THE WATERFRONT OF *LONDINIUM*: THE DATE OF THE QUAYS AT THE CUSTOM HOUSE SITE REASSESSED

JOHN FLETCHER

INTRODUCTION

The Roman waterfront along the River Thames at the 'Custom House' site, close to the Tower of London, was the first and most easterly section to be fully excavated. The work, carried out by T. Tatton-Brown in the late summer of 1973 under rescue conditions for a period of three months, was organised by the then Guildhall Museum. Reports on the discovery of both Roman and medieval waterfronts and their associated deposits were published in two successive volumes of Transactions.[1]

Two early Roman quays (here called A and B) were identified. The earlier (A) was attributed to the early 2nd century,[2] *though the pottery could equally well date from the late 1st century. The later (B) was a massive quay of box construction, in its eastern part some six metres in front of the earlier one; a date in the last quarter of the 2nd century was proposed for it.*

DATING BY DENDROCHRONOLOGY

In order to obtain a relatively accurate date for the two Roman quays, slices were cut from oak baulks and posts, and measurements of ring-widths made and published in the first report.[3] They were the first Roman timbers from the London waterfront to be examined by this method. The samples from the three large beams (III 4, III 3 and III 2), which lay on top of one another and formed the front of the box structure of quay B, had relatively long sequences of annual growth rings with patterns that matched one another. At that time, however, there was no contemporary Roman tree-ring sequence, other than that compiled by Hollstein from material from the Roman wells at Wederath, Belgium, with which to match and date them. A tentative match with that sequence supported a late 2nd-century date and this was included in the report.

Since 1973 several other excavations have been carried out along the Roman waterfront to the west and a similar box structure has been found elsewhere. A significant advance was the matching by Ruth Morgan of the sequences of the three large beams of quay B with later, long sequences from New Fresh Wharf and Seal House: this lead to a mean curve (here called MC 12, based on twelve timbers and covering 282 years) for which the ring widths were published.[4] The dates of this curve remained unfixed until in 1980–81 the German chronologies compiled by Hollstein[5] and Becker[6] for Roman times became available and it could then be dated to BC 73 to AD 209.[7] The New Fresh Wharf timbers included not only one long sequence in MC 12 with nearly the full complement of sapwood but at least two others with much sapwood. As a result the likely felling and construction of the Roman quays there must have occurred very soon after the date of the latest ring measured, *i.e.* very soon after AD 209.

The three long Custom House sequences (from beams III 4, III 3 and

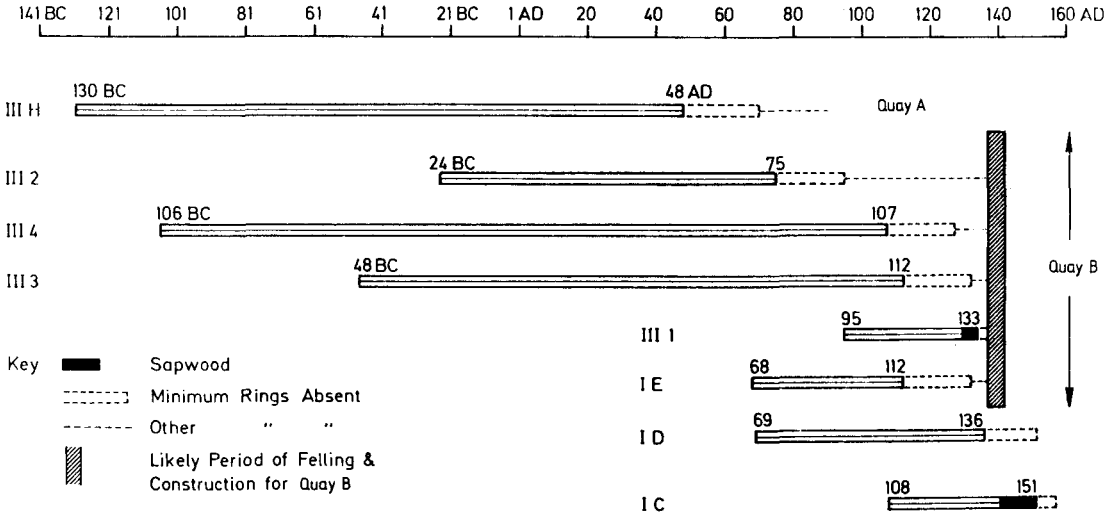

Fig. 1. Roman waterfront, Custom House site, London. Samples from trenches III and I relevant to quays A and B.

III 2, see Fig. 2) were at that time dated indirectly by being in MC 12, and directly by the two German chronologies. The latest ring of the three is for the year AD 112. That merely implied that quay B with the box structure was built sometime after *c.* AD 130.

Two recent advances, made through the research at Oxford in the science of dendrochronology, have now enabled the exactitude of the dating of oak from buildings and excavations in southern Britain[8] to approach that already achieved on the Continent[9] (where the full complement of sapwood is often present).

(i) The first has led to the matching and dating of four short sequences measured on samples taken from the Custom House site; one beam (III 1) and another (post I C) has sapwood; all four cases came from pedunculate oaks and had mean widths of the order of 3 to 4mm.

(ii) The other concerns the likely number of years of sapwood on samples taken in south-eastern England from piles etc. that have few rings and are fast grown, i.e. with annual rings of mean width greater than *c.* 2.5mm; this, provided the date of the heartwood or sapwood is known, allows the likely date of construction to be placed hypothetically within a period of a very few years, even if the amount of sapwood is quite small.

Together the advances enable us to conclude that the construction of quay B, hitherto given[10] as 'after AD 135', is likely to have occurred within the five-year period AD 137 to 142. The conclusion from this work is that beam III H was first used in an earlier waterfront, probably quay A, that was built sometime after AD 70 and is almost certainly of the 1st, not the 2nd, century. These two results, together with the suggested construction date soon after AD 209 for the waterfront at New Fresh Wharf (see above), appear to form three well-defined stages in the development of the Roman waterfront at London.

METHODS AND RESULTS

SHORT SEQUENCES

Site chronologies were of considerable value during the early development of dendrochronology in Europe when no zonal reference chronologies had been developed. The latter, based on dozens of values, were made because it was found, for example by Huber and his colleagues, that a higher percentage of samples over a wide area could be dated with them.[11] With panel paintings (material to which a site mean curve is not applicable) the ring-width sequences have been compared now for a number of years with four to six contemporary western European chronologies. This is highly advantageous since as many as 90% of the sequences have thereby been dated (approximately 400 boards on 240 panels).

The same principle has led to the dating of four of the ten Roman samples with under seventy annual rings that were cut at the Custom House site. The agreement values, with three reference chronologies (the only contemporary ones available at the time) for the four (III 1, I F, I D and I C), are given in Fig. 2, while the years spanned by their sequence are shown in Fig. 1. The positions were accepted as correct because the visual comparisons with the indicators on the reference chronologies were also satisfactory.[12]

The beams III 1 and I E are known from their position to have formed an integral part of the box structure of quay B.[13] Hence the likely date of their latest ring is known, to within ten to twenty years, from the results already obtained on the relatively long sequences of III 2, III 3, III 4. However, as Fig. 1 shows visually, to try to match the sequence of III 1 by those sequences singly, or in combination, is not feasible because there is either no overlap or one of less than 20 years.

ALLOWANCE OF YEARS FOR ABSENT SAPWOOD

For dating the construction of oak artefacts, whether excavated or from buildings, this allowance plays an important role. Ideally, knowledge of its value and likely range for trees of different age, different rates of growth in different dendroecological zones is required to enable an accurate allowance to be made. The variation from tree to tree requires systematic research rather than the acceptance of a fixed allowance based on observations in a few parts of the British Isles.[14]

For some time, 20 ± 5 years has been the allowance used on the continent for oaks 100 to 200 years old when felled. Hollstein also found, from a total of about 200 trees, a value of 26 ± 7 years for trees over 200 years old.[15]

Trench & Ref. No. of sample	*Form*	*No. of rings*	*Mean width*	*Agreement (t) with reference chronologies*§ *London*	*W. Germany, Hollstein*	*S. Germany, Becker*	*Date of latest ring*
III H	beam	178	1.3mm	4.1*	2.0	1.5	AD 48
III 4	beam	213	1.7	6.6†	3.2	2.2	107
III 3	beam	160	1.8	6.0*	3.5	2.9	112
III 2	beam	99	1.7	3.9‡	0.4	1.0	75
III 1	beam	39	3.8	2.5	4.1	3.1	134
I E	beam	45	3.2	4.4	2.5	1.2	112
I D	plank	68	3.2	3.9	4.7	2.8	136
I C	post	44	2.9	3.9	1.4	1.4	151

Of the other six timbers sampled, one, post G from Trench III was unsuitable for measurements. The others were posts from Trench I, III, VIII, IX and XII respectively. The number of rings measured on these samples ranged from 34 to 67; their mean widths, from 1.9 to 4.4mm. Two timbers had sapwood, with 8 and 15 year rings respectively.

* With the sequence of III 4. III H was also matched ($t = 4.4$) for us by J. Hillam using her mean curve for Peninsular House, London.

† With the sequence of III 2.

‡ With the sequence of III H.

§ The mean width of these are approximately 1.7mm. The coefficient of fluctuation of the Hollstein chronology is much higher (28%) than the other two (*c.*14%).

Fig. 2. Details for samples with tree-ring sequences matched and dated.

This agrees, broadly speaking, with the sapwood of oaks grown and used in the London region in the 16th century for panels.

In the present work it is necessary, however, to make an allowance not only for a few oaks comparable in age to those used for panels, but also for the fast grown oaks with under 70 rings which formed nine of the thirteen samples on which measurements were made. Hollstein found 16 ± 4.5 rings for trees under 100 years old. For 132 oaks with less than 50 heartwood rings, Siebenlist-Giertz[16] found 28 (21%) with under ten sapwood rings, the lowest being six; while Brathen[17] finds the mean is 16 for 67 oaks in the Gotha River area of Sweden. The estimates presented here are based on measurements, admittedly fewer than those by the persons mentioned above, on discs from trees recently felled in south-eastern Britain and from trees used in historic times. In the caption to Fig. 3[18] they are related partly to the age of trees but mainly to the mean width of the latest rings. The uncertainty factor increases from (13 − 8) = 5 years for trees felled when growing fast, to (40 − 25) = 15 years for those felled when very old.

In Fig. 3, the minimum likely total of sapwood rings gives, when added to the date of the latest ring, the *terminus post quem* for the samples with no sapwood. Much more important, as it provides the period in which the artefact was used, is the allowance, a small number of years, for the two samples (III 1 and I C) with sapwood. That gives, as the likely period of the felling of the tree from which the beam III 1 was made, the years AD 137–142.

RESULTS

As it was the practice to use timber when 'green', felling and use are likely to have occurred within a year.[19] The main conclusion of archaeological interest is therefore that quay B was constructed within about 3 years of AD 140. The *terminus post quem* for beam I E is consistent with it forming part of quay B, while it is not surprising that the results for plank I D and post I C show they are somewhat later as they were both found in front of the quay.

Beam III H when recovered formed part of quay B immediately to the east of III 2, 3 and 4. It had false tenons and dovetailed joints similar to them. The tree-ring work however shows that it was apparently re-used in that position as, on the one hand, its ring-width sequence ended as much as 90 years before quay B was constructed, while on the other hand, its square section, 12ins × 12ins, was unusual for the large members of quay B which were rectangular rather than square. It may well have been used originally in the adjacent and earlier quay A;

			Sapwood rings			
Timber	*Date of latest ring*	*Mean width of latest rings*	*Likely total*	*Present*	*Likely period of felling and use*	*Use*
Beam III H	AD 48	1.3mm	20/32	nil	After AD 68	Reused in Quay B originally in A
Beam III 4	107	1.7	15/25	nil	After AD 122	In Quay B
Beam III 3	112	1.2	20/32	nil	After AD 132	
Beam III 2	75	1.2	20/32	nil	After AD 95	
Beam III 1	134	4	7/12	5	AD 137–142	
Beam I E	112	2	12/20	nil	After AD 124	
Plank I D	136	variable	10/25	nil	After AD 146	Later addition or replacement
Post I C	151	3.5	8/13	10	AD 152–155	

Note: For oaks in south-east England, the best estimate of the relation between age, rate of growth shortly before felling and the likely number of rings in the (total) sapwood is as follows:

Mean width of latest rings (mm):	3 to 4, 2.4 to 3, 1.8 to 2.3, 1.3 to 1.7, 0.9 to 1.2, 0.8 and under.
Likely number of rings in sapwood:	8 to 13, 10 to 16, 12 to 20, 15 to 25, 20 to 32, 25 to 40.
Likely age when felled:	Under 100 years

Fig. 3. Derivation, by allowing for absent sapwood, of likely period of selling and use.

if so, it provides for that quay the *terminus post quem* of *c.* AD 70.

DISCUSSION

(a) Significance for the dating of excavated material in southern Britain.

This investigation of the Custom House material shows that it is not merely the need for many samples, as recently stressed,[20] that leads to a close approximation to the date of construction of an artefact. The quality as well as the quantity of the samples is important; here there has been considerable benefit from having some long sequences, readily matched and dated, together with short ones with sapwood from fast grown timber, such as is used for posts. It has been said that samples with under fifty rings should be rejected. Here, as with short sequences from the Somerset levels used to advantage by Morgan, that is far from being the case if they include sapwood.

Recent applications of dendrochronology to excavated Roman material from London have yet to provide a construction date for the Roman riverside defensive wall; and *terminus post quem* dates for samples from Thames Street Tunnel site and Watling Court at London and for the Castle well at Rosemary Lane, Canterbury, have been published with different assessments for sapwood than those argued here.[21] Samples from timber piles below the Roman riverside wall at Blackfriars have provided a mean curve that might have been datable if compared to Hollstein's chronology. The use of indices rather than ring-widths has perhaps made difficult the recognition of long-term trends, which are important for visual matching.

(b) Significance for the knowledge of late Roman London.[22]

Examination by excavation of the waterfront zone of the Roman city of London has been intensely pursued since the work at the Custom House site in 1973. When the results of these excavations have been analysed, a fuller picture of the development and operation of this area of the Roman city will be available. Some indications of the chronological stages by which the quays developed are already apparent[23] and the re-dating of quay B at the Custom House site, argued here, provides further evidence of the diversity of dates that can be suggested for the wooden quay structures discovered on both north and south sides of Upper and Lower Thames Street. Substantial wooden quays to the north of this modern street and with a suggested construction date in the late 1st century AD, have been found on both sides (Miles Lane, Peninsular House, Pudding Lane) of the presumed position of the Roman bridge.[24] To the south of Upper and Lower Thames Street at the Seal House and New Fresh Wharf sites, further quays have been recorded that have a suggested construction date in the late 2nd century or early 3rd century.[25] Despite the fact therefore that quay B at Custom House site lies in approximately the same relative position (to the south of Thames Street), the reassessed date argued here for its construction (by AD 140–43) suggests that it did not form part of the same waterfront development as that at the New Fresh Wharf site (or on the western side of the bridge approach at Seal House). Clearly, detailed evidence of coherent development at specific points along the waterfront zone in the Roman period is lacking and further application of the method and principles used at the Custom House site will be of particular value in giving for other sites dates with comparable precision.

Nevertheless it can be suggested at this stage that different sections or individual quays along the waterfront were built as

separate developments and at different times, and that no overall plan at any particular era resulted in a single riparian development along all or any considerable part of the city's southern boundary. If construction and date differences ultimately prove this to be the case, the role the development of the waterfront played in the economic life of the Roman city will be of even greater importance.

NOTES

1. T. Tatton-Brown, 'Excavations at Custom House Site, City of London, 1973' *Trans. London Middlesex Archaeol. Soc.* 25 (1974) 117–219; *ibid.* 26 (1975) 103–170. Ian Gourley of the Department of Forestry at Oxford kindly cut and collected the samples in 1973. Frank Walker and Ruth Morgan participated in their examination and measurements of them. Through a family connection, my father having been on the staff of the Custom House, *c.* 1890 and myself a Londoner, I have a personal interest in this waterfront.
2. The earlier waterfront included 3 later timber piles which were driven in later and may relate to the late Roman riverside wall.
3. *Op. cit.* in note 1, 211–15.
4. R. Morgan and J. Schofield in J. Fletcher (ed.) *Dendrochronology in Europe* BAR Int. Ser. 51 (Oxford 1978) 223–238.
5. E. Hollstein *Mitteleuropäische Eichenchronologie* (Mainz 1980).
6. B. Becker 'Fällundsdaten Römischer Bauhölzen' *Fundberichte aus Baden-Wurttemberg* 6 (1981) 369–386.
7. J. Fletcher 'Roman and Saxon dendro dates' *Current Archaeol.* 7 No. 5 (May 1981) 150–2. J. Hillam and R. Morgan 'Dendro dates from Sheffield' *ibid.* 7 No. 9 (Dec. 1981) 286–7.
8. For buildings see J. Fletcher 'A list of tree-ring dates for building timber in southern England and Wales' *Vernacular Architecture* 11 (1980) List 3 and *ibid.* 12 (1981) List 4. For excavations, AD 794 ± 1 for the well at North Elmham and AD 602 ± 2 for that at Portchester, see Fletcher *op. cit.* in note 7.
9. Hollstein has dated material from the late Hallstatt barrow at Magdalenenberg in the Black Forest to a single year; K. Christiansen of Copenhagen, the fortress of Trelleborg to AD 891.
10. Fletcher *op. cit.* in note 7.
11. The principle behind this is that such reference chronologies show the years in which there are consistent changes in the direction of the ring-width curves. Such changes are often called indicators and are marked boldly on the curves to aid visual comparisons.
12. Indicators are explained in note 11. Morgan's sequences for MC 12, the London Waterfront mean curve were rerun in a slightly modified form by the Mittlebin programme to give a chronology (our MC 11) on which indicators are marked.
13. I am grateful to T. Tatton-Brown for this information and for other helpful comments in the preparation of this paper.
14. J. Hillam see *op. cit.* in note 7, applies to fast grown trees used in London and Canterbury values for sapwood allowance that relate to slow grown ones in scattered wettish areas of the British Isles; see the application, for example, of the value of 32 ± 9 years to the four trees that formed the Roman well at Canterbury in P. Bennett *et al.* 'Excavations at Canterbury Castle' *The Archaeology of Canterbury* 1 (1982) 205–9. The samples had 32 to 88 rings and the mean curve ends with widths in the 2.4 to 3mm range; the appropriate (see Fig. 3) allowance would be 10–16 years. The *terminus post quem* would then be after AD 140 rather than 'after AD 152'; such fast grown trees are incorrectly, in forestry terms, described as 'immature'.
15. For these results see Hollstein *op. cit.* in note 5, 36–38.
16. V. Siebenlist-Giertz in B. Scholtam ed., Suidelfingen/Obere Vorstadt, *Forschungen und Berichte der Archäeologie des Mittelalters in Baden-Warltenberg,* 3 (1978) Abb.43.
17. A. Bråthen *Dendrokronologisk serie från västra Sverige 831–1975* RAÄ 1 (Stockholm 1982) 19.
18. This was given in an earlier form in Fletcher (1980) *op. cit.* in note 8, 11.36. Details of the measurements are in course of being reported.
19. Hollstein *op. cit.* in note 5.
20. R. A. Morgan, J. Hillam, J. M. Coles and S. McGrail 'Reconciling tree ring sampling with conservation' *Antiquity* 55 (1981) 90–95.
21. Hillam and Morgan *op. cit.* in note 7, 287.
22. The author is grateful to Dr H. P. A. Chapman for adding this section.
23. B. Hobley and J. Schofield 'Excavations in the City of London. First Interim report 1974–75' *Antiq. J.* 57 (1977) 33–38; B. Hobley 'The London Waterfront—the exception or the rule?' in *Waterfront Archaeology in Britain and Northern Europe* CBA Res. Rep. 41 (1981) 2–3.
24. L. Miller 'Miles Lane: the early Roman Waterfront' *London Archaeol.* 4 No. 6 (Spring 1982) 147.
25. Hobley and Schofield *op. cit.* in note 23, 34, 38: Hillam and Morgan *loc. cit.* in note 21.