Recent dendrochronological work in Southwark and its implications

HARVEY SHELDON
IAN TYERS

IN THE PAST few years tree-ring dating has become an important archaeological technique in Britain. In this paper we review the results of some recent work in Southwark, and demonstrate a significant change in the dating of the Roman riverside wall of the City of London. Dendrochronological methods will not be described in detail here[1], but it should be explained that dates of timbers and chronologies are confirmed using the computer program CROS[2], which expresses the degree of similarity between two samples as a 't' value. Generally a 't' value over 3.5 is statistically significant — the higher the value the more certain the match.

Dendrochronology allows a date to be assigned to the outer ring of most oak timbers. This is not necessarily the date of the structure from which the timber comes. Fig. 1 shows the three states in which timbers are recovered on archaeological sites. Timbers with bark surviving (a) are the most useful for the accurate dating of a structure, but because sapwood is less resistant to decay than heartwood it survives infrequently on sites. Interpretation on the basis of timbers retaining only some sapwood or the heartwood/sapwood boundary (b) is therefore more common. Consequently the estimation of a reliable "sapwood allowance" (the number of sapwood rings normally present on an oak tree) is crucial if dendrochronological dating is to be applied to archaeological sites with any accuracy. More study of both modern trees and archaeological timbers should help refine the present figures. In this paper all estimates of the felling dates of timbers, where bark was not present, are made using a "sapwood allowance" of 10-55 years. This figure is based on published estimates as well as Roman timbers from Southwark which retained all their sapwood and bark. When a timber has been extensively worked before use (c), it cannot provide a close date for a structure. The felling date of a tree is not necessarily the date of construction, as the timber may have been seasoned for some years before use. There is also the possibility that repairs to a structure with

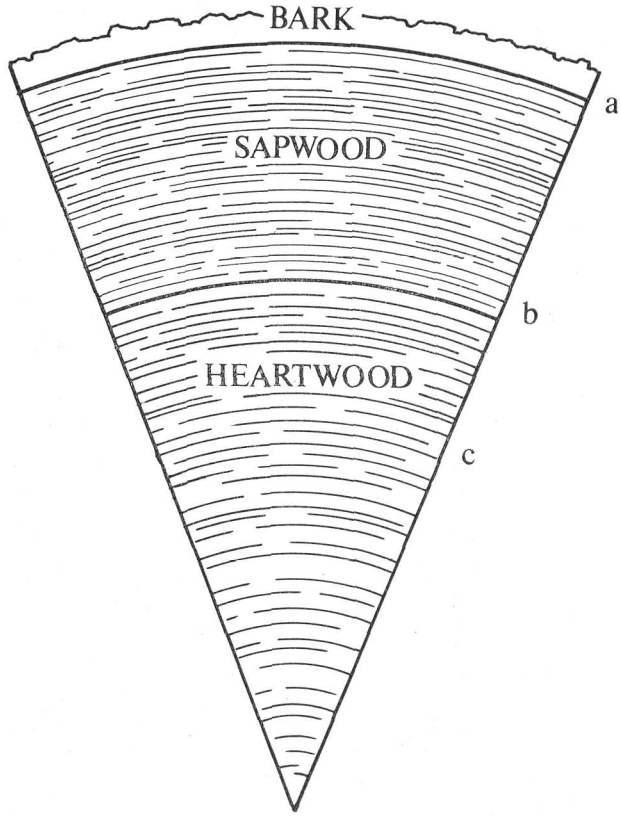

Fig 1: Diagrammatic transverse section of a tree-trunk to show how the potential accuracy of dating varies with the state of the timber recovered:
(a) bark present; outer ring is year of felling,
(b) heartwood/sapwood boundary or some sapwood present; year of felling is 10-55 years after the heartwood/sapwood boundary,
(c) heartwood only present; number of years missing is unknown, but 10 minimum.

1. For fuller information see M. G. L. Baillie *Tree-ring dating and archaeology*, London (1982), or earlier articles in *the London Archaeologist* e.g. R. A. Morgan 'Tree-ring dating of the London Waterfronts', *London Archaeol* **3** no. 2 (1977) 40-45, or J. Hillam and R. A. Morgan 'The dating of the riverside wall at three sites in London,' *London Archaeol* **3** no. 11 (1979) 283-8.
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.

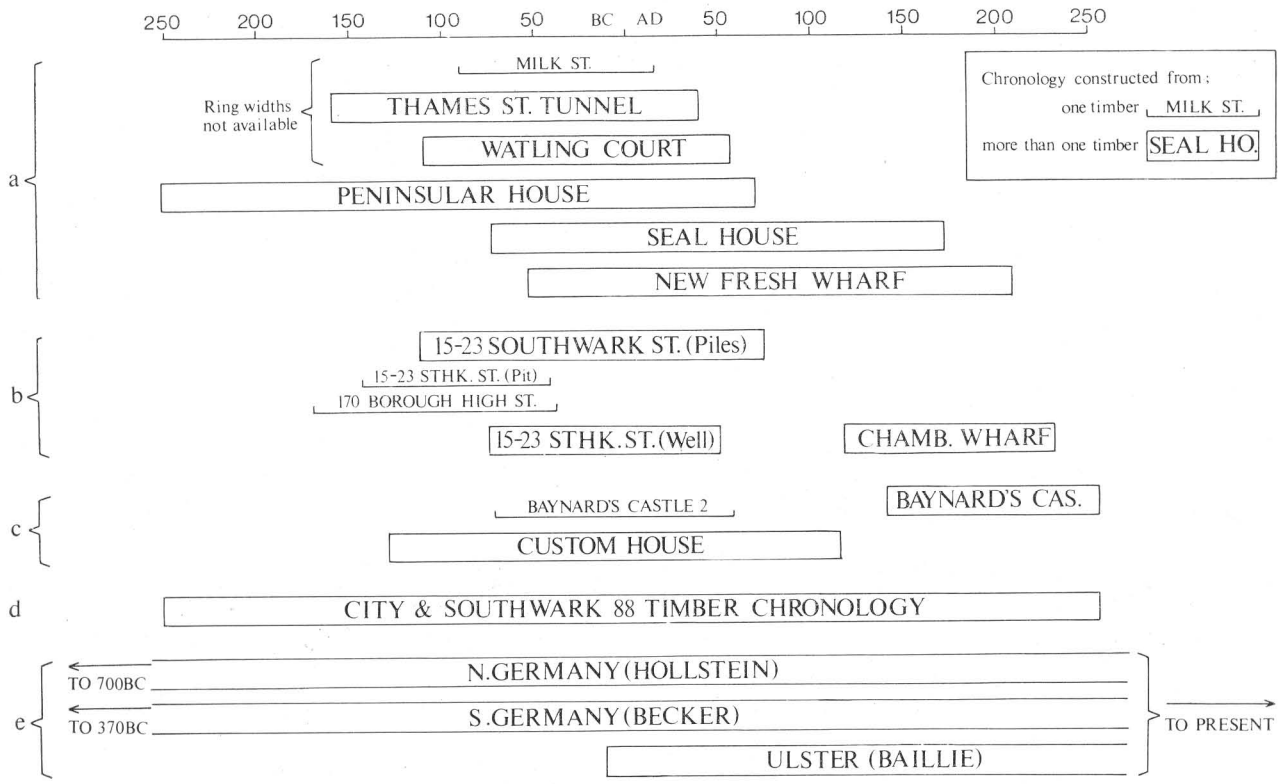

Fig. 2: Shows the relative positions of the Roman chronologies from Southwark and the City, and the European chronologies used to date them:
(a) City of London chronologies (after Hillam and Morgan fn 7),
(b) Southwark chronologies (unpublished),
(c) City chronologies originally published without a date,
(d) The City and Southwark chronology constructed from these timbers,
(e) The European absolute chronologies; see Table 1 for *'t'* values between these and the chronologies.

later timbers, or re-use of earlier timbers, may not be recognised.

In 1981 an absolute chronology of timbers from Saxon and early medieval sites in Britain extending back to AD404 was published[3]. At about the same time two independent chronologies of German timbers, extending well into the 1st millenium BC[4], as well as a chronology from Ulster extending back to 13BC[5], became available. Matching between British archaeological timbers and the German chronologies for the medieval and post-medieval periods is a well established practice[6], and the same technique was used to date the chronologies built up from Roman structures in Britain[7]. Chronologies from the City of London as dated by Hillam and Morgan are shown in Fig. 2a. There are also chronologies from Custom House[8], Baynard's Castle[9], and Billingsgate Buildings[10], all originally published without dates, as well as several unpublished chronologies[11].

An early stone building in Southwark

Excavations in Southwark have yielded large

3. J. Hillam 'An English Tree-ring chronology AD404-1216', *Medieval Archaeol* **25** (1981) 31-44.
4. E. Hollstein 'Mitteleuropaische Eichenchronologie', *Trierer Grabungen und Forchungen* **9** (1980) (from Northern Germany), and B. Becker 'Fallungsdaten Romisher Bauholzer', *Fundberichte Aus Baden-Wurttemburg* **6** (1981) 367-386 (from Southern Germany).
5. M. G. L. Baillie 'Dendrochronology, the Irish view', *Current Archaeol* **7** no. 2 (1980) 61-3 and M. G. L. Baillie *op.cit.* fn 1,193.
6. See e.g. J. Hillam and R. A. Morgan 'What value is dendrochronology to waterfront archaeology' *in* G. Milne and B. Hobley (eds) 'Waterfront archaeology in Britain and Northern Europe', *C.B.A. Research Report* No. 41 (1981) 39-46.
7. J. Hillam and R. A. Morgan 'Dendro dates from Shefield', *Current Archaeol* **7** no. 9 (1981) 286-7; J. Fletcher 'Roman and Saxon Dendro Dates', *Current Archaeol* **7**, no. 5 (1981) 150-2.
8. J. M. Fletcher 'The dendrochronology' 211-5; in T. Tatton-Brown, 'Excavations at the Custom House site.

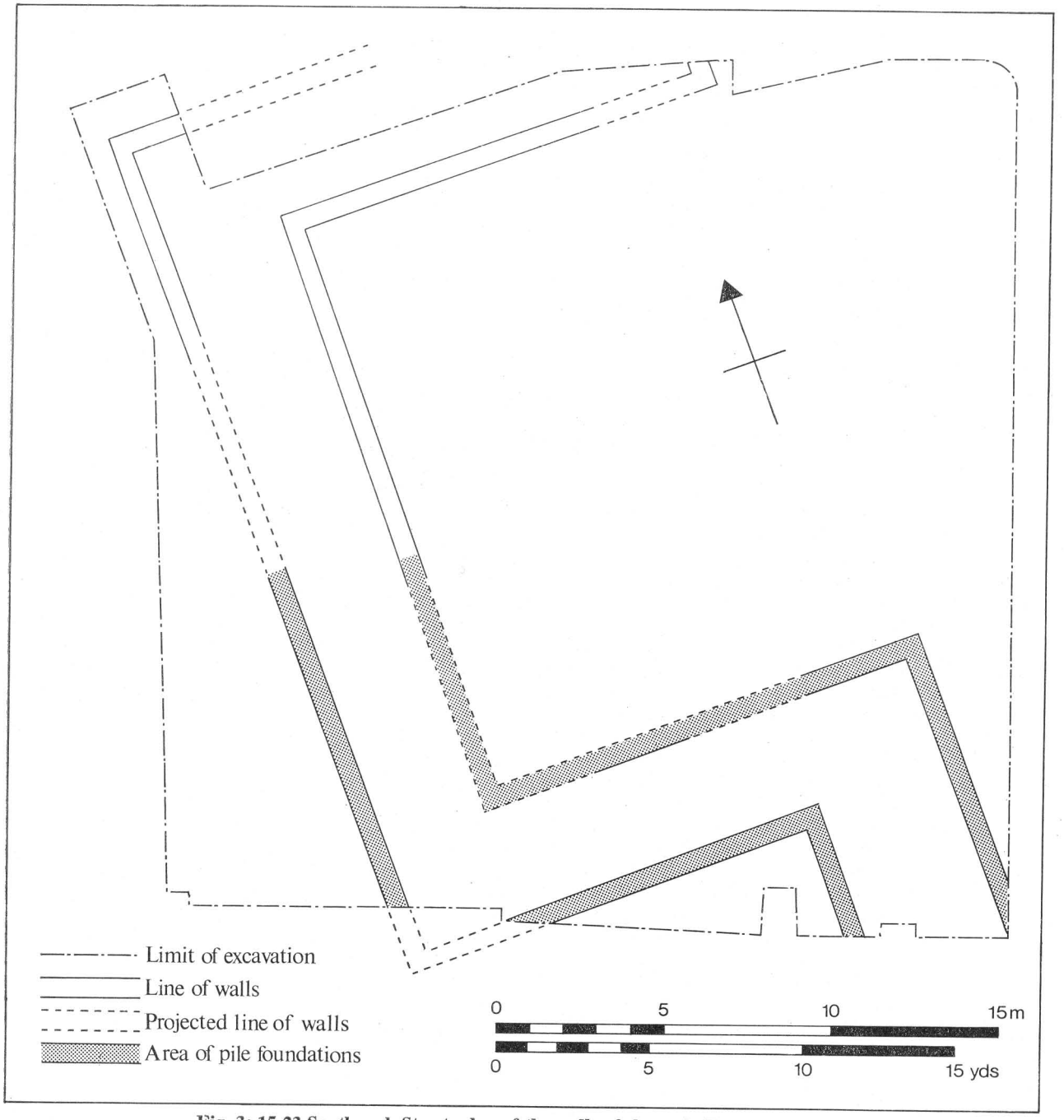

Fig. 3: 15-23 Southwark Street, plan of the walls of the early Roman building.

City of London 1973', *Trans London Middlesex Archaeol Soc* **25** (1974) 117-219.

9. R. A. Morgan 'The C-14 and dendrochronology' *in* C. Hill *et al.* 'The Roman Riverside Wall and Monumental Arch', *London Middlesex Archaeol Soc Special Paper* **3** (1980) 88-94.

10. R. A. Morgan 'Tree-ring analysis of timber from Billingsgate Buildings'; *in* D. M. Jones 'Excavations at Billingsgate Buildings "Triangle" Lower Thames St. 1974', *London Middlesex Archaeol Soc Special Paper* **4** (1980) 28-32.

11. J. Hillam *pers comm.*

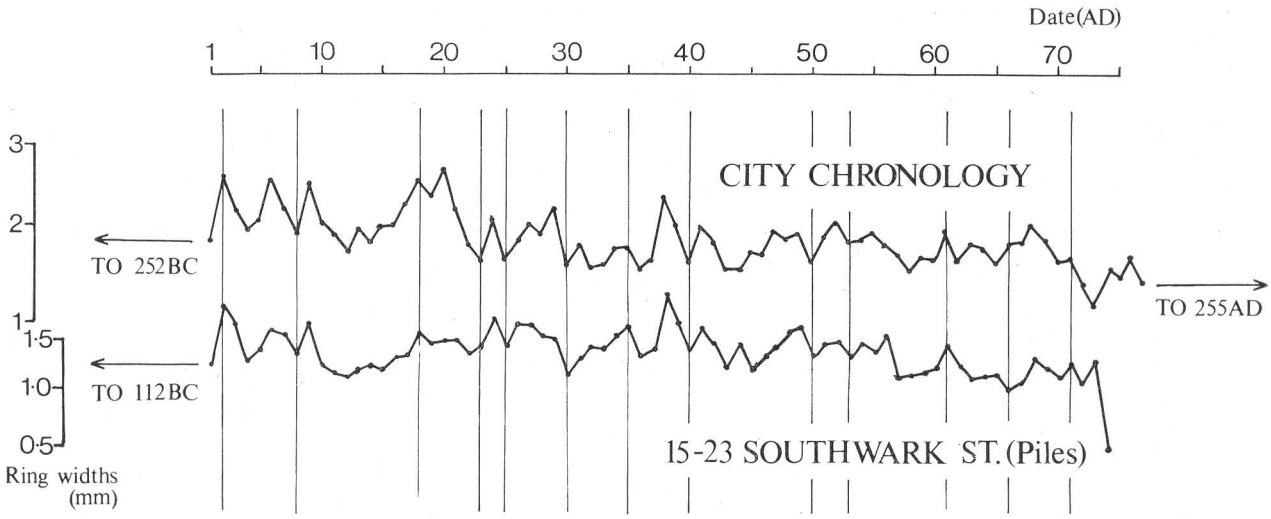

Fig. 4: The last 74 years of the correlation between a City chronology and the 15-23 Southwark Street piles (t = 15.61).

quantities of timber some of which has recently been analysed (see Fig. 2b). One result of this work has been the dating of the construction of an early stone building at 15-23 Southwark Street, based on the study of piles recovered from the foundation trenches (see Fig. 3). These piles had been driven into the ground complete with sapwood and bark, which had survived because of the water-logged nature of the area. As a result the date of the building is not dependent on sapwood estimates: the trees from which the piles were made were felled in AD72, 73, and 74 (Fig. 4). Construction presumably started shortly afterwards. This is of some significance for it demonstrates the existence of at least one early Roman stone building in Southwark. Its architectural style, location (on good ground between the two roads converging on the river), size and period might argue for a public rather than private function. It is the first example found south of the river which might confidently be related to the Imperial Flavian development of *Londinium*. Damage, particularly from Victorian cellars, has unfortunately been substantial, but excavations are in progress west of the original site and more early stone buildings are being revealed.

A Southwark well and the City riverside wall

Study of the planks from a square 3rd-century well at 107-115 Borough High Street[12] produced a chronology of 119 years from seven timbers. Surprisingly, this sequence fails to match either the London chronologies or those from Germany and Ulster. Since chronologies correlate across a wide area of North-west Europe[13], this suggests that the trees from which the well was constructed did not grow in this area. The timber was probably imported from beyond the North-western provinces of the Empire, perhaps in the form of a large container or part of a ship, and was re-used in the well.

While attemping to provide a date for the well most of the available site chronologies from Roman Britain were examined. In doing this work it became apparent that the chronology constructed from piles under the Roman riverside wall at Baynard's Castle[14] had a significant match (t = 8.38, see Fig. 5) with that from the New Fresh Wharf Roman waterfront. This was unexpected since the Baynard's Castle piles have a series of radio-carbon dates which have been taken to suggest felling *c.* ad 330-350 (uncalibrated), while the tree-ring match between Baynard's Castle and New Fresh Wharf gives a final ring date to the Baynard's Castle sequence of AD255. It can now be demonstrated that both the German, as well as the Ulster, chronologies provide a date of AD255 for the final ring (see Table 1). The piles from under the riverside wall did not retain any bark so an additional "sapwood allowance" must be made, suggesting a felling date of between AD255 and 275.

12. B. Yule 'A third century well group and the later Roman settlement in Southwark', *London Archaeol* **4** no. 9 (1982) 243-9.
13. M. G. L. Baillie 'Is there a single British Isles Oak tree-ring signal?" *in* A. Aspinall and S. E. Warren (eds) *Proc. 22nd Syposium Archaeometry* (1983).
14. *loc.cit.* fn 9.
15. C. Hill *et al op.cit.* fn 9,1-209.
16. G. Parnell 'Tower of London, Inmost Ward excavation 1979', *London Archaeol* **4** no. 3 (1981) 69-73.

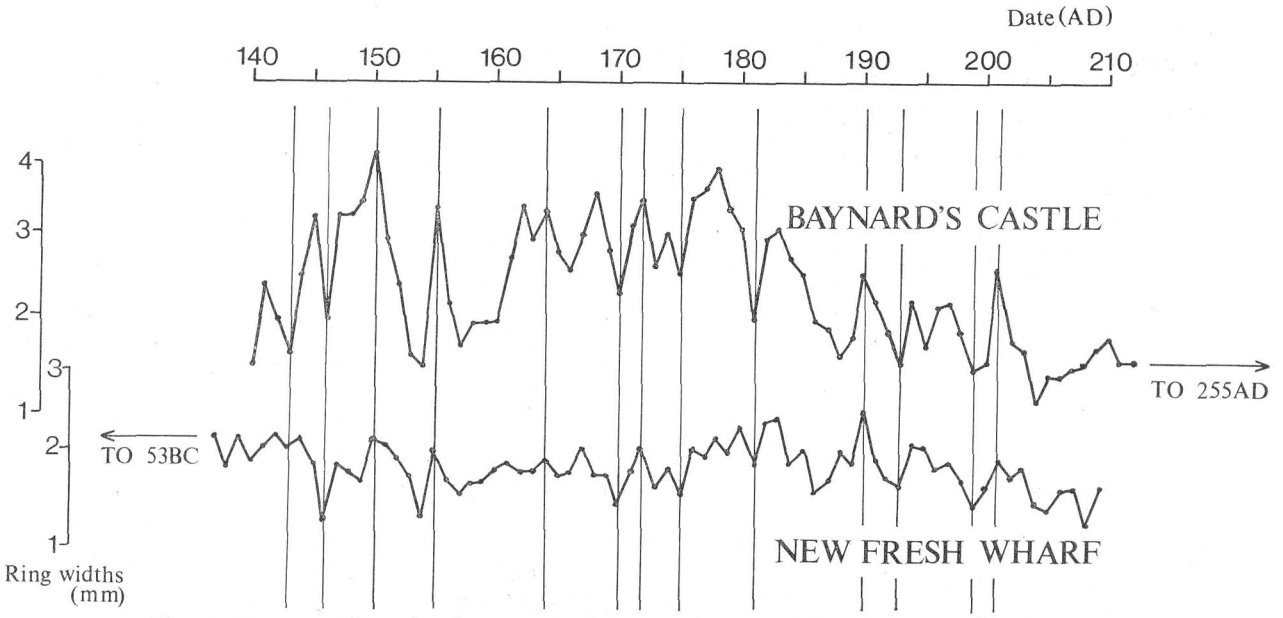

Fig. 5: The area of overlap between the New Fresh Wharf 3rd century waterfront and the Baynard's Castle riverside wall chronologies (t = 8.38).

The riverside wall and its date

Undoubtedly the discovery of the riverside wall at the western end of *Londinium* in 1974-75[15] and the excavation shortly afterwards of two successive stretches (Periods 1 and 2), in the Tower of London[16], were of great importance. Scepticism about the existence of such a wall was finally ended: it could now be demonstrated almost unequivocally that the town's defences had been completed by a protective barrier more than one mile in length along the Thames frontage.

On the basis of radio-carbon dating and the re-used masonry found at Baynard's Castle the wall has generally been accepted as having been built in the later 4th century[17], perhaps as part of the Theodosian reconstructions. This is in spite of the absence of pottery "definitely later than the late 2nd century" in contexts earlier than the wall[18]. Yet if the new dendrochronological dating is correct the second half of the 4th century is considerably too late, at least for the inception of the defensive scheme.

It is important to ask therefore whether the often quoted evidence for the 4th-century date is satisfactory. In our view it is not. First, the accuracy of radio-carbon dates for the Roman period may be limited.[19] In any case recalculation from the original data for those given for the riverside wall, using currently accepted norms, gives a range of AD240-450 which it would be inappropriate to reduce.[20] Secondly, none of the re-used masonry came from that part of the wall which had pile foundations. The monumental fragments were all found to the west of the site within a stretch which displayed "a series of striking differences" from that to the east.[21] These differences included foundations which were less substantial, lacking either piles or a chalk raft, and the absence of an internal clay bank. The re-used stones were, without exception, in a single course along the rear face of the wall.[22]

We accept that the re-used stones derive from 3rd-century monuments and that they are unlikely to have been placed in the wall before *c.* AD300 at

17. C. Hill *et al op.cit.* fn 9, 70 and 94. This date is now widely quoted. See e.g. T. Dyson and J. Schofield 'Excavations in the City of London, Second Interim Report 1974-78', *Trans London Middlesex Archaeol Soc* **32** (1981) 24 and 48, and J. Maloney 'Recent Work on London's Defences' *in* J. Maloney and B. Hobley (eds) 'Roman Urban defences in the West', *C.B.A. Research Report* No. 51 (1983).
18. C. Hill *et al op.cit.* fn 9,29.
19. J. A. Campbell, M. S. Baxter and L. A. Alcock 'Radio-carbon dates for the Cadbury massacre', *Antiquity* **53** (1979) 31-8.
20. Data calibrated using R. M. Clark 'A calibration curve for radiocarbon dates' *Antiquity* **49** (1975) 251-266. Following discussions at the 'Archaeology, Dendrochronology, and the Radiocarbon Calibration Curve' workshop, Edinburgh 1982 all standard deviations of the raw data were taken as ± 100 years.
21. C. Hill *et al op.cit* fn 9,38.
22. *ibid* 44.

Site/context	length (years)	no. of timbers	date of final ring	't' values between the site/context and: S. Germany Becker[4]	N. Germany Hollstein[4]	Ulster Baillie[5]
Peninsular House; waterfront	322	18	70AD	4.73	5.80	2.95
Custom House, waterfront	245	5	115AD	3.35	3.50	4.29
Seal House; waterfront	244	3	171AD	3.71	4.94	3.97
New Fresh Wharf; waterfront	262	11	209AD	4.34	4.56	4.37
Baynard's Castle; riverside wall piles	116	9	255AD	3.04	3.51	4.59
15-23 Southwark St.; building piles	186	33	74AD	4.45	4.86	3.15
15-23 Southwark St.; well	125	2	50AD	2.76	4.16	i.l.o.
Chamberlain's Wharf; well	115	4	231AD	1.97	1.48	3.95
LONDON MASTER	507	88	255AD	8.40	8.99	7.88

i.l.o. insufficient length of overlap to produce a correlation

Table 1: The 't' values for the major Roman chronologies from the City and Southwark against the 3 independent absolute chronologies from Western Europe, (see Fig. 2c). The London chronology constructed from these and some single timbers are shown to have highly significant 't' values to these chronologies and can be regarded as firmly dated to absolute years.

the earliest.[23] However the structural differences could suggest either that the western sector was not contemporaneous with that to the east of the site — perhaps a later addition — or that an original but less well-built wall subsequently required repair.[24] Both possibilities could account for the presence of stones from the demolished monuments.

At the Tower, Parnell noted that his Period 1 river wall had foundations similar to those discovered on the eastern part of the Baynard's Castle site, and they may therefore have been contemporaneous.[25] A mid-3rd-century date, consequently, would allow a reasonable interval between its construction and that of the puzzling late 4th-century Period 2 wall some four metres (13ft) to the north.

If the absolute dendrochronological dating no longer allows the suggestion that the riverside wall was originally conceived as part of the re-organisation undertaken in the years following the incursions of the AD360s, other and earlier causes need to be sought. Perhaps its construction can best be placed in the context of the increasing defensive emphasis in southern Britain during the mid-3rd-century shown by the construction of town walls and coastal and estuarine forts.

There are still difficulties in assigning precise dates for the construction of urban stone fortifications in the south, but many towns including Winchester, Chichester, Silchester, Canterbury and *Verulamium*, are likely to have been walled between *c.* AD220-280.[26] The building of the riverside wall may well have been part of this programme. Whatever motivations led to these town defences there can be little doubt that the 'Saxon Shore' forts established around the south and east coasts of Britain during the 3rd century were built in response to the threat of sea-borne attack. A number of these close to the Thames estuary, including Richborough, Dover and Lympne on the Kent headland, and Bradwell in Essex are thought to have been completed in the AD260s and

23. See T. Blagg 'The Sculptured Stones': *in* C. Hill *et al op.cit. fn* 9,125-193, and M. Hassall 'The Inscribed altars' *in* C. Hill *et al op.cit* fn 9,195-8.

24. The likelihood of two phases at Baynard's Castle was recognised by P. Marsden in *Roman London,* London (1980) 177.

25. G. Parnell 'An earlier Roman Riverside Wall at the Tower of London', *London Archaeol* **3** no. 7 (1978) 171-76.

26. For a general review see J. Wacher *The Towns of Roman Britain,* London (1974), but note that S. Frere has recently suggested AD265-270 for *Verulamium* in 'Verulamium in the 3rd century' *in* A. King and M. Henig (eds) 'The Roman West in the Third Century', *BAR International* **109 (ii)** (1981) 390. Other recent assessments include *c* AD225-275 for Silchester in M. Fulford 'Silchester' *in* J. Maloney and B. Hobley (eds) *op.cit.* fn 17,89, and AD270-290 for Canterbury in S. S. Frere *et al, Archaeology of Canterbury Vol.* 2 (1982).

270s.[27] It may be significant that a signal station, probably of similar date, was discovered one mile down river from *Londinium*, at Shadwell, in 1974. The excavator suggested that it was one of a chain of Thames towers conveying military information, perhaps originating in the coastal forts, to London.[28] If this view is correct, some form of contemporaneous riverside defence becomes more likely.

We therefore conclude that the riverside wall located on the eastern part of the Baynard's Castle site and at the Tower of London (Period 1 wall) was built *c.* AD255-275, rather than 100 years later, and suggest that its construction was an aspect of the increased provision made for the defence of south-east Britain in the mid-3rd century.

More excavation needs to be done. First to demonstrate whether or not the original work really was a continuous fortification, and secondly to ascertain what later extensions and alterations were made. The riverside wall may prove to have had a complex history, but as a result of the dendrochronological analysis this no longer needs to be confined to the last half century of Roman Britain.

Acknowledgements

The authors wish particularly to thank David Haddon-Reece of the Ancient monuments Laboratory, DoE, for a great deal of practical help and useful discussion; Jennifer Hillam of the DoE Dendrochrononological Laboratory, Sheffield, for initial advice and practical assistance. We are grateful to Jennifer Hillam and Ruth Morgan (Peninsular House, New Fresh Wharf, and Seal House), Mike Baillie (Ulster; Teeshan) and John Fletcher (Custom House) for permission to use unpublished information. Facilities were kindly provided by the DoE to carry out the analysis of the tree-ring data at their laboratory.

Finally we would like to thank our colleagues in Southwark, especially Peter Hinton and Tony MacKenna, for their help.

27. B. Cunliffe 'Some Problems and Misconceptions' *in* D. E. Johnston (ed) 'The Saxon Shore', *C.B.A. Research Report* No. 18 (1977) 3.

28. T. Johnson 'A Roman Signal Tower at Shadwell E1', *Trans London Middlesex Archaeol Soc* **26** (1975) 280.

Excavations & post-excavation work

City, by Museum of London, Department of Urban Archaeology. A series of long term excavations. Enquiries to DUA, Museum of London, London Wall, E.C.2. (01-600 3699).

Brentford, by West London Archaeological Field Group, Excavation and processing. Enquiries to 273A Brentford High Street, Brentford, Middlesex. (01-560 3880).

Croydon & District. Processing and cataloguing of excavated and museum collections every Tuesday throughout the year. Archaeological reference collections of fabric types, domestic animal bones, clay tobacco pipes and glass ware also available for comparative work, Hon. Curator, Croydon Natural History & Scientific Society Ltd., Museum Building, Croydon Biology Centre, Chipstead Valley Road, Coulsdon, Surrey. (01-660 3841 or 22 43727).

Hammersmith & Fulham, by Fulham Archaeological Rescue Group.
Processing of material from Sandford Manor and Fulham High Street. Tuesdays, 7.45 p.m.-10 p.m. at Fulham Palace, Bishops Avenue, Fulham Palace Road S.W.6 Contact Keith Whitehouse, 86 Clancarty Road, S.W.6. (01-731 0338).

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

Kingston, by Kingston - upon - Thames Archaeological Society. Rescue sites in the town centre. Enquiries to Marion Hinton, Kingston Heritage Centre, 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).

South West London Boroughs, by the South West London Unit, excavations and processing. Enquiries to Scott McCracken, St. Luke's House, Sandycombe Road, Kew (01-940 5989).

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, SE1 2HT. (01-407 1989).

Surrey, by Surrey Archaeological Unit. Enquiries to David Bird, County Archaeological Officer, Planning Department, County Hall, Kingston, Surrey. (01-546 1050 x 3665).

Vauxhall Pottery, by Southwark and Lambeth Archaeological Society. 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).

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 field work. The Calendar gives details of extra-mural courses, summer schools, training excavations and sites where volunteers are needed. The annual subscription is **£5.50** *post-free, which should be made payable to C.B.A. 112 Kennington Road, S.E.11.*