

Fragments of a 10th-Century Timber Arcade from Vintner's Place on the London Waterfront

By DAMIAN GOODBURN

with contributions by

IAN TYERS *and* DANA GOODBURN-BROWN

AN ASSEMBLAGE of articulated timbers was recovered from an 11th-century waterfront where they had been reused. They had originally formed part of an arcade of a 10th-century building and exhibit as yet unparalleled features, including the use of an ogival arch. Dendrochronological dating suggests felling of the timbers between A.D. 956 and 979.

During rescue excavations at Vintner's Place in the City of London, Museum of London archaeologists recorded a complex sequence of waterfront structures dating from the end of the 2nd century A.D. to the 14th century. Many of these structures had been partly made of reused timbers. In a roughly made pile and plank revetment dating to the first quarter of the 11th century a unique assemblage of pre-Conquest architectural timbers was found. The timbers were still articulated and comprise a post and associated arches which appear to have once formed part of a timber arcade in a moderately large building. They thus provide important information on the upper parts of a pre-Conquest timber building; such structures have hitherto only been recognized as post-hole, post-pad or foundation-trench patterns.¹ Recently other groups of early medieval reused building timbers from London have received attention but they derive from very different types of buildings.² This study investigates the nature of pre-Conquest buildings above ground, considering implications both during construction and use.

THE VINTNER'S PLACE PROJECT AND THE FIND CONTEXT

The site on which the timber assemblage was excavated lies on the N. bank of the R. Thames, just W. of the N. end of the modern Southwark bridge, and just E. of the late Saxon dock area of Queenhithe (Fig. 1). The N. part of the site was initially reclaimed from the river in Roman times, after which the river migrated southward, of its own accord, in stages during the 10th and 11th centuries. The Vintner's Place

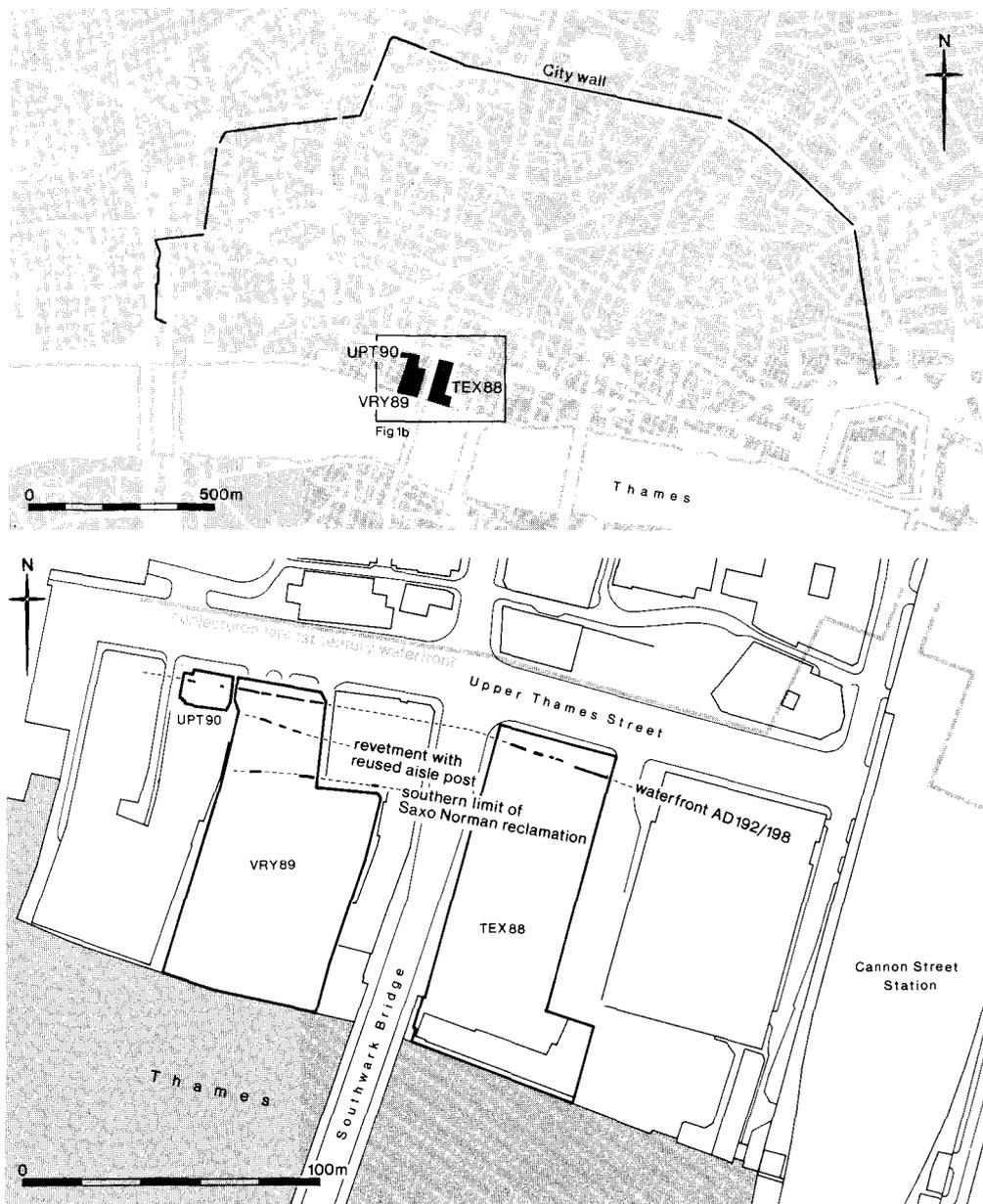


FIG. 1

Above: Map showing the limits of the recent Museum of London archaeological excavations and watching briefs between the late Saxon dock of Queenhithe and the approximate position of the Walbrook river mouth. Below: The line of the excavated later Roman quay timbers, found on all three sites, is shown. The extent of the Saxo-Norman reclamation at Vintner's Place, and the position of the revetment in which the timber arcade assemblage was found are both indicated.

site lay within the core area of the late Saxon town.³ Later the area was concerned with the wine import trade, hence the ward name of Vintry.

The Vintner's Place rescue archaeological project took place in several phases from 1989 to 1991 under the overall supervision of R. Malt, assisted by R. Brown, D. Lees, L. Dyson, and J. Ayre. Although limited areas of the site were excavated under controlled conditions most of the archaeological recording took place during phases of rapid ground reduction, in the form of a 'stopping brief'.⁴ This pace of work required that the recording and sampling of structures be carried out rapidly and selectively. Although some information was clearly lost, a reasonably complete view of the complex archaeological sequence on the site has been recovered.⁵ The assemblage discussed in this paper was one of many important groups recovered; accounts of some others will be published in due course.⁶

THE LAST PHASE OF USE OF THE ARCADE TIMBERS

The arcade post assemblage was found reused as part of a very roughly constructed pile and plank revetment, a type well known from the 10th- to 11th-century waterfronts of London (Pl. III).⁷ This structure ran E.-W. for at least 10 m and would have reinforced the contemporary river embankment against erosion by the tidal Thames. It was for this phase of use that the post was shortened and roughly pointed with an axe. Clearly, this awkwardly shaped and loosely connected assemblage of timbers was unlikely to have been carried very far, and a local origin can be assumed. The dendrochronological analysis suggests that the timbers derive from SE. England, and the cross-matching to other late Saxon timbers from London is reliable. The revetment also contained reused boat timbers and other building timbers which do not appear to have any obvious association with the arcade assemblage and are not described here.⁸

AN INTERMEDIATE PHASE OF CASUAL REUSE

Despite clear evidence of erosion during the last phase of use the post element of the assemblage showed numerous cut marks (Fig. 2), indicating that it was used as a rest on which other timbers had been hewn. For this to have taken place the whole assemblage of timbers must have lain in a position such that the post was near horizontal. Unless one of the planked 'wings' attached to the post was gently supported on a jumble of timbers, overhung a bank or perhaps was buried in soft silt, it would have been broken off by such a reuse. Perhaps the arcade assemblage had lain in a collapsed mass of timbers from a moderately large building near this part of the waterfront.

The Anglo-Saxon Chronicle provides a possible context for the destruction of such a timber building on the pre-Conquest waterfront of 'Londonburgh'. It describes a great 'sea flood' in 1014 in which many people died and lost their homes.⁹ There is some evidence from both Vintner's Place excavations and those on the Bull Wharf site, immediately to the W., of the accumulation of deep silt deposits which were products of flooding episodes in the 10th and 11th centuries.¹⁰ However, these

deposits exhibit fine banding, indicating rhythmic deposition over a period of time, not a single catastrophic event. Perhaps the 'great sea flood' has to be interpreted as a period of flood tides rather than one episode.

DESCRIPTION OF THE TIMBERS

The assemblage is composed of an oak post [5606] of complex shape (Fig. 2). The lower end is bluntly pointed and the top has the beginnings of two arches and a corbel-like bulge on one face. Two short oak planks were fastened to each side of the post at an angle of *c.* 70 degrees ([5607], [5608], [5609], and 5610]) [Pl. III]. The planks were nailed to a small oak cross batten [5718] with distinctive Saxon-style rawl-plugged boat nails (Fig. 3).¹¹ The lower edges of the planks were cut to form what appear to be ogival half arches.

During the unavoidably hurried lifting of the assemblage, the batten holding the two pairs of planks was cut and the assemblage lifted as three units. Unfortunately the thin fragile section of batten that once passed behind the arcade post was lost at this time. However the position of the batten could be clearly traced as a less eroded ridge on the N. side of the post, and two nail shanks that had been part of nails used to fasten it to the post survived (Fig. 2). It was clear that all the timbers were eroded to varying degrees and that the upper parts had decayed due to being above the permanently waterlogged zone and had been damaged by a medieval wall foundation (Pl. III).

THE POST

The post when found was 2.33 m long, though it had originally been longer. The width at the surviving top was 780 mm, and the thickness with the solid corbel 435 mm. The maximum diameter of the slightly oval stem was *c.* 350 mm.

Raw materials

The three-dimensional sculpted timber was hewn out of the stem and first major branching point of a medium-sized oak. The grain patterns clearly indicate that the upper part of the post had been hewn out of the junction of three major branches with the main stem (Fig. 2). The sapwood on the post had been neatly hewn away over nearly all the surface, but enough remained to calculate that the approximate diameter of the parent tree at chest height had been *c.* 0.45 m outside the bark. The truncation of the timber prevents reconstruction of the original height of the parent tree. It had a reasonably straight stem, few large knots and fairly fast growth and the tree probably grew in coppice woodland with standards. However, the ease with which the timber of the post can be matched against other pre-Conquest timbers of 'wildwood' origin suggests an origin in woodland less intensively managed than was typical in the later medieval period or more recent times.¹² The systematic process used to reconstruct hypothetical parent trees for archaeological timbers has been described in detail elsewhere.¹³

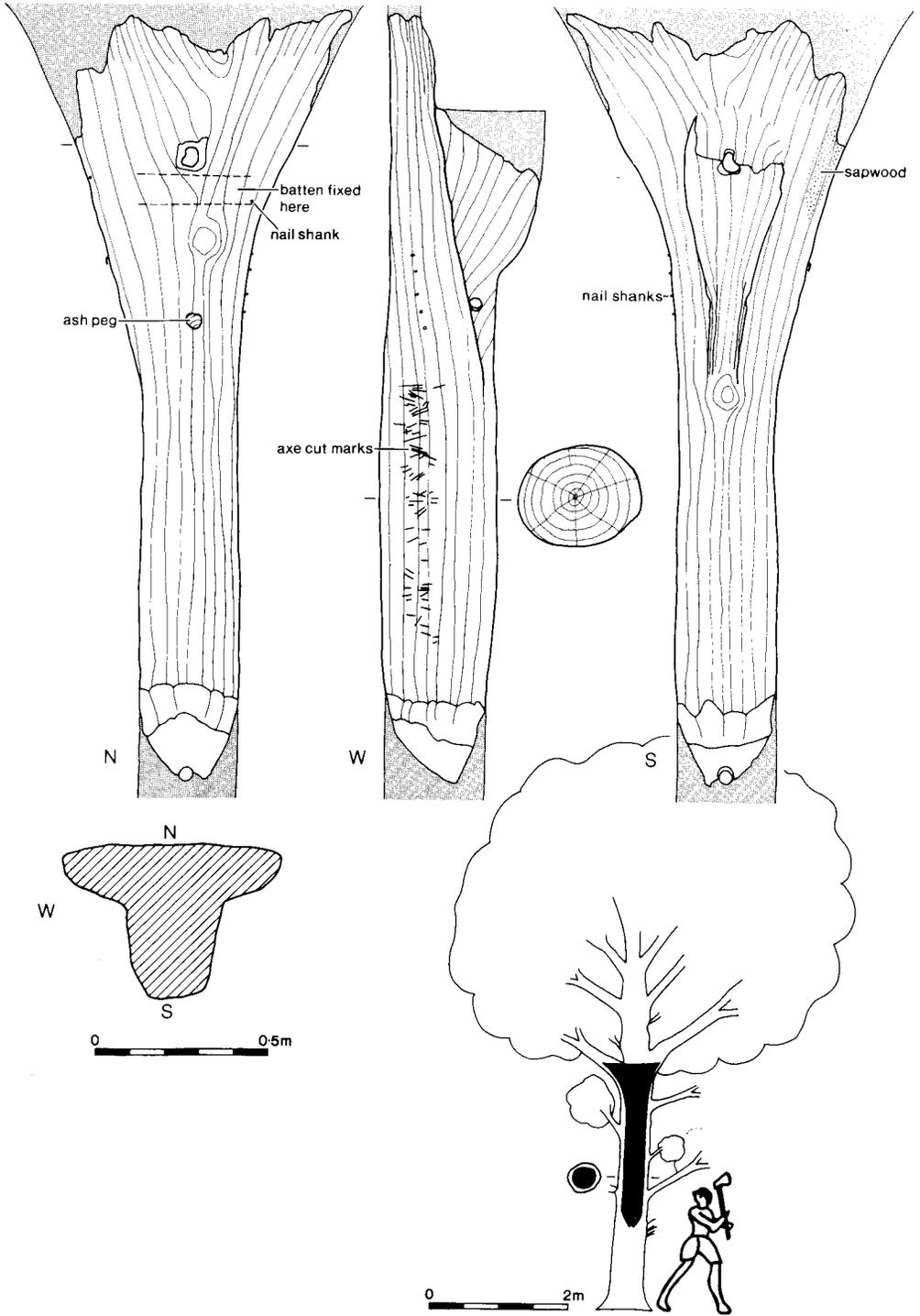


FIG. 2

The Vintner's Place 10th-century arcade post [5606] and the hypothetical parent tree from which it was hewn

Fastenings and joints

The stem of the post was pierced by a 50 mm diameter ash (*Fraxinus excelsior*) peg made from a billet rather than a branch. A hole, probably for another similar large peg, survived at the bottom end. It is not clear how these pegs functioned but it is possible that they were used to hold a beam or batten lapping round the stem of the post, such as are seen in some Norwegian medieval mast churches.¹⁴ Alternatively, the upper peg may have secured a brace timber supporting an aisle tie as in the reconstruction offered below.

The post was also pierced by a total of seven iron nails, with square shanks 8–10 mm across. Four of these were driven into the western edge and one into the eastern. These nails were used to hold the tapering lower ends of the planking in place. Two similar nail shanks were also found in the N. face, which were clearly once used to hold the batten supporting the planking ([5718]) in place. None of the heads of the nails survived.

A hole roughly cut all the way through the post, above the corbel, seems to have been cut to accommodate the end of another timber, articulating at right angles; it is too irregular to be termed a mortice. Another hole cut through the lower tapered end of the corbel appears to have been cut to provide a suspension point as it is too narrow to hold a fastening of any kind.

Toolmarks

There were three apparent phases of toolmarks. The latest marks relate to when the lower end of the post was cut to a blunt point for reuse in the revetment, using an axe with a slightly curved blade wider than 50 mm. A great number of earlier, moderately deep axe 'incut' marks were recorded on one side of [5606], commensurate with those left by hewing other timbers resting on it, clear of the ground.

Despite the erosion and subsequent reuse it was clear that the timber had originally been very smoothly hewn round to true up its outline and remove nearly all of the sapwood. Incut marks survived around the corbelled protrusion, the longest suggesting that the axe or adze had a narrow blade only *c.* 60 mm wide. It is probable that the rounded shape of the stem of the timber was smoothed with some type of drawknife, which might explain the lack of axe or adze paring facets. However, no clear evidence of the use of a drawknife was found, as the surface was abraded. The hole through the corbel was irregular and roughly made but did not have any clearly preserved tool marks. It was slightly hour-glass shaped, perhaps indicating augering and gouging out from both sides.

THE ARCH FILLING PLANKS

The planks attached to each side of the post varied slightly and arbitrarily in length between 0.55–0.73 m when found, but had originally been longer. They also varied in width between 230 mm and 350 mm and had an average thickness of *c.* 35 mm. Both the widths and thicknesses of the planks had originally been a little greater (Fig. 3).

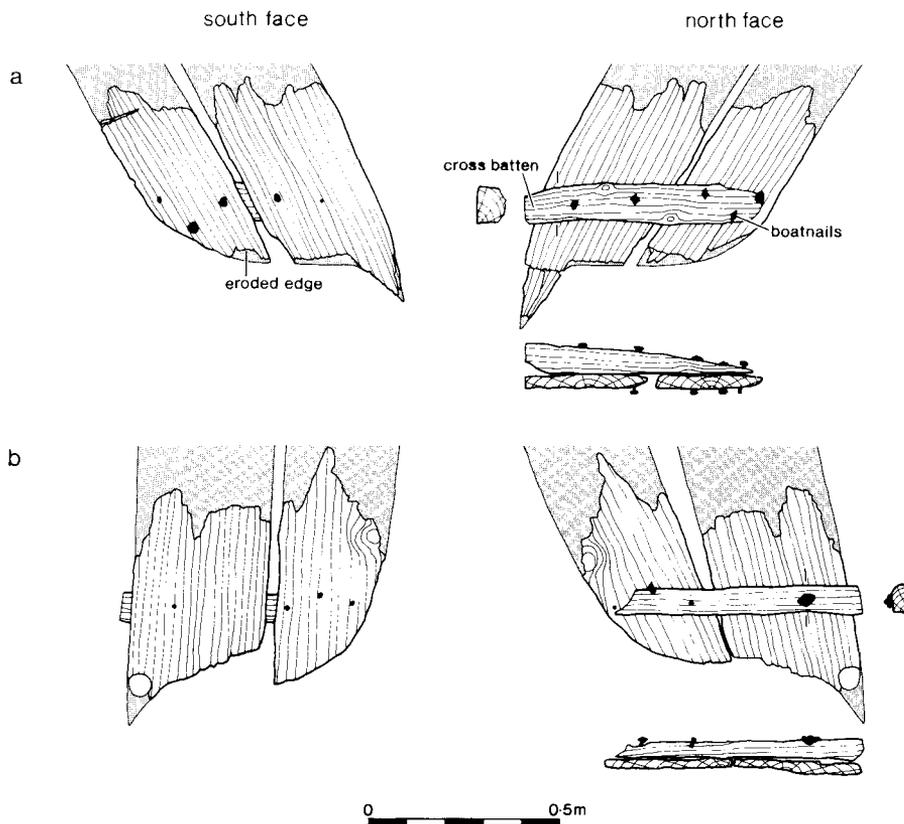


FIG. 3

The Vintner's Place arcade arch filling planks and the cross batten which originally held them to the post [5606], with late Saxon style rawl-plugged boat rivets used as fastenings. Note one of the planks was dislodged when first drawn and due to its fragility it could not be easily aligned

Raw materials

The timbers were cut from a tangentially faced oak plank. The surfaces were heavily eroded so that it was impossible to assess whether they had been sawn out or cleft. However, evidence for lengthwise sawing is unknown at this time in SE. England. The technique was not apparently reintroduced, after the lapse of Roman practice, until perhaps A.D. 1180.¹⁵ The grain of the medium growth rate oak used for the planking was generally reasonably straight, although the E. edge of [5610] was dominated by a large knot. This knot would have made tangential cleaving difficult. On balance, taking the irregularity of the planking widths and thicknesses into account, it would seem that they were probably produced by splitting an oak log in half and hewing one plank from each half. The shortness of the planking prevents reconstruction of the parent tree or trees from which they came, although the parent log or logs would have to have been at least 0.5 m in diameter, probably considerably more.

Fastenings

The planks were very irregularly fastened: [5609] had only one fastening, [5608] had two, and [5607] and [5610] each had three. The iron rivets securing these planks to the batten are highly distinctive rawl-plugged 'rove nails'. These boat rivets are of a specifically Anglo-Saxon type first recorded in the Graveney boat and latterly in several 10th-century fragmentary boat finds from London.¹⁶ The heads of these nails are *c.* 30 mm in diameter and the roves roughly diamond-shaped and *c.* 40 mm long (Fig. 3).

An iron nail shank, *c.* 5 mm square, was found in the W. edge of [5607], indicating that a timber had been fastened edgewise to it. The same edge is also pierced by a slightly degraded 11 mm square non-oak (possibly willow or ash?) peg. These plank edge fastenings clearly indicate the extension of the arch filling planks in some manner.

THE CROSS BATTEN

This timber was, prior to being cut during the lifting of the timbers, originally *c.* 1.26 m long, 100 mm wide and 70 mm thick, the width and thickness clearly having been reduced by erosion (Fig. 3).

Raw materials

The timber was a cleft and hewn quartered segment of oak, with knots and some sapwood. It was pierced by eight rawl-plugged rove nails attaching it to the planking and two square iron spikes which were driven through it into post [5606]. No toolmarks survived.

GRAPHIC RECONSTRUCTION OF THE ARCADE

The first stage in reconstructing the original form of this architectural feature was effected by simply moving cut-out overlay drawings of the various elements around until a 'best fit' was achieved. Nail shanks and nail holes were lined up, as were areas of staining. By this means the slightly dislocated assemblage could be more closely redrawn to its original shape (Fig 4).

It is virtually certain that the main timber was a structural aisle post in an arcaded line of similar posts. As the base of the post had been truncated, the height of this hypothetical arcade is conjectural (Fig. 5b) However, as coppice woodland standard oaks generally produce largely branch-free stem lengths of *c.* 3 and 5 m, the height of the corbel might have been between *c.* 2.2 and 4.5 m, allowing for some height lost to felling.

It is impossible to reconstruct the spacing of the posts in the original arcade with great precision, though the graphic reconstruction of the arch assemblies shows that a spacing of 2.2 m was likely (Fig. 5b). This spacing is slightly less than that recorded as post-pads and hole spacings in the late pre-Conquest aisled hall excavated at Waltham Abbey.¹⁷

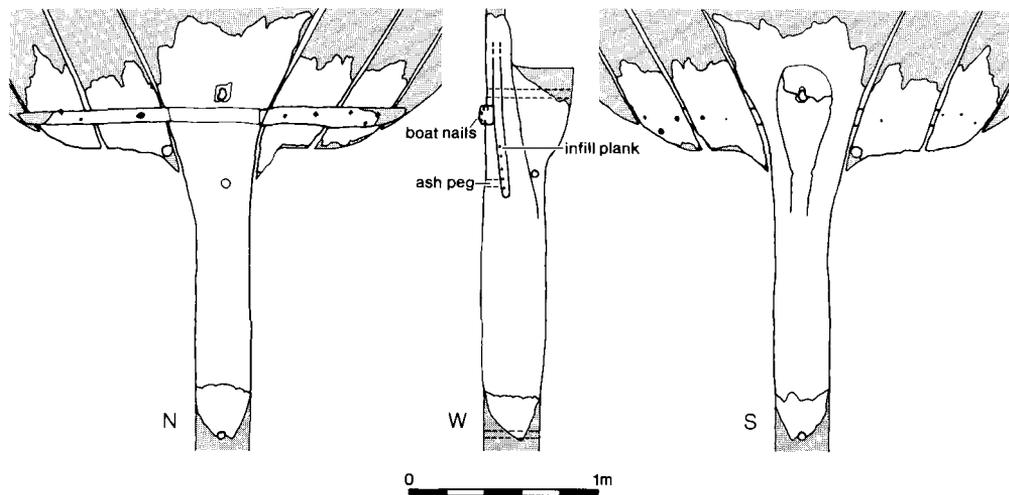


FIG. 4
Reconstruction of the excavated timbers

The assemblage was fragile and could not have been transported very far in antiquity, so a search was made through the site records of the Vintner's Place and Bull Wharf projects (Fig. 1) for evidence of an earlier building plan that might conform to the hypothetically reconstructed nature of the arcade. The flat-bottomed bases of several rounded posts were found decayed *in situ* but none formed part of a line spaced at *c.* 2.2 m centres. However, less than 15 m to the W. of the spot where the arcade assemblage was found, an incomplete line over 8 m in length, of rough post pads and one remaining rounded oak post base was found. These were set about 1.0 m centre to centre¹⁸ and were part of an aisled or arcaded structure. The rounded oak post base *in situ* (UPT90 [7053]) was about 350 mm in diameter, the same as [5606], and had also been shaved of its sapwood and bark in the same manner. Initial post-excitation analysis of the records of this building show that it was extensively rebuilt and the post spacing probably changed. It is possible that the arcade post assemblage was derived from a part of this building where the post interval was about 2.2 m. A longer interval might have been used in any end aisles, but these lay beyond the excavated area at Bull Wharf.

Although the assemblage of timbers is without any close parallels, some individual features such as the corbel can be paralleled in early Romanesque stone architecture in Britain, and in very rare fragments of Norman timber architecture. Perhaps the closest parallel for some of the features can be found in the surviving parts of the late 12th-century great hall of the bishop's palace in Hereford.¹⁹

The great hall is about two hundred years later in date and was no doubt a rather grander, and certainly larger building than that from which the Vintner's Place timbers derive. The graphic cross-sectional reconstructions of the original structure of the Hereford great hall proposed by Raleigh Radford *et al*, have been used

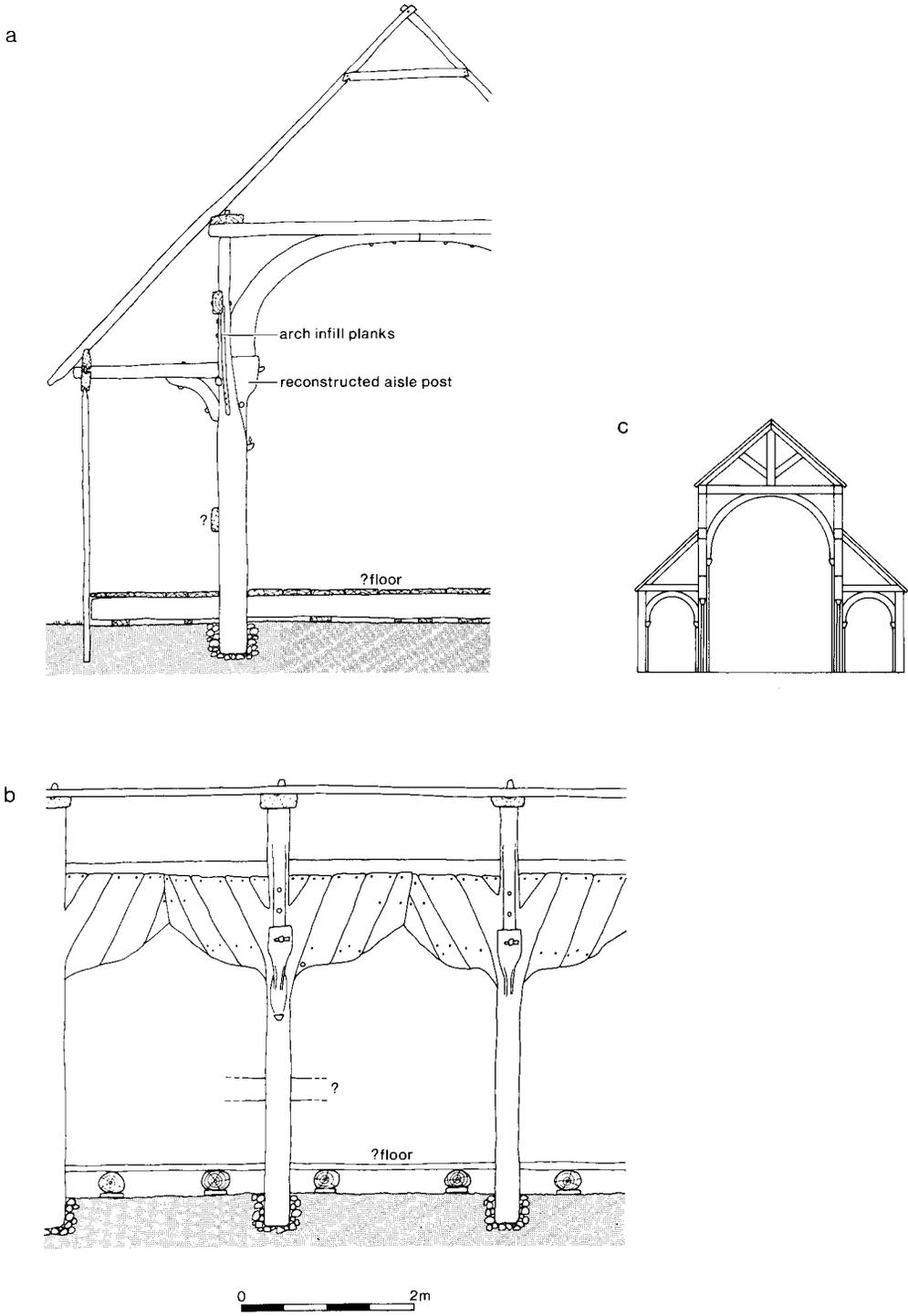


FIG. 5

Reconstruction of the arcade. *a*, *b* hypothetical elevations of the building from which the Vintner's Place timbers were derived. *c* cross-section of the Hereford great hall (after Radford *et al.*)

for comparison here (Fig. 5c). The similarities between the Hereford Palace carpentry and the Vintner's Place arcade assemblage are:

1. Sculpted oak arcade (aisle) posts with capital protuberances used to support other timbers.
2. Decorated arches in the arcade, partly nailed together.
3. Carved, simulated or real nail-head decoration on the arches (real iron nails in the Vintner's Place example).
4. The use of large face pegs to secure other timbers to the arcade posts.
5. The non-structural in-filling above the lower limits of the arcade arches (equivalent to the arch filling planks in the Vintner's Place assemblage).
6. The tapering of the arcade posts towards the arcade plate-roof junction.

There are also some major differences in the style or 'grammar'²⁰ of carpentry used in the later Hereford great hall. Most noteworthy is the use of pegged mortice and tenon joints with neatly cut shoulders between the lowest tier of interrupted beams joining the arcade posts, and in the post themselves. It would appear that the common use of this type of joint in building carpentry begins at the end of the 12th century and so this is an early example. The presence of large transverse curving arch braces implied in the Hereford structure may or may not have been a feature of the parent building for the Vintner's Place assemblage though the size and form of the corbel is suggestive here (Fig. 5a). The corbel might have supported a horizontal tie beam but this is less probable than the curving transverse brace design.

Parallels with later standing Norwegian stave churches of the aisled type can also be drawn. The use of sculpted and shaved-round arcade posts having integral corbels or capitals is well known. The rough mortice that passes through the Vintner's Place arcade post just below the top of the corbel is also similar to the aisle tie joints used in the Norwegian buildings. The decorative plank in-fill above the arcade arches is also known. However, there are clear differences between the 'grammar' of the carpentry exhibited by the Vintner's Place material and the standing Norwegian carpentry which was based on the use of pine as the raw material, and involved a reluctance to use boat nails.

The reliable dating of the Vintner's Place assemblage to A.D. 956–979 is much earlier than the dates proposed for the surviving Norwegian mast churches, and it may be that the stave mast church is a Norwegian derivative of an earlier Anglo-Saxon or Anglo-Scandinavian architectural form. Indeed some early Norwegian scholars have already considered stave churches within the context of 'Saxon architecture',²² and the Greensted stave church in Essex has often been cited as an example of an ancestral form of stave building despite the fact that it has not yet been properly dated or systematically recorded.

DISCUSSION

The Hereford great hall and the mast churches of Norway²³ have been used as models for the reconstruction of the Vintner's Place timber assemblage (Fig. 5).

Jones and Smith saw their investigations of the Hereford great hall as possibly providing some links between the better-known standing buildings of the 13th century²⁴ and buildings known only from excavation. The discovery and investigation of the Vintner's Place assemblage has provided more evidence from the earlier period. However, the find also raises further issues concerning pre-Conquest architecture.

The unusual and complex shape of the arch reconstructed from the shape of the 'wing' planking is unparalleled in surviving masonry or timber architecture in Britain until the late medieval period. However, it is an arch shape also known in Islamic medieval architecture. The shape was not an easy one for the woodworkers to assemble or support, and as it was too weak to have a structural function in the Vintner's Place case, it must be deliberate and decorative. The shape may have been borrowed from contemporary Islamic architecture by a well-travelled inhabitant of the late Saxon port of London. Contacts between the Islamic world and NW. Europe are well known both historically and from archaeological material. A few runic inscriptions demonstrate the presence of NW. Europeans in SE. Europe at about this period.²⁵ Watson recently summarized the evidence for some apparently Islamic influences on Norman architecture in France,²⁶ but this issue clearly requires further investigation.

The use of naturally curving oak timber and distinctive rawl-plugged late Saxon boat nails has links with contemporary ship-building, though the assemblage could not have come from a ship. In medieval times ship rivets were used in church and other high-status doors.²⁷ They were also often covered with images of ships in iron, indicating a symbolic and practical reference to ships and ship-building. Documentary sources demonstrate that shipwrights could be the very craftsmen who carried out some of the work on substantial doors.²⁸ It is also possible that the ogival arch shape, which is reminiscent of the cross sections of some contemporary NW. European ship finds,²⁹ was cut out according to a shipwright's aesthetic sense.

By a strange historical coincidence the late 16th-century historian of London, John Stow, records the existence in the Vintry area of a very unusual building with earth fast posts, about which he made this comment: '... it seemeth that the builders of the hall of this house were shipwrights, and not house carpenters ...'; and of the boarded walls he noted: '... every board ledging over other as in a ship or galley, nailed with ship nails called rough and clenche ...'³⁰ — that is, they were fastened with rove nails as used in contemporary clinker built vessels. Stow felt that the building was not old because it had not 'worm or rottenness'. Perhaps we see here an unexpected survival of an ancient practice of timber building in the maritime areas of port towns, quite beyond what we normally expect of 16th-century carpentry.

Although the arcade post assemblage is part of a building and thus a sample of 'carpentry', the work may have actually been carried out partly or wholly by shipwrights.

The Bayeux Tapestry illustrates another hypothetical parent structure slightly reminiscent of later English market halls, from which the Vintner's Place assemblage could have been derived. The corbel in the post [5606] could then be seen as capable of supporting a heavy floor joist, and so a raised first floor. Such a structure

could have been a functional building within the rapidly growing port area near Queenhithe, even if the majority of trade was carried out from boats on the strand itself.³¹

APPENDIX I

The Tree-ring Analysis

IAN TYERS

The unique nature of the assemblage described here was such that tree-ring sampling and analysis were undertaken at an early stage.³²

The Samples

Of the four planks only [5609] contained more than 50 rings and so was potentially capable of producing a reliable tree-ring date. The cross-batten [5718] also appeared to have enough rings and crucially, even some sapwood. This timber was thus capable of providing a 'felling date range', not just a *terminus post quem*.

Sections of both these timbers were removed after recording had been completed. Following the tree-ring analysis these fragments were returned to be conserved with the rest of the assemblage.

The arcade post [5606] posed a different problem. It was considered essential to sample it to check its relationship with the additional smaller timbers, as it was possible that the minor timbers were repairs or had even been reused from another structure. Unfortunately it was hard to estimate the number of rings it contained, and most of the sapwood had been removed. Two additional factors had to be considered: the tree-ring pattern at the upper end of the timber was likely to be confused at the multiple branching point, and our normal procedure of sawing a slice was considered inappropriate. Thus the post was core sampled in two places to maximize the number of rings recovered and obtain the most recent surviving ring. A Mattson No. 5 Swedish Increment corer was used to cut two 5 mm cores, one near the lower end of the timber to reach the centre of the tree and the other higher up in an area which retained traces of sapwood.

Tree-ring Analysis Results

The samples from the plank [5609] and the cross-batten [5718] contained 79 and 67 rings respectively. The two cores from the arcade post [5606] contained 40 and 55 rings, the sequences were linked visually to provide a composite 58-year sequence. Each sequence was then compared individually with a wide range of independent site chronologies from London covering the period A.D. 400–1600, as well as with chronologies from elsewhere in England and much of NW. Europe covering the last two millennia. It was immediately apparent that all three sequences were producing consistent cross-matches in the 10th century, and that these were also consistent with the cross-matches between the individual sequences.

The dates of the final ring of each sequence are as follows: [5606] A.D. 927 heartwood only (but known to be close to the sapwood boundary), [5609] A.D. 946 at the probable heartwood–sapwood boundary and [5718] A.D. 930 with six sapwood rings. Assuming the assemblage is one build, these results are indicative of felling the trees for the timbers between A.D. 956 and 979.³³

Discussion

The timbers match sixteen contemporaneous tree-ring chronologies from other London sites; these are: 3 from Billingsgate, New Fresh Wharf, Seal House,³⁴ Cheapside, Billingsgate boat, Thames Exchange boat, Bull Wharf, Fennings Wharf and the Clapton boat,³⁵ Milk Street and Tudor Street,³⁶ Thames Exchange,³⁷ and the Fleet Valley, and Vintner's Place sequences,³⁸ as well as a few chronologies from further afield. These results suggest that the timber derived from woodland in SE. England. Despite their short lengths and poor replication there is no reason to doubt the date ranges produced. No alternative positions with significant correlations were discovered against any other reference chronology.

The age of the tree cut for the main post was *c.* 80–100 years (allowing for the missing sapwood) and its fast growth rate may support the discussion above about its original growth type. The presence of such oaks in the London region in the later 10th century has important implications for our

understanding of the nature of woodland at that time. The success of the tree-ring analysis, despite the poor nature of the samples, demonstrates the strength of both the methodology used and the quality of the London chronologies for this period.

APPENDIX II

Note on the Conservation of the Arcade Post Assemblage

DANA GOODBURN-BROWN

The rescue conditions on the site prevented application of sophisticated approaches to lifting of the timbers. The cross-batten was gently sawn through and the arch filling planks were slid gently on to plywood boards, double-labelled and then double-wrapped by field staff. The composite (timber and iron) arch filling planks were wrapped in open cell foam for support and then immersed in a weak solution of Polyethylene Glycol (PEG 4000) and Hostacor, an iron corrosion inhibitor. The solution was heated to 50°C and the percentage of PEG gradually increased to 62 per cent over five months, followed by freeze-drying at the Museum of London.

The central post, containing very little iron, was craned into a large heated tank and treated with many other timbers from London excavations. PEG 4000 was used, taken up to a 50 per cent concentration over nine months. The post was then polythene wrapped, padded and being too long for the Museum's equipment, transported to a larger facility at Portsmouth where it has been freeze-dried successfully by C. O'Shea.

ACKNOWLEDGEMENTS

None of this work would have been possible without the hard work of site archaeological staff of the Museum of London carried out under very difficult rescue conditions. The site contractors Laings were particularly helpful in craning the heavy arcade post off the site. Thanks are also due to S. Gannon for assisting with the recording of this group of timbers. They are also due R. Brown, D. Lees, R. Malt and J. Schofield for reading and commenting on drafts of this paper. However, none of the former are responsible for any mistakes it may still contain. T. Wellman redrew the drawings for publication, and M. Cox took the photographs. The excavation and initial post-excavation work, including this paper, was funded by Wates City, the site developers. Ian Tyers would like to thank D. Goodburn, R. Malt, and H. Hibberd for discussion and comment on the tree-ring analysis report.

NOTES

¹ For a survey of early and mid Anglo-Saxon evidence, see S. James, A. Marshall and M. Millett, 'An Early Medieval Building Tradition', *Archaeol. J.* 141 (1984), 182–215. Also V. Horsman, C. Milne and G. Milne, *Aspects of Anglo-Norman London 1: Building and Street Development*. London and Middlesex Archaeol. Soc. Special Paper 11 (1988) deals with later dry site evidence from London.

² T. Bringham, 'Reused House Timbers from the Billingsgate Site, 1082–83' in G. Milne (ed.), *Timber building Techniques in London c. 900–1400*, London and Middlesex Archaeol. Soc. Special Paper 15 (1992), 86–105.

³ G. Milne and D. Goodburn, 'The Early Medieval Port of London AD 700–1200', *Antiquity* 64 (1990), 629–36.

⁴ G. Milne, 'Approaches to the Archaeological Excavation of the Urban Waterfront: a London View', in J. Coles and D. Goodburn (eds.) *Wet Site Excavation and Survey* (23–26, 1991).

⁵ R. Brown and D. Lees, 'Vintner's Place Site Archive Report' Museum of London, Unpub. (1993).

⁶ Details of the other timbers recorded in detail found on the Vintner's Place excavations are described in D. Goodburn, 'Vintner's Place Archaeological Woodworking Archive Report', Museum of London, Unpub. (1992).

⁷ G. Milne, op. cit. in note 2.

⁸ D. Goodburn, op. cit. in note 6.

⁹ G. Garmonsway, *The Laud Anglo-Saxon Chronicle* (London, 1982) p. 145.

¹⁰ R. Brown and D. Lees, op. cit. in note 5.

¹¹ D. Goodburn, 'Anglo-Saxon boat finds from London: Are They English?' in *Procs. of the 6th International Ship and Boat Archaeology Symposium* (forthcoming).

¹² O. Rackham first introduced a clearly defined terminology in this field, drawing upon medieval English usage; *Trees and Woodland in the British Landscape* (London, 1976). Later he summarized his view of the evidence for Anglo-Saxon woodland types and use of 'Tree Land' in *Ancient Woodlands* (London, 1980).

¹³ D. Goodburn, 'Wet Sites as Archives of Ancient Landscapes', in J. Coles and D. Goodburn (eds.), op. cit. in note 4, 51–53.

- ¹⁴ G. Bugge, 'Stave Churches in Norway' (Dreyer, 1983).
- ¹⁵ Structural attribute table, in G. Milne, note 4.
- ¹⁶ D. Goodburn, 'Some Unfamiliar Aspects of Early Woodworking Revealed by Recent Rescue Excavations in London', in P. Hoffmann (ed.), *Proc. of 4th ICOM Wet Organic Archaeological Materials Conference 1990* (Bræmnerhaven, 1990), 157–61.
- ¹⁷ P. Huggins, 'The Excavation of an 11th-Century Viking Hall and 14th-Century Rooms at Waltham Abbey, Essex, 1969–71', *Medieval Archaeol.* 20 (1976), 75–113.
- ¹⁸ J. Ayre, unpub. Bull Wharf Archive Report, in prep. The post UPT90 [7053] was given a last ring dendrochronological date of A.D. 936, but it did not have an obvious heartwood-sapwood boundary and was given a rough date estimate of A.D. 973++ (N. Nayling pers. comm.). This would allow for a narrow overlap in date with the felling date range given for the Vintner's Place arcade timbers; it is therefore possible that the structure on the Bull Wharf site and the structure from which the Vintner's Place arcade timbers came were contemporary.
- ¹⁹ S. R. Jones and J. T. Smith, 'The Great Hall of The Bishop's Palace at Hereford', *Medieval Archaeol.* 4 (1960) 69–80; C. Ralegh Radford, E. Jope and J. Tonkin, 'The Great Hall of the Bishop's Palace at Hereford', *Medieval Archaeol.* 17 (1973), 78–86; C. Hewett, *English Historic Carpentry* (Chichester, 1980), 39–41.
- ²⁰ R. Harris, 'The Grammar of Carpentry', *Vernacular Architecture* 20 (1989), 1–8.
- ²¹ G. Milne, op. cit. in note 4.
- ²² G. Bugge, op. cit. in note 14, 1.
- ²³ G. Bugge, op. cit. in note 14.
- ²⁴ D. Stenning, 'Report on the Crossing Temple Barley Barn and Associated Early Aisled Barns', Essex County Council, forthcoming.
- ²⁵ R. Page, 'Rune Masters and Skalds', in J. Graham-Cambell, *The Viking World* (London, 1980), 154–67.
- ²⁶ K. Watson, 'Islamic Contributions to Western Architecture', in *Medieval Europe 1992, Technology and Innovation*, Pre-printed Papers, 3 (York, 1992), 126–31.
- ²⁷ C. Hewett, op. cit. in note 4; see section on ecclesiastical doors.
- ²⁸ L. Salzman, *Building in England down to 1540*, (Oxford, 1952), 309.
- ²⁹ O. Olsen and O. Crumlin-Pedersen, *Five Ships From Roskilde Fjord* (Copenhagen, 1978).
- ³⁰ J. Stow, *The Survey of London*, (London, 1987), 124. First published 1598, Stow was born in 1525.
- ³¹ G. Milne and D. Goodburn, op. cit. in note 3.
- ³² See for example M. G. L. Baillie, *Tree-ring Dating and Archaeology* (London, 1982) for details of dendrochronological methodology.
- ³³ J. Hillam, R. Morgan, and I. Tyers, 'Sapwood Estimates and the Dating of Short Ring Sequencies', in R. Ward (ed.), *Applications of tree-ring studies — Current Research in Dendrochronology and Related Subjects*, British Archaeol. Reports, Int. Series 333, 165–85.
- ³⁴ J. Hillam, 'Appendix 2: Tree-ring Analysis of Oak Timbers', in K. Steadman, T. Dyson and J. Schofield, 'Aspects of Saxo-Norman London: III The Bridgehead and Billingsgate to 1200', 143–73. London and Middlesex Archaeol. Soc. Special Paper 14 (1992).
- ³⁵ I. Tyers, Unpub., Cheapside, and London Boat Find Chronologies; Fennings Wharf, Bull Wharf, and Clapton Dugout.
- ³⁶ J. Hillam, Unpub., Milk St. and Tudor St. Chronologies.
- ³⁷ N. Nayling, Unpub., Thames Exchange Chronologies.
- ³⁸ H. Hibberd, Unpub., Vintner's Place and Fleet Valley project.