

Figure 1: The location of the three sites along London's waterfront. 1 — Blackfriars, 2 — New Fresh Wharf, 3 — Tower.

The Dating of the Roman Riverside Wall at three sites in London

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OVER THE LAST FEW YEARS, excavations by the DoE and by the Museum of London's Department of Urban Archaeology have resulted in the discovery of several stretches of the Roman riverside wall along the Thames waterfront. The existence of a defensive wall was suggested by documentary evidence from the 12th century, but it was not until 1974 that it was confirmed by work

1 C Hill, "The London riverside wall," *Current Archaeology* 5 No. 10 (1977) 308-310.

in the Blackfriars area¹. Subsequent excavations at the Tower of London and New Fresh Wharf (Figure 1) led to further stretches of the wall being located.

The structures at these three sites were similar. They consisted of a foundation of chalk and oak piles; the piles were rammed into the ground and then infilled and covered with a compact layer of chalk, thus forming a firm base on which the main wall was constructed. The foundations and the wall

were thought to be contemporary so the oak piles provided a suitable medium with which to date the riverside wall.

Using tree-ring analysis, it was possible to obtain relative dating for the three sites which proved that the construction of the wall along the mile-long waterfront was roughly contemporary at each place. The date of the wall was fixed more firmly by C14 dating; this agreed with the 4th century date suggested by archaeological evidence.

The three sites

Ten of the wooden piles from the Baynard's Castle site at Blackfriars were sectioned for dendrochronology. The average size of the sampled piles, which had all been roughly hewn into square or rectangular section and then pointed with an adze, was 224 by 284mm (9 by 11in).

The samples were sent to the DoE dendrochronology laboratory in Sheffield where they were

- 2 M G L Baillie and J R Pilcher, "A simple cross-dating program for tree-ring research," *Tree Ring Bulletin* 33 (1973) 7-14.
- 3 R A Morgan, "Dendrochronological analysis of oak piles supporting the Roman riverside wall in Lon-

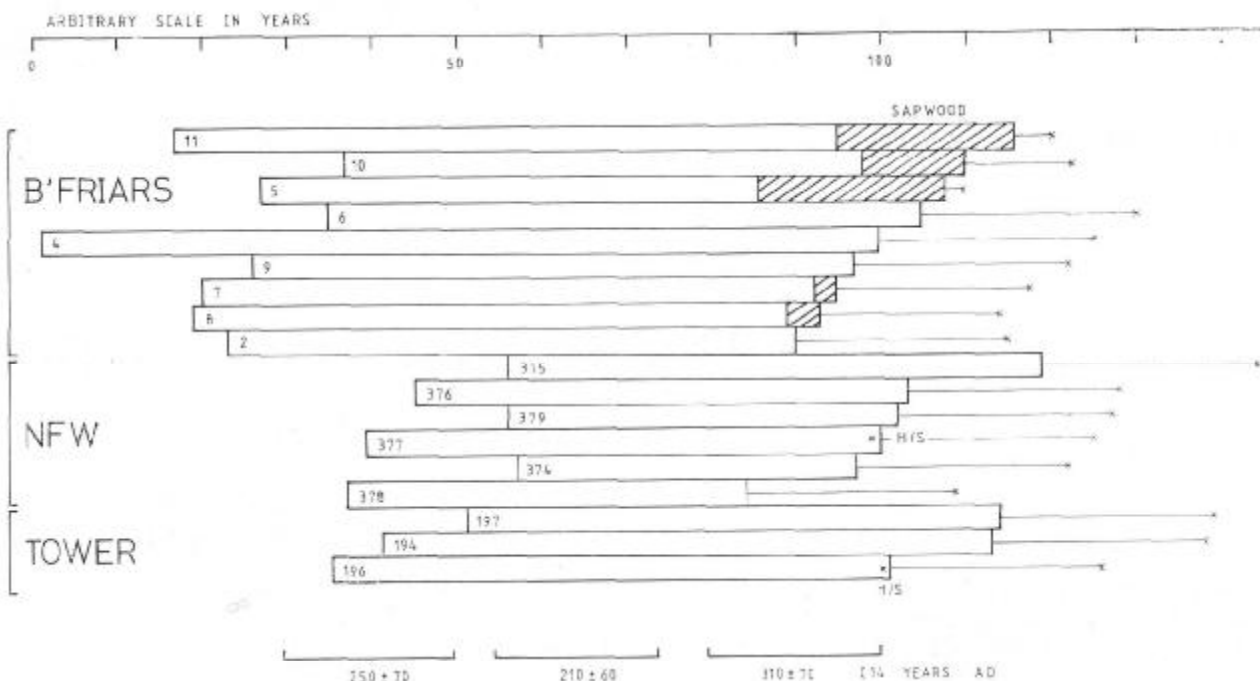
don," in C Hill LAMAS special paper (forthcoming).

cleaned and their annual rings measured. The length of the tree-ring sequences from the ten piles varied between 53 and 100 years (Figure 2). Some of the samples still retained their sapwood so that the felling years of those trees could be estimated with some accuracy; this is important when interpreting the tree-ring results with a view to discovering the construction date of the wall.

The ring patterns were compared with each other, both visually and using the Belfast computer program² to give an objective measure of the degree of agreement between any two curves. Nine out of the ten curves were found to be contemporary, enabling a site mean curve of 116 years to be constructed³.

During 1976 and 1977, the remains of the riverside wall were located at the Tower of London⁴; like that at Blackfriars, to which it was similar, it was thought to be defensive as well functioning as a riverside embankment. The piles again had

- 4 G Parnell, "An earlier Roman riverside wall at the Tower of London," *London Archaeol* 3(7) (1978) 171-176. (Period I wall).



ROMAN RIVERSIDE WALL, LONDON

Figure 2: Block diagram indicating the relative positions of the timbers from the three sites. Suggested felling dates are given, along with results from the C14 analyses. H/S — heartwood/sapwood transition.

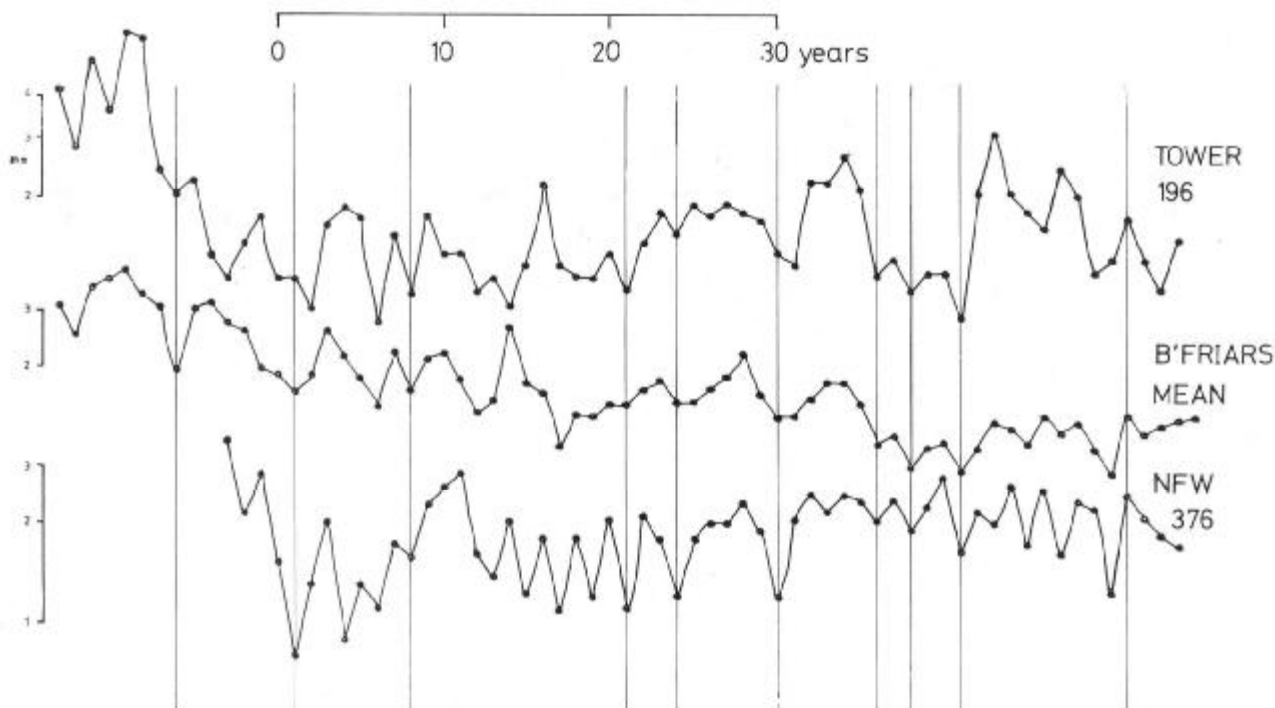


Figure 3: Comparison of the Blackfriars mean curve with individual curves from New Fresh Wharf and the Tower showing the high agreement between them, although the New Fresh Wharf and Tower samples do not in fact crossmatch well with each other (see text). The t values between Blackfriars and NFW 376 and between Blackfriars and Tower 196 are 5.87 and 3.51 respectively.

been roughly shaped into square and rectangular section: those examined dendrochronologically had an average size of 195mm by 245mm ($7\frac{1}{2}$ by $9\frac{1}{2}$ in). Seven samples were taken for tree-ring analysis, although one proved to be unsuitable since it had less than 30 very wide rings.

The resulting tree-ring sequences of 42 to 86 rings were compared together. Unlike the Blackfriars samples, crossmatching was very difficult to establish. Only three of the six were proved to be of the same age (Figure 2); it is probable that the remaining three were also contemporary but this could not be verified statistically. However it was possible to construct a site master of 80 years from the three matching curves.

This illustrates the problems involved in using tree-ring samples with less than 100 rings: it is much more difficult to find acceptable agreement between their short ring patterns⁵. Many dendrochronologists, in fact, will only examine samples

with more than 100 rings. In England, this would effectively rule out about 75 per cent of all archaeological wood sent for tree-ring analysis and would thereby suppress much useful information. Samples belonging to the same structure frequently came from the same source so that their ring patterns show close agreement. In this case, crossdating of samples with less than 100 rings can be achieved, as at Blackfriars. If, on the other hand, the trees were subjected to local differences of habitat and climate, it is often not possible to synchronise short curves; the Tower is a good example of this.

A watching brief by the DUA at New Fresh Wharf during 1978 produced many samples for dendrochronological work. They varied in age, covering the Roman, Saxon and Medieval periods; amongst them were six sections from the foundations of the riverside wall. These timbers had been hewn into square or rectangular section and they were thought to be comparable in age and structure to the riverside wall timbers described above. Their average size was 147mm by 202mm (6 by 8 in) and they proved to contain between 41 and 64 annual rings.

5 B Huber and V Giertz, "Central European Dendrochronology for the Middle Ages," in *Scientific Methods in Medieval Archaeology* ed R Berger, Univ. California Press, (1970) 201-212.

The short curves were again difficult to cross-match, due to the ring patterns not being completely unique. It was possible to synchronise four of the samples visually, although statistically some of the results were not very significant. After the production of a site master, the other two samples were also found to match (Figure 2).

Relative dating of the three sites

The three mean curves plus the individual curves were compared together and it was immediately obvious that the New Fresh Wharf samples were synchronous with those from Blackfriars (Figure 3). The individual curves of the former gave a higher agreement with the Blackfriars mean than did the master curve from the same site. This is not usual but is probably a result of their short ring patterns. The Tower mean produced a low agreement with Blackfriars but again one of the individual curves crossmatched extremely well (Figure 3). The New Fresh Wharf and the Tower samples did not appear to match at all; an occurrence which is all too common in dendrochronology when dealing with three curves or individual samples. It does not signify that the two are not contemporary; provided that both are in acceptable agreement with a third curve (in this case, Blackfriars), it is less important that the other two should also match. Similar situations have arisen when examining three sets of data from modern trees, all of which have known felling dates. The phenomenon is due to the complex interrelationship of factors which affect the growth of trees.

Figure 2 sets out the relative positions of the timbers from the three sites. A substantial amount of sapwood was present on only some of the Blackfriars samples, indicating that a greater volume of

wood was removed from the Tower and New Fresh Wharf piles during the hewing process. The heartwood-sapwood transition could be seen on sample 196 from the Tower and possibly on 377 from New Fresh Wharf. Its absence on the remainder makes the estimation of the felling dates more difficult.

The number of sapwood rings is fairly constant for mature oaks with the value usually falling between 20 and 40 rings. The figure is often less for immature trees, from which these samples were undoubtedly derived (Table 1). For the purpose of this study, therefore, the number of sapwood rings was taken as 25, but it must be stressed that this is only an estimate; the true value probably fluctuates around this figure. When there is no visible heartwood-sapwood transition, it is only possible to quote a *terminus post quem* for the year in which the tree was felled.

The felling date for the Blackfriars samples was taken to be year 120 ± 10 on the arbitrary scale⁶. However, since the heartwood-sapwood transition fluctuates by at least 20 years, it is probable that the trees were not felled in the same year.

The absence of sapwood at the other two sites complicates the interpretation of the relative dating. The sites appear to be of a similar age: compare, for example, the outer years of NFW 375 with Tower 197 and 194 or the two samples with heartwood-sapwood transitions, NFW 377 and Tower 196. However, as at Blackfriars, the trees used for each of the two sections of wall may not have been felled at the same time. Comparing all three sites, sample 5 from Blackfriars must have been felled before NFW 375 or Tower 197, although it may have the same felling date as NFW 378. The reason

6 *Op. cit.* fn. 3.

	TOWER	NEW FRESH WHARF	BLACKFRIARS
No. of samples examined	6	6	10
Average ring width (mm)	1.91	2.12	2.16
Size (mm)	195 x 245	147 x 202	224 x 284
Average No. of rings	65.2*	53.3	77.1

Table 1: Details of the timbers summarised, giving the average size, ring widths and number of rings for the three sites.

* This figure is an under-estimation due to the decay at the centre of the samples.

for this variation is discussed below. It is illustrated in Figure 2 where the crosses suggest the earliest possible felling dates for all the samples.

C14 dating of the riverside wall

At present, there are no absolutely dated tree-ring chronologies in the British Isles extending back beyond c AD 800 by which to date floating chronologies. A German curve does go back to 717 BC but this has not yet been fully published⁷. When the Blackfriars material was examined, the probability of dating the relatively short curves by dendrochronology was felt to be low. Thus samples were submitted to the Harwell laboratory for C14 measurements. The position of the samples at known time intervals and their results are depicted in Figure 2; they indicate that the piles were felled around 330-350 (uncalibrated radiocarbon years).

The subsequent analysis of the timbers from New Fresh Wharf and the Tower showed that the construction date might in fact be slightly later. The youngest timber is NFW 375; the tree from which it originated must still have been growing until at least year 144 on the arbitrary scale (Figure 2). This is about 20 years later than the felling date suggested by the Blackfriars samples and makes the construction date of the wall c AD 350 - 370. Calibration would bring this value nearer to AD 400 but, since radiocarbon dates have inherent statistical errors (the standard error is ± 70 for Blackfriars), the date would not be inconsistent with the well documented Theodosian Reconstruction which followed the *barbarica conspiratio* of AD 367⁸.

The alternative theory is that the wall was not completed at the same time, with that at Blackfriars being constructed before the New Fresh Wharf and Tower sections. This could be postulated from the block diagram in Figure 2. However, in view of the variations between the outer years at all three sites, it is thought to be unlikely. Archaeologically, the theory does not have any support: at Blackfriars, there is much evidence of re-use of large slabs of sculptured stone for the wall's construction as though there was pressure to

finish this stretch of wall as soon as possible. This did not occur at the other two sites. Furthermore, since the raids were coming up the Thames, it would be more logical for construction to start at the Tower end of the wall⁹.

It was estimated that 750 piles were required for the foundations of the c 40m section of wall at Blackfriars¹⁰. The construction of the one mile length from Blackfriars to the Tower (Figure 1) then would involve a vast number of piles. The substrate is such that the oak piles would be needed over most of this stretch so that many thousands of timber posts would have had to be found. This would suggest exploitation of the surrounding woodland on a huge scale. To compensate, it is possible that the timber was felled and accumulated for use over a period of perhaps 20 years ie the Romans were either stockpiling or reusing the timber themselves or they acquired a large supply of stockpiled wood. This is the only explanation which accounts for the widely fluctuating outer years, although it is not in accord with what has up till now been regarded as the usual Roman practice of using freshly felled timber¹¹.

The timber

Table 1 summarises the information from the timber at the three sites. The average ring widths are almost the same and indicate that the trees put on a c 2mm (1/12in) annual increment of new wood. The implication is that the trees came from similar types of woodland, if not from the same one. It is not possible to judge from the short ring patterns whether or not the trees used at each site came from the same source, but the good agreement between Blackfriars and all the New Fresh Wharf samples suggests that they at least were brought from the same woodland. The annual rings are of average width indicating that the trees must have been subject to some competition from other trees, but that they were not densely crowded. The woodland must have been fairly typical of the Roman period since most wood samples from that time exhibit similar average ring widths¹².

7 E. Hollstein, "Jahrringchronologische Datierung von Eichenhölzern ohne Waldkante," *Bonner Jahrbuch* 165, (1965) 12-27.

8 *Op. cit.* fn 1.

9 G. Parnell, *pers. comm.*

10 *Op. cit.* fn. 1.

11 e.g. *op. cit.* fn. 7; 13.

12 J. Hillam, unpublished.

Local Societies - amendments

THE EIGHTH LIST of amendments to the list of local societies published in Vol. 2, No. 9, is as follows:

Greater London Industrial Archaeological Society. Membership Secretary: Mrs Lyn Holliday, 17 Dudley Road, Walton-on-Thames, Surrey, KT12 2JT.

City of London Archaeological Society: Sec. Mrs. C. Thomas, 113a North View Road, London, N8.

Orpington & District Archaeological Society: Sec. B. J. Bull, 36 Walden Road, Chislehurst, Kent.

The size of the trees from each site were not identical but the number of samples is large enough only to make very general comments. It is probable that, since a large amount of wood was needed for the foundation piles, the Romans selected any timber which looked to be suitable without being too particular about the exact size. The woodland must have supported a range of trees with differing diameters; this is demonstrated by the timbers from the revetment structures at New Fresh Wharf or Seal House, where colossal sill-beam timbers of up to 1m (3ft 3in) in width are found alongside piles of similar dimensions to those described here¹³. The size of the piles would also be affected by the method of conversion. It has already been shown that more

wood was wasted at New Fresh Wharf and the Tower than at Blackfriars during the hewing of the felled trunks into the required shape.

No doubt the long term excavation programme currently being undertaken in London by the DUA and the DoE will reveal further stretches of the riverside wall. It should then be possible to elaborate on the results set out in this paper.

Acknowledgements

The authors would like to thank the archaeologists involved with the three sites: in particular Mr. Geoffrey Parnell of the DoE and the many members of the DUA. We are also grateful to the DoE for financing the work at Sheffield.

13 J Hillam and R A Morgan, "What value dendro-chronology to waterfront archaeology?" Proceedings

of conference *Waterfront Archaeology in North European Towns*. CBA Report (forthcoming).

Excavations & Post-Excavation work

City, by Museum of London, Department of Urban Archaeology. A series of long term excavations. Enquiries to Alison Balfour-Lynn, DUA, 71 Basinghall Street, E.C.2. (01-600 3699). For information on post-excavation work, contact Penny MacConnoran at this address.

Brentford, by West London Archaeological Field Group. Excavation and processing. Enquiries to Alison Parnum, 71-72 Brentford High Street, Brentford, Middlesex. (01-560 3880).

Fulham, by Fulham Archaeological Rescue Group. Sandford Manor, Rewell Street (New Kings Road), S.W.6. Excavation work in grounds of 17th century house, traceable back to at least 14th century, hopefully will find medieval and earlier occupation. Enquiries to Excavation Director, C. E. Oliver, 18 Albany Court, Ashburnham Road, Ham, Richmond, Surrey. (01-948 2633) or K. Whitehouse.

Fulham Palace, Bishops Avenue, Fulham Palace Road, S.W.6. Examination of existing buildings and research work has revealed earlier buildings underneath. Sundays and some weekdays. Enquiries to Keith Whitehouse, 86 Clancarty Road, S.W.6. (01-731 0338).

Blakes/Redline/Esso and Rosebank Wharves, Stevenage Road, S.W.6. Urgent rescue work during redevelopment for housing is producing evidence for occupation during Neolithic and medieval times. Some weekdays and Saturdays. Enquiries to Keith Whitehouse (as above).

Hammersmith, by Fulham Archaeological Rescue Group. Processing of prehistoric finds from Blakes Wharves and medieval material from Fulham Palace. Tuesdays, 7.30 p.m. - 10 p.m., at Fulham Palace, Bishops Avenue, Fulham Palace Road, S.W.6. Contact: Keith Whitehouse (see Fulham).

Inner London Boroughs, by the Inner London Unit. Several rescue sites in various areas. Enquiries to Irene Schwab (01-242 6620).

Kingston, by Kingston-upon-Thames Archaeological Society. Rescue sites in the town centre. Enquiries to Marion Smith, Kingston Museum, Fairfield Road, Kingston (01-546 5386).

North-East Greater London, by Passmore Edwards Museum. Enquiries to Pat Wilkinson, Passmore Edwards Museum, Romford Road, E.15. (01-534 4545).

Putney, by Wandsworth Historical Society. Two acre site at junction of Felsham Road and High Street lies on Roman and medieval settlements. Alternate weekends. Enquiries to Nicholas Farrant, 7 Coalecroft Road, S.W.15. (01-788 0015).

South West London Boroughs by the South West London Unit, excavations and processing. Enquiries to Scott McCracken, 21 Harbut Road, Battersea SW11 (01-223 2478).

Southwark, by Southwark and Lambeth Archaeological Excavation Committee. Several sites from the Roman period onwards. Enquiries to Harvey Sheldon, S.L.A.E.C., Port Medical Centre, English Grounds, Morgan's Lane, S.E.1 2HT. (01-407 1989).

Surrey, by Surrey Archaeological Society. Enquiries to David Bird, County Archaeological Officer, Planning Department, County Hall, Kingston, Surrey.

Vauxhall Pottery, by Southwark and Lambeth Archaeological Society. Excavation at weekends only. Processing of excavated material continues three nights a week. All enquiries to S.L.A.S., c/o Cuming Museum, 155 Walworth Road, S.E.17. (01-703 3324).

GENERAL EXCAVATIONS

The Council for British Archaeology produces a monthly Calendar of Excavations from March to September, with an extra issue in November and a final issue in January summarising the main results of fieldwork. The Calendar gives details of extra-mural courses, summer schools, training excavations and sites where volunteers are needed. The annual subscription is £3.00 post-free, which should be made payable to "C.B.A., 112 Kennington Road, S.E.11.