of well I are radially split timbers which probably utilised most of an oak trunk whilst the well II timbers were tangentially split from the outside of a trunk leaving a square core for other purposes. There is no way of estimating the size or age of the tree used for well II.

The timbers were of poor to moderate quality especially compared to timbers used in some Saxon wells, such as those at Slough House Farm near Maldon in Essex (Hillam 1990) or Hamwic in Southampton (Hillam 1984a).

Conclusions

Although no date was obtained for well II, tree-ring analysis indicated that the well I timbers were felled after AD100. The study also produced a new Roman reference chronology for the period 112BC-AD90.

Acknowledgements

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Table 1: Details of the tree-ring samples. Sketches are not to scale; sapwood on the sketches is represented by shading.

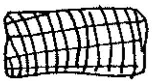
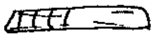
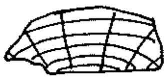
sample	total no of rings	sapwood rings	average ring width (mm)	sketch	dimensions (mm)	comments
WELL I						
660	63	-	1.6		235x90	knotty
661	65	-	4.6		315x65	
663	202	-	1.4		300x110	
664	159	-	1.9		315x70	
WELL II						
692	-	-	-		175x20	knotty; rejected
693	30	-	4.7		150x15	rejected
702	21	-	5.3		360x115	
703	34	11	4.2		425x120	
704	32	-	4.7		435x135	
705	30	-	5.0		310x150	

Table 2: The Snettisham master chronology, 112BC-AD90. Although data from two samples are included, they are probably from the same tree.

date	ring widths (0.02mm)										no of samples									
112BC									241	240									1	1
	239	185	173	132	76	113	146	183	196	150	1	1	1	1	1	1	1	1	1	1
100BC	133	141	58	66	43	82	73	65	53	48	1	1	1	1	1	1	1	1	1	1
	73	45	43	47	97	95	105	138	81	66	1	1	1	1	1	1	1	1	1	1
	30	37	66	69	127	104	124	101	149	103	1	1	1	1	1	1	1	1	1	2
	107	61	83	111	78	112	93	78	64	45	2	2	2	2	2	2	2	2	2	2
	58	49	121	113	157	115	70	70	51	70	2	2	2	2	2	2	2	2	2	2
50BC	126	96	98	111	72	68	60	43	28	40	2	2	2	2	2	2	2	2	2	2
	77	79	107	77	87	76	103	87	37	107	2	2	2	2	2	2	2	2	2	2
	99	65	53	110	157	166	82	45	127	150	2	2	2	2	2	2	2	2	2	2
	92	79	98	66	70	68	121	104	85	75	2	2	2	2	2	2	2	2	2	2
	59	116	93	91	82	87	80	50	66	131	2	2	2	2	2	2	2	2	2	2
AD1	85	118	105	86	107	95	73	44	61	114	2	2	2	2	2	2	2	2	2	2
	121	95	64	28	35	45	101	115	78	73	2	2	2	2	2	2	2	2	2	2
	100	141	44	61	85	34	117	102	112	92	2	2	2	2	2	2	2	2	2	2
	85	67	62	39	41	54	105	162	100	68	2	2	2	2	2	2	2	2	2	2
	98	56	53	63	113	70	74	106	82	80	2	2	2	2	2	2	2	2	2	2
AD51	47	46	69	88	82	79	28	37	40	73	2	2	2	2	2	2	2	2	2	2
	72	70	70	105	107	67	50	37	42	46	2	2	2	2	2	2	2	2	2	2
	36	50	45	34	39	77	73	57	40	37	2	2	2	2	2	2	2	2	2	2
	37	43	25	30	32	45	58	52	31	39	2	2	2	2	2	2	2	2	1	1

Table 3: Dating the Snettisham chronology. t values with dated reference chronologies. SDL - Sheffield Dendrochronolgy Laboratory unpublished data.

chronology	t value
Droitwich, Upwich 1 (Groves & Hillam 1990)	4.4
London - Calverts (Tyers pers comm)	5.4
- Miles Lane (SDL)	4.9
- Peninsular House (SDL)	3.9
- Southwark (Tyers pers comm)	3.9
- Thames Street Tunnel (SDL)	4.4
- Triangle (SDL)	4.7
Mancetter (Hillam 1984b)	4.0
York, Bishophill (SDL)	4.4