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TITLE Tree-Ring analysis of a timber-lined well from Canterbury

Tree-ring analysis of a timber-lined well from Canterbury

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In 1977, excavation at the Rosemary Lane Car Park site uncovered the remains of a timber-lined Roman well. Sections were removed from four of the stout oak boards and sent to Sheffield for tree-ring analysis. The work was funded by the Department of the Environment.

Dendrochronology can be a very precise method of dating, which makes use of the annual rings of a tree. A new ring is produced each year and its width is controlled by such factors as climate and soil type. Thus, trees growing simultaneously, under the same ecological conditions, will show similar patterns of wide and narrow rings. A tree-ring chronology is constructed by overlapping series of matching ring patterns from the present day back in time so that each ring is equivalent to a calender year. Alternatively, if the sequence is not linked to the present, it is known as a floating chronology. Although it is not absolutely dated, this can be useful in providing relative dating for a site.

In the British Isles, oak is generally used for tree-ring dating. Apart from being the timber found most frequently in medieval buildings or waterlogged archaeological sites, its wood has well defined rings which are relatively easy to measure under a low power binocular microscope. There are none of the problems associated with double or missing rings which often occur in some other species e.g. some conifers or alder. Furthermore, there are now available many reference chronologies for oak from different parts of the country. Several floating sequences exist for the Roman period. Once these have been crossmatched with the absolutely dated German curve for the area west of the Rhine (e.g. Hollstein, 1974), then it will be possible to date timber of this age very accurately.

Results

The samples were sawn into sections of 5-10 cms. thickness for easier handling. They were deep-frozen to harden the soft waterlogged timber. The cross-sections were cleaned with a surform plane to give a smooth surface on which each annual ring was easily visible. Sample A' had only 32 rings and was not included for measurement. Timber with less than 50 rings is generally rejected as it cannot be dated with confidence; ideally at least 80 rings are preferred.

The rings were measured on a travelling stage which was connected, via a linear transducer, to a digital voltmeter. The width was flashed up on the screen of the voltmeter after each ring had been traversed, so that it could be recorded. The ring widths, in 0.1 mms, were plotted against time, in years, on transparent semi-logarithmic recorder paper. Each board consisted of two or three sections, all of which were measured. Mean curves A, B, C and D were made by averaging the data of the individual samples for the four boards (Table 1). When the graphs of Means A, B, C and D were compared by sliding one graph over another, they were all found to match; their relative positions are given in Figure 1. The level of correlation was so high that it was not felt necessary to check the matches by use of the computer. The boards may have derived from the one tree and reference to the sketches in Table 1 indicates that numerous timbers could be obtained from a single tree. A site master with 92 rings was constructed by averaging the widths of Means A, B, C and D; the resulting ring widths are given in Table 2. The first part of the site mean was rather complacent, showing little variation in width, whilst the second part tended to be narrow-ringed and sensitive, with marked changes in width from year to year (Figure 2).

The master was compared with many of the Roman tree-ring chronologies, making use of the Belfast crossdating computer

program (Baillie and Pilcher,1973). This calculates the value of Student's 't' for each position of overlap between two sets of data. A value of greater than 3.5 is statistically significant, although not always acceptable. A crossmatch which gave a t-value of e.g. 7.5 would, however,be a very good match. All computer matches are checked by visual comparison for confirmation. The only Roman chronology to give a high t-value with Canterbury was that from the London Waterfront (Morgan and Schofield,1978). The t-value was 4.79 and the visual match, shown in Figure 2, was found to be acceptable. It will be noticed that the earlier complacent rings do not correlate as well as the later ones, as would be expected. The London curve is dated by four radiocarbon results (HAR-1864, HAR-1865, HAR-1867, HAR-1868) to c. AD 1-300 (Figure 1). This gives a date for the last measured ring of approximately AD 210.

None of the samples had their sapwood preserved. This is the outer portion of wood, softer and lighter in colour than the inner heartwood, which performs the living functions of an oak tree; the heartwood serves solely as a strengthening agent. The presence of sapwood is valuable in estimating a fairly accurate felling date since the number of its rings are relatively constant. The total number has been calculated as 32 $\pm$9 years for a mature oak, where $\pm$9 represents one S.D. from the mean (Baillie,1973). Even if only the heartwood-sapwood transition remains, an estimation of the date of felling can be obtained. However, its softer texture makes it subject to decay and it is frequently absent from waterlogged samples. In such a case, the earliest possible felling date must be calculated i.e assuming that no heartwood was removed during the working of the timber. Figure 1 shows the position of the estimated felling dates for each of the four timbers. It will be seen that they are roughly contemporary, suggesting that little heartwood was lost in trimming the wood. This gives a felling date of c. AD 250. As it is unlikely that the timber was seasoned for

any length of time (Hollstein,1965), this can be taken as the construction date of the well. However, this date is based on radiocarbon dating and so must be regarded as approximate. Only when the London curve is firmly dated by the German chronology will it be possible to give a more exact date for the well.

References

Baillie M.G.L. 1973, A recently developed Irish tree-ring chronology. Tree Ring Bulletin 33 15-28.

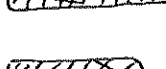
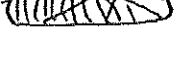
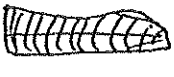
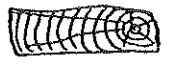
Baillie M.G.L. and Pilcher J.R. 1973, A simple crossdating program for tree-ring research. Tree Ring Bulletin 33 7-14.

Hollstein E. 1965, Dendrochronologie Datierung von Eichenhölzern ohne Waldkante. Bonner Jahrbuch 165 12-27.

Hollstein E. 1974, Eine Romische Deichel aus Dillingen, Kreis Saarlouis. Bericht der Staatlichen Denkmalpflege im Saarland 21 101-104.

Morgan R.A. and Schofield J. 1978, Tree-rings and the Archaeology of the Thames Waterfront in the City of London. In 'Dendrochronology of Europe' ed. J.M. Fletcher, British Archaeological Reports (in press).

Table 1

Sample no.	No. of rings	Sapwood	Average width(mm)	Sketch	Dimensions (cms)
A	67	-	2.47		5-6 x 44
A'	32	-	4.52		2-5 x 18
B upper	54	-	3.87		4 x 23
B lower	70	-	2.67		5-6 x 18-19
B'	51	-	2.81		3-6 x 18
C upper	85	-	2.40		4 x 20
C lower	48	-	2.75		4.5-6 x 22
D upper	52	-	3.93		5.5 x 21
D lower	85	-	2.46		6 x 22
D'	69	-	2.66		1-3.5 x 21
A mean	67	-	2.47		one radius
B mean	72	-	2.89		three radii
C mean	81	-	2.83		two radii
D mean	88	-	2.89		three radii
Site mean	92	-	2.75		4 timbers (1 tree?)

Details of all timbers examined, showing the number of rings and their average widths. A rough sketch is given to indicate the way in which the wood was cut.

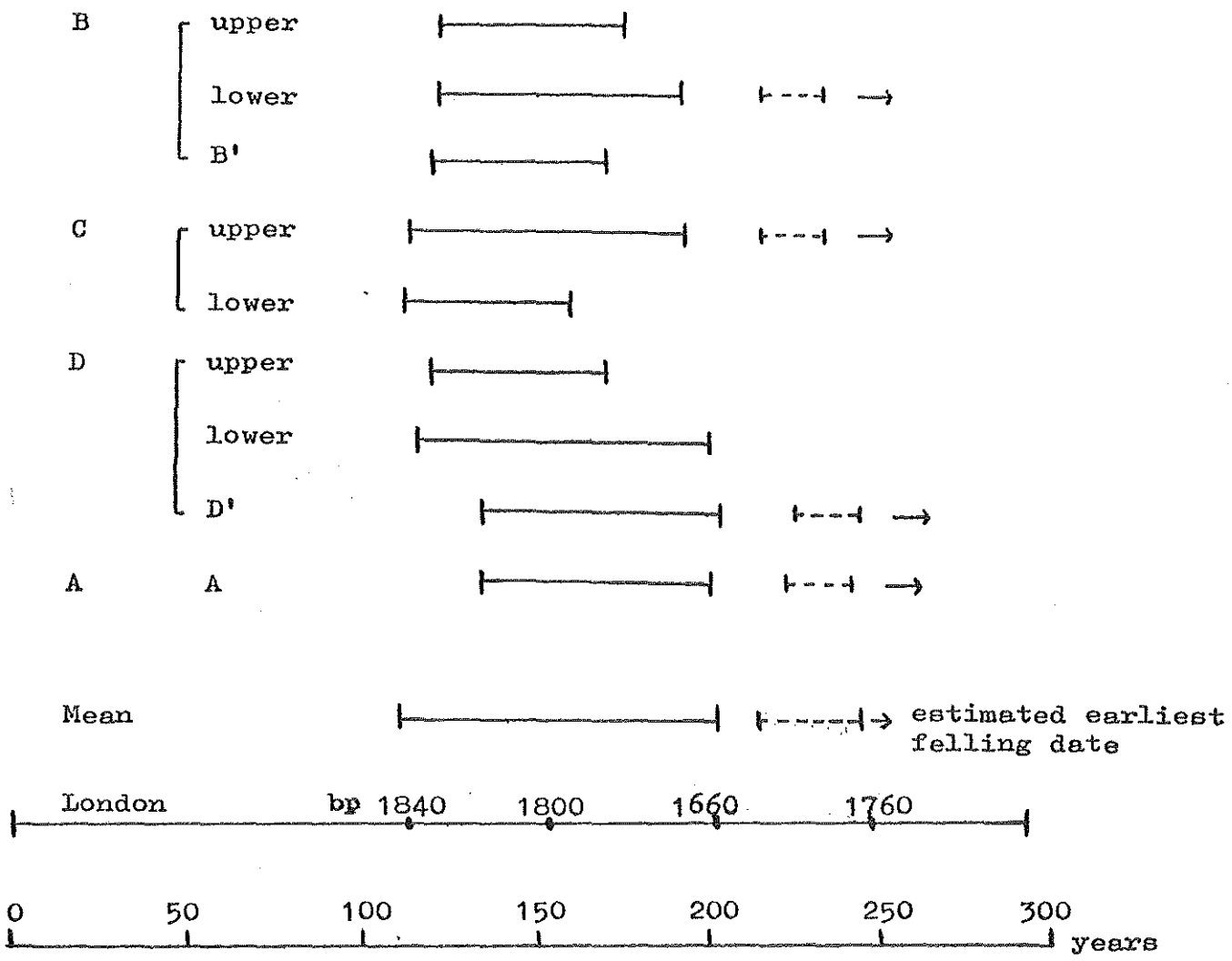
Table 2

Canterbury Roman Mean Curve

years	0	1	2	3	4	5	6	7	8	9
0		20	20	13	21	28	22	30	24	21
10	26	28	32	25	22	39	32	34	35	38
20	32	33	31	35	37	36	31	36	33	40
30	31	35	28	31	37	37	39	36	34	31
40	27	35	26	36	28	29	23	35	28	37
50	34	26	22	17	26	31	21	13	32	26
60	30	18	23	27	25	24	15	22	20	29
70	26	23	21	20	16	25	17	28	17	29
80	29	32	30	26	16	22	22	27	21	34
90	26	28	21							

The floating chronology is constructed using data from four oak planks. The mean ring widths are in 0.1 mms..

Figure 1



Block diagram showing the relative positions of all the measured samples. The calculated felling date is represented by the dashed lines; the number of sapwood rings is taken as 32 ± 9. Arrows signify that the felling date could be later. The relationship between the Canterbury and London mean curves is illustrated; also given are the Harwell C-14 dates for London - each date has a 1 S.D. error of ±60. The overall time scale is arbitrary, since both curves are floating.

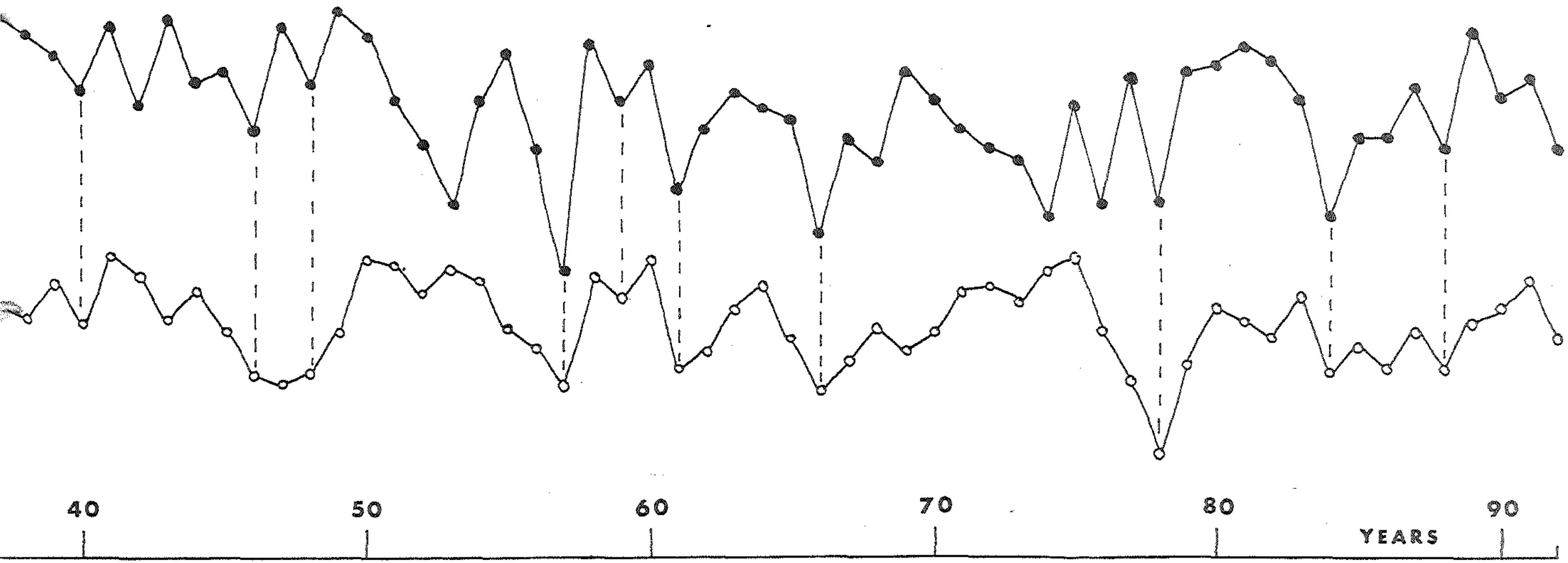

40
50
60
70
80
90
YEARS

Figure 2 - shows the match between Canterbury and the London Waterfront chronology (Morgan and Schofield,1978). The scale is an arbitrary one. Dotted lines are provided to aid visual comparison.