

EDWARD IV'S BULWARK: EXCAVATIONS AT TOWER HILL, LONDON, 1985

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SUMMARY

Excavations within a drainage trench traversing Tower Hill uncovered remains of an 11th or 12th-century structure and the Tower Bulwark, an outwork or barbican to the Lion Tower begun by Edward IV in 1480. Defensive walls, the northern bastion and a building attached to the inside of the Bulwark walls were all recorded. Evidence of bone-working and smithying was discovered in the cellar of the building, while a large group of distillation vessels was found nearby. Encroachments against the Bulwark were pulled down during the Great Fire of 1666 to help create a fire break. Demolition of the Bulwark itself began in 1668 as part of a scheme to strengthen the western entrance to the Tower. During the early 18th century its visible remains were concealed by the landscaping of Tower Hill.

INTRODUCTION

Between November 1985 and January 1986 the Museum of London's Department of Greater London Archaeology undertook an archaeological excavation at Tower Hill (TQ 3346 8063; see Figs 1 and 2, and Pl 1) prior to relandscaping and repaving. Most of the work was confined to a drainage trench 120m long and 2m wide which extended from the foot of Tower Hill northwards to the junction with Byward Street.

Practical limitations and restrictions on the excavation

Excavation could not take place below the designated level of the drainage pipe (hereafter

called the 'invert level'), which varied in depth between 1.5m and 2.0m below modern ground level. As a consequence the full archaeological sequence could not be examined in most areas. The unusual shape and limited area of the excavation (see Fig 2), in addition to the relandscaping, hindered the analysis of stratigraphic relationships. In some areas modern relandscaping had truncated all archaeological deposits down to the surface of the terrace sands and gravels.

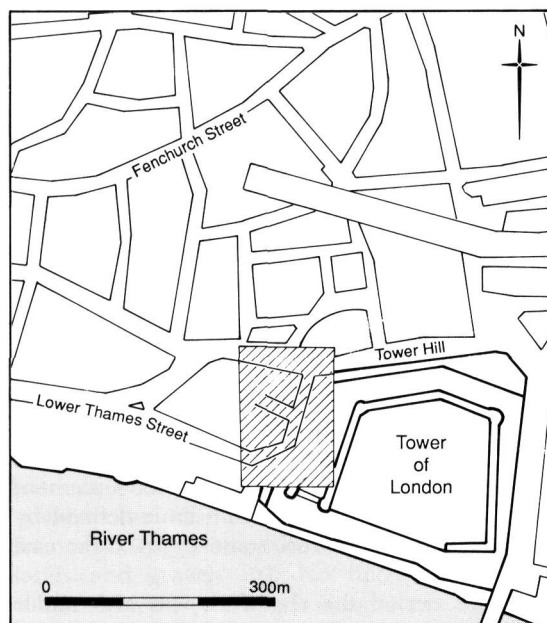


Fig 1. Location plan of site

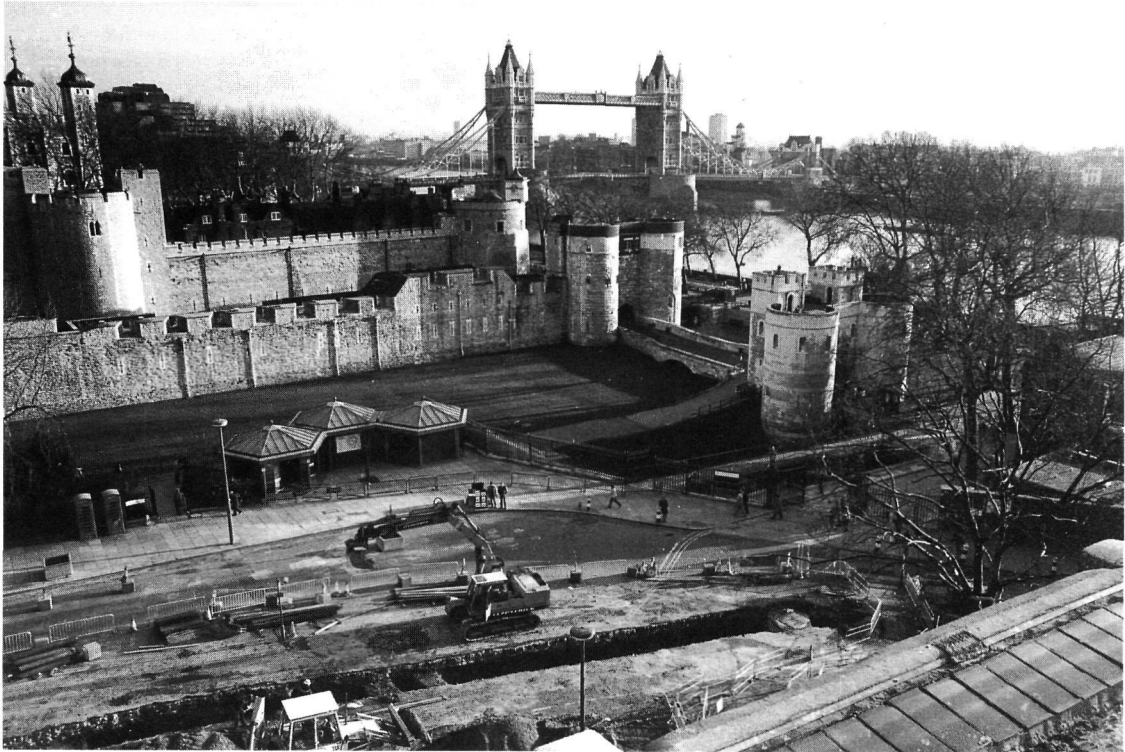


Plate 1. The Tower of London looking east with excavation trench in the foreground

Previous archaeological and documentary evidence for the occupation of Tower Hill

Tower Hill has developed continuously since the medieval period, and excavation has indicated earlier activity. Evidence of prehistoric land-use came to light in 1976 when excavations along the southern side of the Tower of London located a pit containing possible Iron Age pottery and cut in turn by a shallow inhumation burial (Parnell 1977, 97). No other pre-Roman occupation has been identified in the immediate area.

A mid to late 1st-century burial, found near the church of All Hallows (Page 1909, fig 1), suggests the presence of an early Roman cemetery just north of the excavation (Merrifield 1983, 112). The cemetery may have been abandoned in the late 1st century when the settlement boundary was extended to the limit defined by the City wall of c.AD 200, some 175m to the east of Tower Hill.

At this period the riverfront was also under development: two Roman quays were revealed during excavations at the Custom House

immediately west of Tower Hill (Tatton-Brown 1974, 117–219). First-century building was also taking place along the Thames c.200m to the east (Parnell 1977, 97; 1981, 71; 1982, 88) and on the near side of the ‘Lorteburn’ valley east of Seething Lane (Bentley 1984, 13–16).

A mosaic pavement and ragstone walls found below All Hallows Barking indicate that high-quality Roman buildings superseded the redundant cemetery to the north of Tower Hill at about the time the City wall was built. There is little further evidence of activity in the south-east corner of the Roman city until the 4th century when the river wall was added to the City’s defences. This has been excavated at the Custom House site (Tatton-Brown 1974, 122) and along the south side of the Tower of London (Parnell 1977, 97; 1982, 133). Its projected alignment suggests that it ran just beyond the southern limit of the Tower Hill 1985 excavation.

Evidence of later Roman activity was found north of Lower Thames Street where a possible 5th-century house or hostel has been excavated (Marsden 1980, 152–5). The site also revealed 5th-century Saxon activity and later 7th or

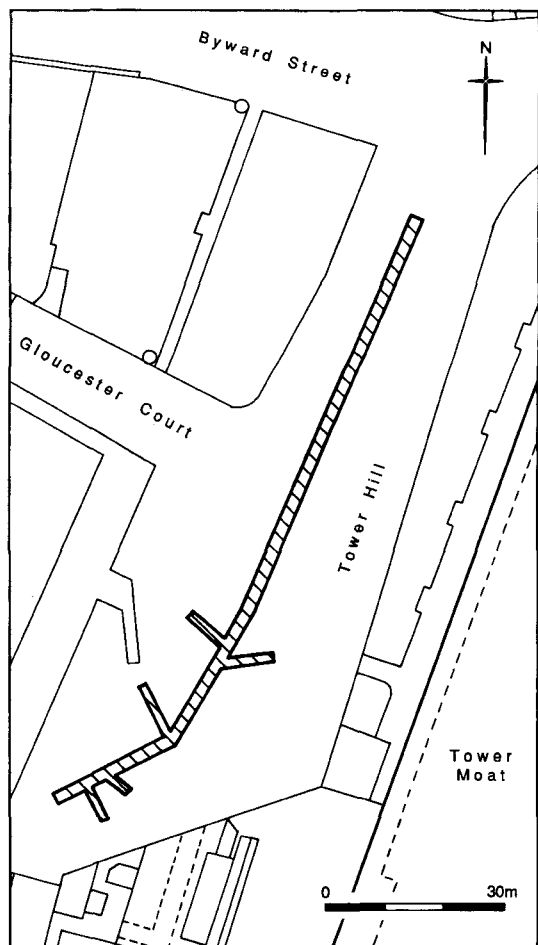


Fig 2. Location plan of drainage trench

8th-century robbing for building material, possibly for use at All Hallows Barking.

After the abandonment of the Lower Thames Street house, no subsequent activity is recorded until the 12th century when a rammed gravel surface was laid down which Merrifield (1983, 255) suggests was a road. This break in activity was also recognised on the Custom House site and was marked by a series of sandy gravels, possibly deposited during a phase of marine transgression (Tatton-Brown 1974, 120).

From the earliest stages of the Norman Conquest defensive structures were built within the City walls. One such may have been located within the south-east corner of the City walls of c.AD 200. Later, from c. 1078, the White Tower was erected, and beginning in 1184 the castle was enlarged by extending the bailey to the west and encircling it with a moat. More defensive

structures were added between 1275 and 1285, when a new curtain wall and moat were provided, and the main entrance was moved from the middle of the western curtain wall to the south-west corner. In the two centuries that followed, only repairs are recorded to the western entrance. There is no evidence of substantial modification until Edward IV's construction of the Bulwark or outwork to the Lion Tower in 1480, which proved to be the principal feature of the present excavation.

Topography and geology (contexts [1]–[3])

Tower Hill is formed by a spur extending southwards from the northern edge of the lowest river terrace. The excavation trench ran north-south down the southern scarp from just below the summit and terminated c.20m north of the pre-Roman bank of the Thames.

Owing to the restrictions imposed by the invert level, natural river terrace deposits were recorded in only two areas; one opposite Gloucester Court, and the other a further 20m to the south. The river terrace deposits [1] consisted of bands of pale yellow and pale orange fluvial sandy gravels with occasional bands of darker stained gravel.

Ordnance datum heights taken from these areas show that deposits slope downwards from +8.46m OD in the north to +6.65m OD in the south. Although this represents a drop of 1.80m over a distance of 38m (an inclination of about 1 in 20), it need not represent the natural slope, which may have been altered by relandscaping. As previous excavations in the area located a thin layer of brickearth overlying the river terrace gravels (Tower Hill underground station, Parnell 1982, 125; Wakefield Gardens, Whipp 1980, 49), its absence at Tower Hill would suggest that the slope had been artificially modified.

The fluvial sands and gravels were overlaid by a series of clean silty sands [2], which were recorded in the excavation trench just north of Gloucester Court. The deposit was 0.25m thick and may have been formed by accumulating hillwash material. The layer sloped downwards towards the eastern limit of excavation and formed a depression which was filled with 'clean' sands and gravels [3]. No finds or traces of charcoal were retrieved from these deposits, confirming that they probably evolved before the occupation of Tower Hill.

THE SITE**Roman** (contexts [4]–[6])

Although a possible Iron Age inhumation was found on the southern side of the Tower (Parnell 1977, 97), the earliest material on the Tower Hill site was dated to the Roman period. A south-west to north-east orientated linear feature [4], between 2.40m and 4.40m wide, was observed over a distance of 5m opposite Gloucester Court and may have been formed by natural erosion. Although it was cut into the fluvial sands and gravels, its relationship with the early hillwash had been destroyed by modern truncation, and its full profile is unknown since only the bottom 0.30m survived. The base was flat in cross-section and sloped downwards towards the south. It was filled with fine sand containing rare shell fragments and charcoal flecks. One sherd of 1st-century pottery was found in the northern fill [5], while the southern half produced a small amount of pottery which dated to after AD 120. A 17th-century clay pipe stem found in the feature is thought to be a modern intrusion. No other Roman features were observed during the excavation.

Another early feature [6] which cut hillwash deposits [2] was located 10m to the north of feature [4]. Owing to depth restrictions imposed on the excavation, it was not completely excavated and no finds were recovered. Its eastern side formed an arc which extended westwards beyond the limit of excavation. Although the date and function are unknown, the early status of the feature is confirmed stratigraphically as it cut 'clean' hillwash material [2] and was sealed by later deposits [7].

Post-Roman (context [7])

The area may have been abandoned after the Roman period when a 0.30m deep layer of sterile, clean sandy clay and clayey silt [7] accumulated. The deposit was located just north of Gloucester Court and probably represents hillwash or natural soil, or both.

Early medieval*Development of soils* (contexts [8]–[12])

Further hillwash material [8] accumulated over layer [7] and formed a thick deposit of sandy clayey silt up to 1.0m deep.

Lower down the slope the deposit was represented by layers of sandy silt and clay [9]–[12]. Unlike the earlier hillwash, this material contained charcoal, mortar flecks, fragments of animal bone and oyster shell whose presence suggests that this area of Tower Hill was once again occupied. The thickness of these layers indicates that they may not have derived exclusively from hillwash, but may also represent agricultural activity or upcast dumped on the site during levelling prior to building. Several 12th-century sherds were retrieved from these deposits, including fragments from cooking pots in Early Surrey ware and chalk-tempered ware (Fig 16, No. 2). Early 12th-century masonry foundations were located c.90m north of the excavation (Tucker 1988), and an 11th or 12th-century structure was located just south of Gloucester Court (see below).

Further to the south these deposits were truncated during the construction of the Bulwark, while, to the north, depth restrictions precluded investigation.

11th/12th-century building (contexts [13]–[15])
(Figs 3, 4)

An ill-defined building was recorded just south of Gloucester Court, but was observed in the western section of the site where controlled excavation was not possible; the following interpretations must therefore be seen as tentative.

The deposits consisted of floor make-up and levelling material [13] derived from redeposited natural, overlaid by a floor [14] composed of brickearth make-up over which a surface of crushed chalk was laid. Demolition material [15] was composed of pale brown mortar, chalk and ragstone cobbles, and was dumped over the crushed chalk surface. Fifty-five sherds of pottery were recovered from this material and dated the demolition to the 12th century, including Fig 16, No. 3. The relationship between the structure and the hillwash was destroyed by later intrusions.

Area of rubbish pits (contexts [16]–[27])

A number of pits concentrated in an area c.40m north of the structural remains were excavated, but the associated ground surface was truncated by modern road make-up. Twelve pits were excavated in all, three of them dated by pottery

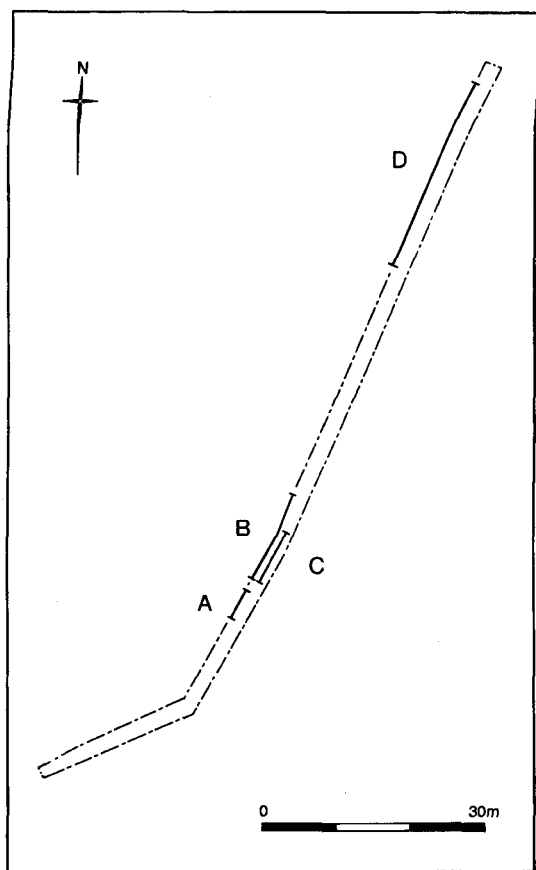


Fig 3. Location of sections

to the 12th century. Several residual Roman tile fragments, two *tesserae* and an irregular copy of a coin dated to the reign of Tetricus I (governor of the Gallic Empire, AD 270–73) or soon after, were also found within the fills of these pits (see Coin Report, below). As all but two of the fills were similar, and contained similar inclusions, the whole group has been analysed together.

In one part of the concentration a sequence of four pits was excavated. The entire sequence is dated by pottery to the 12th century, and it is suggested that this part of Tower Hill was used as an 'open' refuse area.

All the pits extended beyond the limit of excavation, obscuring their interpretation. They were divided by shape into two groups; those which appeared to be circular, and those which were square. Their surviving lengths ranged from 0.80m to 2.60m. Nearly all were filled with dark clayey silts which contained fragments of animal bone, residual Roman tile, oyster shell, charcoal

and cobbles of greensand and chalk. Pit [16] was filled with sands and sandy clays with tip lines of almost pure charcoal, and a mixture of charcoal and sandy clay. The fill also contained inclusions similar to those in the other pits, as well as fragments of mortar. Pit [17] contained an upper fill similar to that in the other pits but was lined with packed chalk fragments and flint pebbles. The lining was 0.10m thick at the sides of the pit and 0.25m on the bottom.

All the pits, with the exception of [17], have been interpreted as rubbish pits. Pit [17] may have had an industrial usage, *eg* tanning or fulling.

Medieval (contexts [28]–[34])

A layer of sandy silt [28] accumulated over the demolition rubble of the 12th-century building, suggesting further neglect and accumulation of hillwash. The 0.25m thick deposit contained many pebbles, tile and mortar fragments, and agriculture or dumping may also have contributed to its formation.

A similar combination of events may have been responsible for the deposition of a widespread deposit of sandy silt with clay lenses [29]–[32], which were excavated *c.*50m further up the hillside. Clay lenses, however, do not seem characteristic of hillwash and may indicate that the material was dumped in the wake of relandscaping, and the presence of clay would suggest that it originated from further down the slope. It formed a 0.75m thick layer before continuing beyond invert level. Several sherds of pottery were recovered from the layer, which indicate that it was deposited in the mid-13th century (Fig 16, Nos 4–6).

Cut into the dumped material was a large feature [33] whose shape and function were obscured by subsequent intrusions. Several sherds of residual Roman pottery were recovered from the fill [34], but the feature was dated to the 13th century by sherds of London ware and South Hertfordshire ware. The 13th-century deposits lower down Tower Hill were truncated during the construction of the Bulwark in *c.*1480.

Late medieval (contexts [35], [36])

Prior to the construction of the Bulwark, the lower part of Tower Hill was levelled by dumping clays [35] and [36] over the hillwash. The dumps

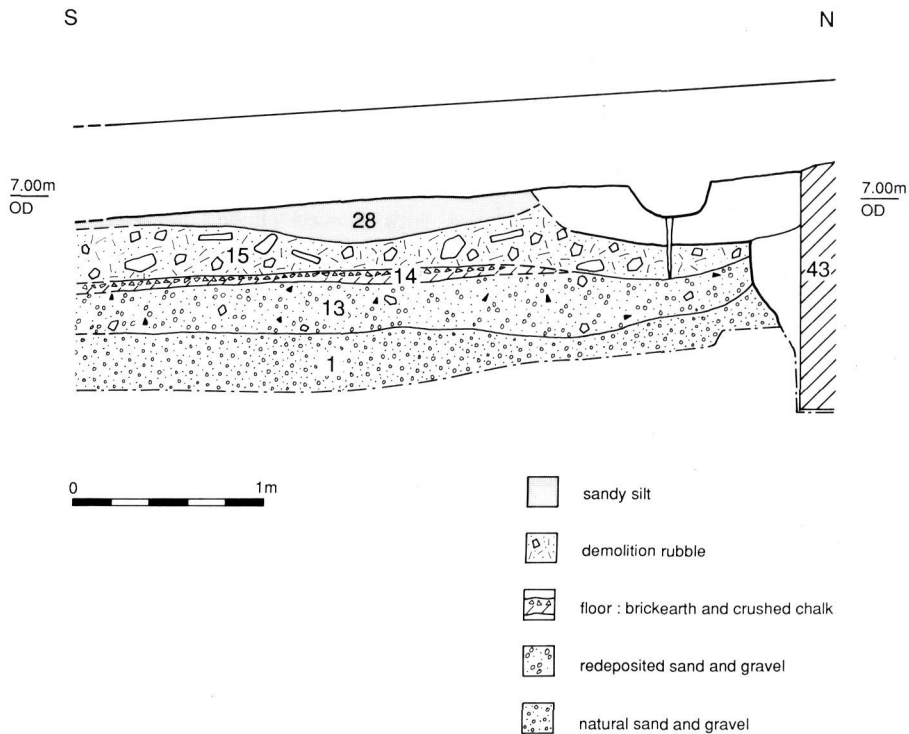


Fig 4. Section A

contained lenses of sandy gravel, pebbles and flint nodules, and were at least 1.0m thick above invert level. They are not considered to represent flood deposits since they extended c.2.5m above the medieval highest astronomical tides (Milne & Milne 1982, 60), to heights of +6.25m OD and +4.23m OD respectively.

Construction of the Bulwark (contexts [37]–[48])

The foundations of the brick Bulwark were cut into the hillwash and clay deposits at the bottom of Tower Hill (see Fig 8). The outer defensive walls were built first, and were encountered at the southern end of the trench, where the Bulwark defences seem to have comprised two parallel walls set on trench built foundations: an outer wall [37], and an inner wall [38]. The space between the walls was 1.20m wide, and each wall was 1.20m thick and survived to a height of 2.30m. In between were three small cross-walls [39], [40] and [41] whose function is unknown but which probably provided strengthening and support for a parapet walkway. No deliberate infilling of the space that could be

considered structural was observed during the excavation.

Further north, opposite Gloucester Court, the initial Bulwark defences were represented by walls [42], [43] and [44], which formed three sides of a square and suggested a hollow bastion (see Fig 9). Walls [42] and [43] were c.1.0m thick and survived to a height of 1.5m, while wall [44] extended beyond the limit of excavation. All the walls were bonded to each other and represented a single phase of building. Wall [45] was bonded with the side of wall [42] and extended northwards from it, curving slightly towards the east. It may have represented a rounded bastion associated with the Bulwark gate and designed to accommodate artillery intended to cover Great Tower Street (Colvin 1963, 1.452–3; Ross 1975, 272).

A large cut feature [46] was excavated just outside the northern end of the Bulwark. It extended at least 8.0m northwards from the bastion foundation of wall [45] before being truncated by a later cut feature [88]. Its eastern and western sides extended beyond the limits of excavation, making interpretation difficult, but it may represent an external ditch associated with

the defence of the Bulwark. Primary fills [47] and [48] accumulated over the foundation of wall [45] and were composed of waterlaid silts and clays.

The salient feature of this period, and of the whole excavation, was the location of the northern part of the Bulwark or outwork constructed outside the Lion Tower by Edward IV in 1480. It will be useful to consider first the documentary background to this late addition to the Tower's defences.

The documentary evidence for the Bulwark

Geoffrey Parnell

The vast and expensive works carried out by Edward I at the Tower, mainly between the years 1275 and 1285, marked the ultimate expansion of the castle. Apart from a few modifications and additions, the concentric pattern of the defences established at the end of the 13th century is essentially the plan that survives to this day.¹

Edward I's scheme involved the excavation of the outer moat and the resiting of the main western entrance from a position along the projected line of Great Tower Street (*ie* the site of the present Beauchamp Tower) to the south-west corner of the defences. The new arrangement comprised an inner and outer gatehouse (Byward and Middle Towers) with a great half-moon shaped barbican beyond. This imposing structure, known as the Lion Tower because of its long association with the king's beasts, was approached by a causeway to the north, itself controlled by another small gate labelled the 'Lyons Gate' on the 1597 survey (Fig 5). All this seems to have been completed by the summer of 1281 when the new approach was in use. It might also be mentioned that the slope of Tower Hill at this time was terraced and planted with vines and fruit trees by the king's gardener.²

During the next two hundred years repairs to the western entrance are recorded, but there is no evidence for any remodelling of the established layout. According to John Stow it was Edward IV who ordered the approach to be further strengthened by the addition of the brick outwork known as the Bulwark,³ a statement supported by an entry in a draft Tellers' Roll of c.1480 for £16 towards 'making the bulwark at the Tower of London.'⁴

On 9 March 1484, a certain Thomas Redhede

was appointed 'porter of the Tower of London and Keeper of *le bulwerk* without the west gate of the same and 6d daily for his wages ... and a mansion within the bulwark aforesaid.'⁵ The following year the post was granted to Robert Jay, 'the houses on Tower Wharf and the gardens on Tower Hill' also being included within his custody.⁶ In 1495, when an inventory of ordnance at the Tower was prepared, three guns are listed as being 'in the Bulwark'.⁷

References to the Bulwark in surviving 16th-century accounts are often brief and provide little evidence for the appearance and condition of the structure. Some recommendations made in a report on the state of the Tower and its Liberties while Sir Francis Jobson was Lieutenant of the Tower, and therefore dated some time between 1564 and 1570, may, however, be cited:

Also we present that any p[er]sons keeping Shoppes or Sheddys within the Bullwarke shall not lye within the same a night, except they be English men ...

Also we present all the Inhabitants within the sayd Bullwark or else within the libertys of the sayd Tower, for casting their Rubbish into the Tower dytch, or on Tower hyll ...

Also we present the Smyths shedds adjoyning to the said Bullwark on the backsyde of James Jacob's howse, unmeete to stand there for that it is hurtfull to the sayd Bullwark.⁸

At about this time the first cartographic evidence for the Bulwark begins to appear. Wyngaerde's view of c.1550 shows the enclosure with a large entrance on the north-east corner and a bastion on the north-west corner. To the rear of the latter stands a building, to the south a gatehouse controls the narrow passage from the wharf.⁹ A similar representation is shown on the Agas map of c.1560, with an additional building depicted against the inside of the west wall.¹⁰ An elevation of the northern defences is featured in a herald's sketch of Queen Elizabeth's coronation procession leaving the Tower in January 1559 (Fig 6), while more detail can be found on the Haiward and Gascoyne bird's-eye survey of the Tower in 1597 (Fig 5). By then the west wall of the Bulwark, the area about the Tower Hill entrance and the edge of the moat immediately to the north, are seen to be crowded with buildings. These and other encroachments evidently formed the subject of a letter from the Lieutenant of the Tower, Sir William Waad, and two chief officers of the Works in 1606, part of which reads:

Moreover, where there is one chiefe Bullwark on the west syde of the hyll, to which all the Tower hyll is subject, the same is quite within few yeres made no use by

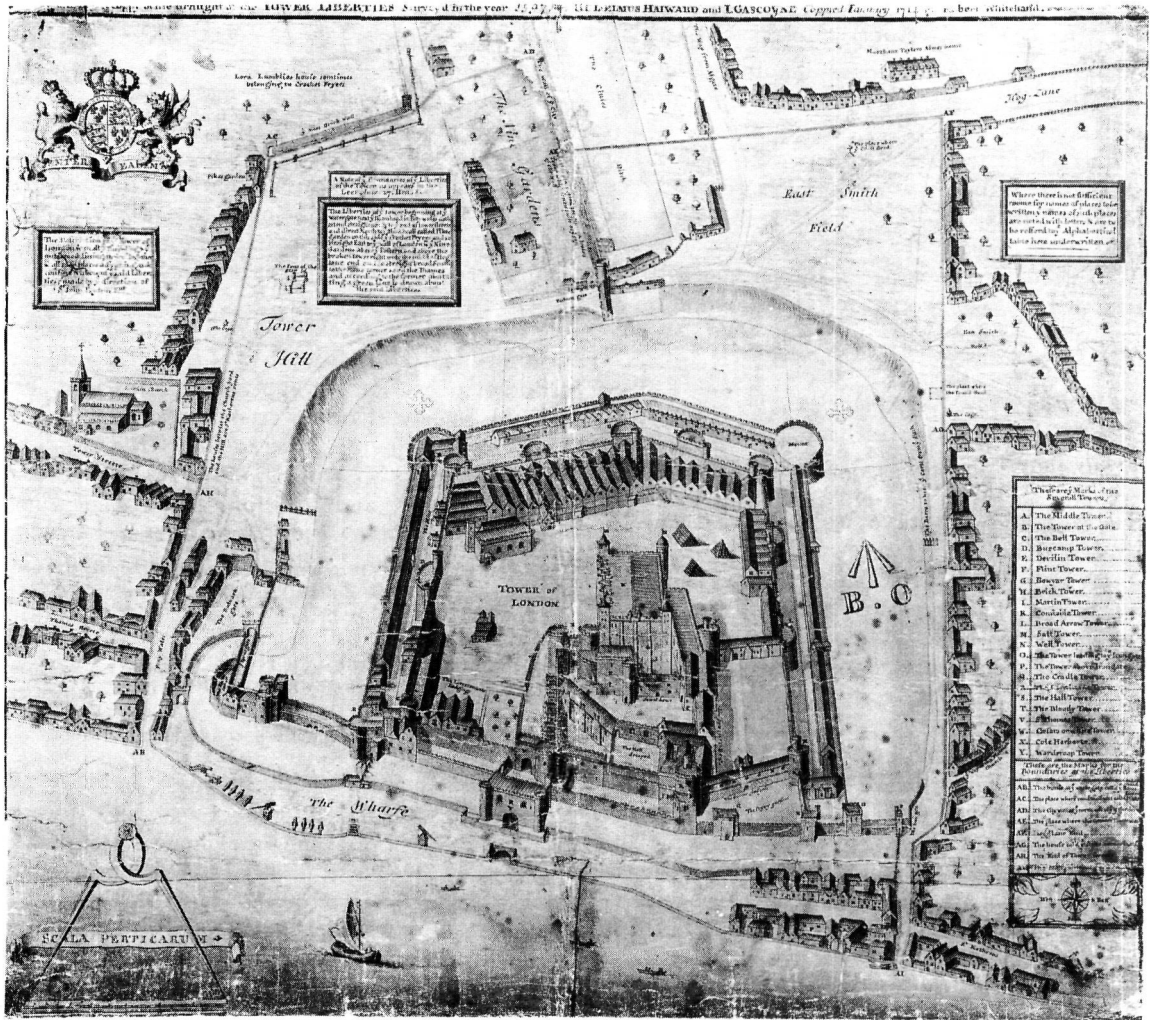


Fig 5. Detail of the Bulwark and the Western Entrance from Haiward & Gascoyne's survey of the Tower in 1597 (by permission of the Museum of London)

buildings from the one end to the other, that have been erected by leave of the Gentlemen Porters.¹¹

The letter was accompanied by a very rudimentary plan of the Tower which emphasises the encroachments but provides no further information about the defences.¹² The extent of the encroachments provoked one of a number of complaints made by six members of the Privy Council who considered the condition of the Tower in 1620.¹³ They called for a detailed survey which, when supplied in December 1623, referred to some 220 houses, sheds, timber yards, wheelers' yards and such like which encumbered the margins of the moat and the western entrance.¹⁴ The description of the Bulwark in the 1623 report is of considerable interest:

The first gate called the Bullwarke (proportioned with 2 halfe Rounds the one is 16 foot over, and the other 2 Rods with a straight wall of 2 Rods between them and soe from the greater round to the Wharfe gate a strong wall of 11 Rods and 8 foote long) hath formerly been enclosed round with a Moate where of some parte is now called the Tower dock, the rest is filled up This Bullwarke with his walls and two gates are planted with howses, both within and without, where formerly Ordnance have been placed as appeareth by the great loopeholes over arched yett to be seene within their houses: To proportion this bullworke to its former intended service and use the charge of the perticulers there of is to be calculated but by gesse, except the howses were pulled downe that the defects might appeare and is therefore left to your Lordships consideration.¹⁵

The significance of this account, in terms of the architecture of the Bulwark, is discussed

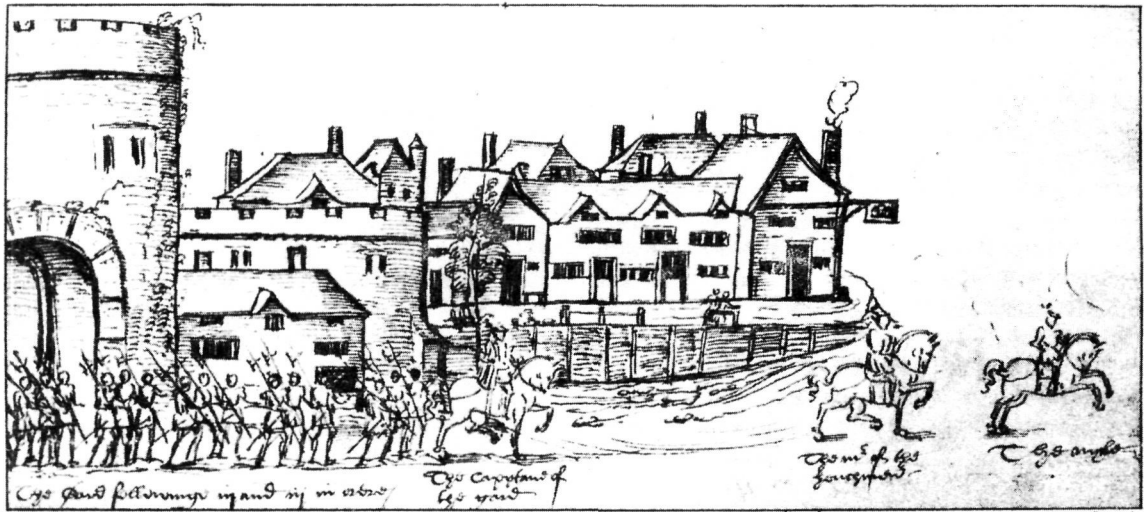


Fig 6. Part of Elizabeth I's coronation procession leaving the Bulwark in 1559. The north-east bastion, incorporating the entrance gate, occupies the foreground, while the larger north-west bastion can be seen to the rear (By permission of the British Library)

below. As regards the proposed reparations, however, no work is revealed in the accounts at this time nor in any of those associated with the flurry of activity to improve the Tower's defences before the outbreak of the Civil War.¹⁶

The long-standing problem of encroachments about the moat and the western entrance was finally resolved in a dramatic manner during September 1666 when the offending structures were summarily demolished to prevent the flames of the Great Fire reaching the fortress.¹⁷ The Gentleman Porter was eventually compensated £135 by the Office of Ordnance in 1675 for the loss of his rents.¹⁸

In the wake of the City's destruction the Ordnance reconsidered the effectiveness of the Tower's defences, and in November 1666, their Chief Engineer, Sir Bernard de Gomme, produced a draft design for refortification which included the replacement of much of the existing western entrance with a great ravelin and moat.¹⁹ This, the most radical of his proposals, was not implemented, but demolition of much of the Bulwark was to proceed and on 4 July 1669 the Lieutenant of the Tower, Sir John Robinson, requested to see a warrant that was being drawn up by the Ordnance Commissioners in respect of the Bulwark and other matters.²⁰ Orders must have been issued almost immediately for on 11 August the Privy Council advised the Commissioners and the Lieutenant of the need

for an estimate of the cost of works already under way which included the 'planeing & Levelling the Place called the Bulwarke'.²¹ Demolition of the Bulwark had in fact begun in November 1668²² and during the following year hundreds of thousands of bricks and a mass of rubbish were removed from the site.²³ Between 21 November and 22 December 1670 the Office bricklayer was engaged in 'taking down the outward great gate into the Bulwarke',²⁴ presumably the principal entrance on the north-east corner of the enclosure previously referred to.

During 1670 a new wall and gate was constructed on an east-west alignment to the north of the Lion Tower²⁵ which linked up with a wall about the Lion Tower and evidently the vestiges of the Bulwark near the Wharf.²⁶ For reasons which are not apparent, substantial remains of the Bulwark were left standing to the north of the new enclosure (see cover picture) and in October 1675 the Ordnance Board authorised 'stoppinge up the Gapp of the wall of that parte of the old Bulworke goinge into Thames Streete' and the 'Repaire [of] the Wall in several places with out the Gate'.²⁷ Five years later the Board ordered some 35 yards of the remaining Bulwark by the Wharf Gate to be taken down after they were advised that the brickwork was ready to collapse.²⁸

Vestiges of the west wall of the Bulwark and the north-west bastion seem to have stood until

at least the start of the 18th century.²⁹ Further losses probably occurred in 1706 when modifications were made to the inlet known as Tower Dock, whose origins seems to have been associated with a defensive ditch about the Bulwark. On 7 March the Board ordered the breast wall of the dock to be repaired and the northern extent, 'between the End of Thames Street and Tower Hill', to be filled in with rubbish from the locality.³⁰ Contracts with the builders were drawn up in May and June³¹ and the principal accounts with the mason and carpenter were settled in September 1708.³² Twenty years later, surveys of the Tower suggest that all visible trace of the Bulwark had effectively disappeared.

Notes for Documentary Evidence for the Bulwark

¹ Colvin 1963, ii.715–23.

² Maclean 1981, 70.

³ Kingsford, 1908, i.48.

⁴ Colvin 1963, ii.729.

⁵ *Cal Pat R, 1476–85*, p 380; cf also *Cal Close R, 1476–85*, no 1294 (payment of arrears of salary dated 26 November 1484). The mansion was the first in a long line of lodgings assigned to the Porter at the western entrance, the last, attached to the south side of the Middle Tower, was demolished in 1845 (Parnell 1993, 94; pl 10).

⁶ *Cal Pat R, 1485–94*, p 14 (21 September 1485).

⁷ PRO E36/8/203.

⁸ BL Add MS 14,044, f 40.

⁹ Colvin 1963, pl 44.

¹⁰ Fisher 1981, 13.

¹¹ Hatfield House, Cecil Papers 119, f 160.

¹² Parnell 1985b, 66–9.

¹³ *Cal SP Dom 1619–23*, 160; BL Harley MS 1326.

¹⁴ Doubtless many of the traders and artisans had established themselves in the area to avoid the restrictions placed on commercial life within the City by the Livery Companies.

¹⁵ BL Harley MSS 1326, f 108; 5913, f 15.

¹⁶ *Cal SP Dom 1640–41*, 158, 186–7; PRO WO 49/72, ff 64–6.

¹⁷ PRO PC 6/19, pp 103–4. For payments to the Lieutenant of the Tower and others, *Cal TreasBills 1667*, 161, 643; *Cal SP Dom 1666–67*, 582; WO 51/7, ff 158, 169; PRO 30 37/16. See PRO PC2/60, ff 84, 97 for petitions of inhabitants.

¹⁸ WO 51/18, f 90.

¹⁹ Parnell 1985b, 69–72 & figs 5–6.

²⁰ *Cal SP Dom 1668–69*, 395.

²¹ WO 55/426, entry 129.

²² WO 48/9, p 488.

²³ *Ibid*, p 477; WO 51/10, f 114; WO 51/18, f 98.

²⁴ WO 51/12, f 158.

²⁵ WO 48/9, p 519; WO 48/11, p 21; WO 51/12, ff 52 & 61.

²⁶ Parnell 1985b, fig 9.

²⁷ WO 47/19B, f 93.

²⁸ WO 47/9, f 33.

²⁹ Parnell, 1985b fig 11; this undated drawing was assumed to be late 17th century as it is a copy of a plan in the possession of English Heritage bearing the date 1692. Subsequent research, however, has shown that the drawings include Ordnance lodgings erected in 1699–1701 and it may be supposed, therefore, that the date of 1692 was entered at a later date and is incorrect.

³⁰ WO 47/23, p 186.

³¹ *Ibid*, pp 311 & 389–90.

³² WO 51/74, f 71; WO 51/75, f 37.

The construction and function of the Bulwark

Geoffrey Parnell

The word 'Bulwark' seems to have come into use during the 15th century to describe a kind of outwork or barbican specially designed for artillery. Structures of this kind were devised by engineers in response to the development of heavier and more accurate guns which, by the end of the century, had rendered many earlier forms of medieval military architecture obsolete.

Some of the most advanced examples of 15th-century English artillery works were associated with the Calais pocket and were intended to resist a French assault. Bulwarks of brick and stone were added to the town defences between 1448 and 1454, while the castle at Guines was strengthened with two masonry bulwarks furnished with gunports all round between 1462 and 1474 (Colvin 1963, i.488–9, 453). There are also references to repairs in the castle to three stone vaults in an earthen bank 'for guns to shoot out of'. These emplacements, called 'murderers' (similar devices are mentioned at Calais in 1468–9), presumably represent early casemates. Perhaps one of the oldest surviving casemates in the country can now be found in the glacis beyond the moat on the east side of Castle Rushen, Isle of Man. Both the sloping glacis, which was added to mask the curtain wall from gunfire, and the casemate, probably form part of the innovative works carried out by the 3rd earl of Derby in c.1536–40 (O'Neil 1951, 14–5, 25–6).

It is against the backdrop of these early developments in artillery fortifications that the Bulwark at the Tower may be seen. The plan of the enclosure was highly irregular and determined by the need to surround the western entrance from the river in the south to the moat about the outer *enceinte* to the east. As far as the surviving historic views are concerned, the shape of the two towers or bastions on the north side of the enclosure appears to vary from circular to horseshoe. The excavated footings suggest that the north-west bastion was circular, and the north-east horseshoe, but their precise plans can only be determined by further investigation. In outline, however, the excavated remains seem to conform with the dimensions recorded in the 1623 survey (see above). This gives the circumferences of the north-east bastion as 16ft and the north-west as 33ft (*ie* 2 rods), with a 33ft stretch of wall between the two. The length of wall from the larger bastion to the gatehouse by the Wharf was 189ft 6in (*ie* 11 rods and 8ft). The description of the bastions as 'halfe Rounds' supports the cartographic evidence that they were hollow.

Apart from allowing some flanking fire to be brought to bear along the faces of the adjoining walls, the bastions must to some extent have covered the approaches from Great Tower Street to the west and Tower Hill to the north. In addition, as may be appreciated from the 1597 survey, the principal entrance into the enclosure was incorporated in the east elevation of the north-east bastion (Fig 5). The gateway can also be seen in this position on the Elizabethan sketch of 1559, together with a building against the external face of the enclosure between the two bastions (Fig 6). Brick footings revealed by excavation in this area possibly belong to the same structure, and might amount to one of the encroachments referred to in the 1623 report.

The same report complained about encroachments concealing the 'great loopholes over arched' in the walls of the Bulwark, where formerly ordnance had been planted. This is a particularly interesting observation, for it indicates that the enclosure had once been armed with heavy artillery. It is regrettable that the document does not indicate the level at which the apertures were located. At Dartmouth Castle in Devon (begun in 1481), which is noteworthy for representing the earliest surviving castle in England to be designed to have guns as its main armament, the heavy ordnance was placed on

the lowest floor. The gunports have large rectangular openings with internal splays to allow a degree traverse (O'Neil 1935, 138, 140-1).

Recent restoration work at Kingswear Castle, built in 1501-2 on the opposite side of the Dart estuary, has resulted in the gunports on the ground floor being fully exposed. These are of identical size to the Dartmouth Castle examples, but have suffered little alteration and exhibit the remains of large timber baulks set in the cills of the openings, which are flush with the floor. It is clear that the wooden beds which supported the guns were pivoted into these timbers. Evidence from the floor above indicates that smaller, hand held, ordnance was mounted in a similar manner, but in openings formed at a level above the floor, while the top floor and the roof parapet are pierced with loops for handguns. What is now clear is that the pattern of armament replicates the earlier arrangement at Dartmouth (Parnell, forthcoming).

The only surviving evidence for early gun emplacements at the Tower is found in the Byward Barbican, immediately to the east of the Byward Tower and overlooking the Wharf. The wedge-shaped addition to the south face of the building, generally attributed to the reign of Henry VIII but unrecorded and possibly earlier, is pierced at ground floor level with two small gunports, one in the east face the other in the salient. These were clearly intended for small pieces of ordnance mounted on beds, rather than wheeled carriages. Of further interest are loops with double key-holes for handguns at mezzanine level overhead.

If the large gunports mentioned at the Bulwark were located at ground level, the artillery could have been accommodated in casemates formed in the thickness of the curtain wall. This was c.3.20m wide and of unusual construction, being composed of two brick walls c.1.20m wide, tied together at intervals with cross walls and presumably containing an infill to cushion the impact of cannon shot, though in the area examined the core was disturbed by later activity. The height of the walls is difficult to gauge from the available views, but there is no reason to suppose that they were not reasonably high, as the two bastions appear in the 1559 view (Fig 6), and are therefore rooted in the medieval tradition.

The only other evidence for the nature of the fortifications, as revealed in the 1623 report, is a

reference to a moat or ditch which had formerly surrounded the enclosure. The report identifies the inlet known as Tower Dock as the southern extent of this feature and the only part by then still visible. There is some archaeological evidence for the continuation of a cutting to the north, but apart from Tower Dock nothing can be seen on any of the views dating from the middle of the 16th century, and as a defensive feature the ditch must have had a relatively short life.

Post medieval (Figs. 7, 8, 9)

Internal development of the Bulwark (contexts [49],[50])

Sometime after the completion of the Bulwark defences, buildings were added to the interior. In 1606 the Lieutenant of the Tower and two principal officers of the works complained that the 'chief Bulwark on the west syde of the hill, to which all the Tower is subject ... is quite within a few years made of no use by buildings from one end to the other'. One of these buildings, represented by wall [49], was located at the southern end of the trench while the remainder of the building presumably extended beyond the limits of excavation. A brick wall, observed during a watching brief c.6m to the south of wall [49], could have formed the southern extent of the building. Wall [38] may have represented the western side of the building, but the relationship between walls [38] and [49] was truncated by a later feature.

To the north of the trench, an internal wall [50] was built against bastion wall [43]. The wall was observed in the eastern section only and may have formed part of a further internal building for which there is no other evidence.

Lean-to added to the exterior of the Bulwark (contexts [51]–[60])

The large cut feature [46], which may have been an external ditch of the Bulwark, contained sand and gravel [51] and [52] with which it had apparently been backfilled deliberately in view of the lack of waterlaid material in the upper part of the fill. This action may have been taken to level the ground prior to the construction of an external bulwark building represented by wall [53].

Wall [53] may form the northern wall of a

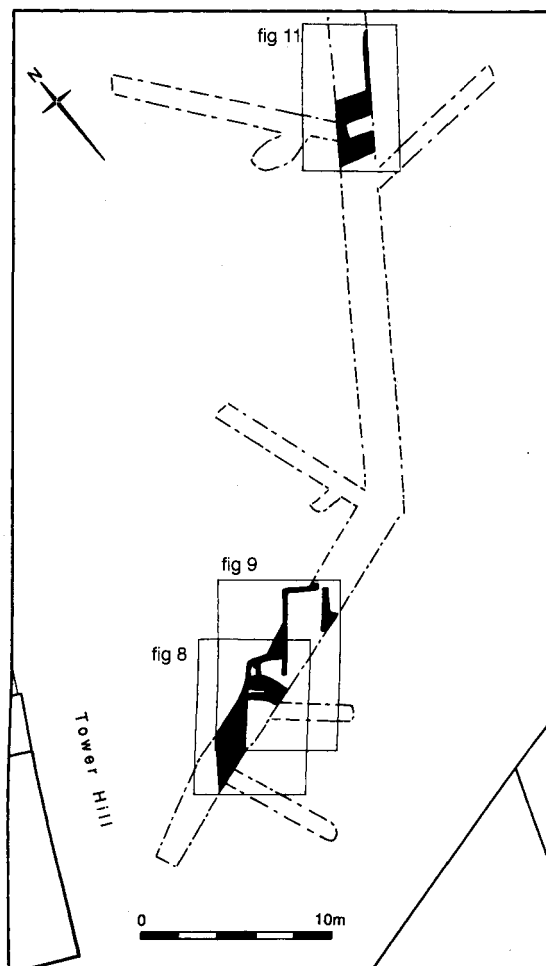


Fig 7. Location plan for Figs 8, 9, and 11

lean-to structure occupying an external corner of the Bulwark created by walls [42] and [45]. It was built of brick and was 0.50m wide, surviving to a height of 0.70m. Inside the building a mortar spread [54], interpreted as a floor, was laid over the backfill of ditch [46] and against wall [53]. A hearth [55] was sunk into the corner of the building against walls [42] and [45]. It was composed of bricks set within a clay base [56]. Occupation debris and hearth rake-out [57] accumulated against the front of the hearth and over the mortar surface. Iron smithing slag was found within the hearth rake-out, suggesting that the building was used as a smithy. Forty-one sherds of pottery were recovered from the floor and hearth rake-out, and have been dated to c.1480–1550 (Fig 16, Nos 7, 8). A pinner's bone

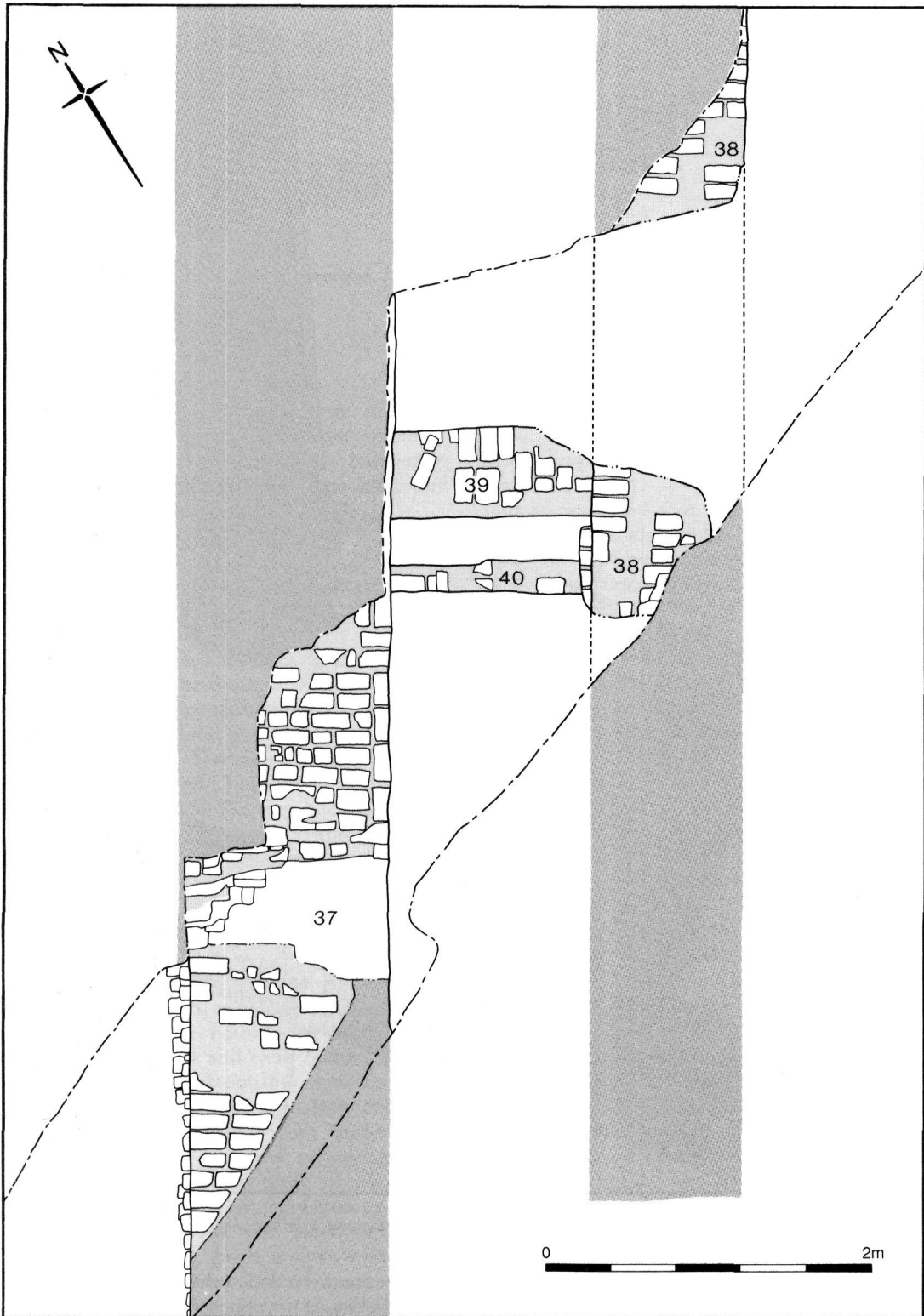


Fig 8. Bulwark walls at south end of trench. Dark tone shows projected walls and light tone shows mortar

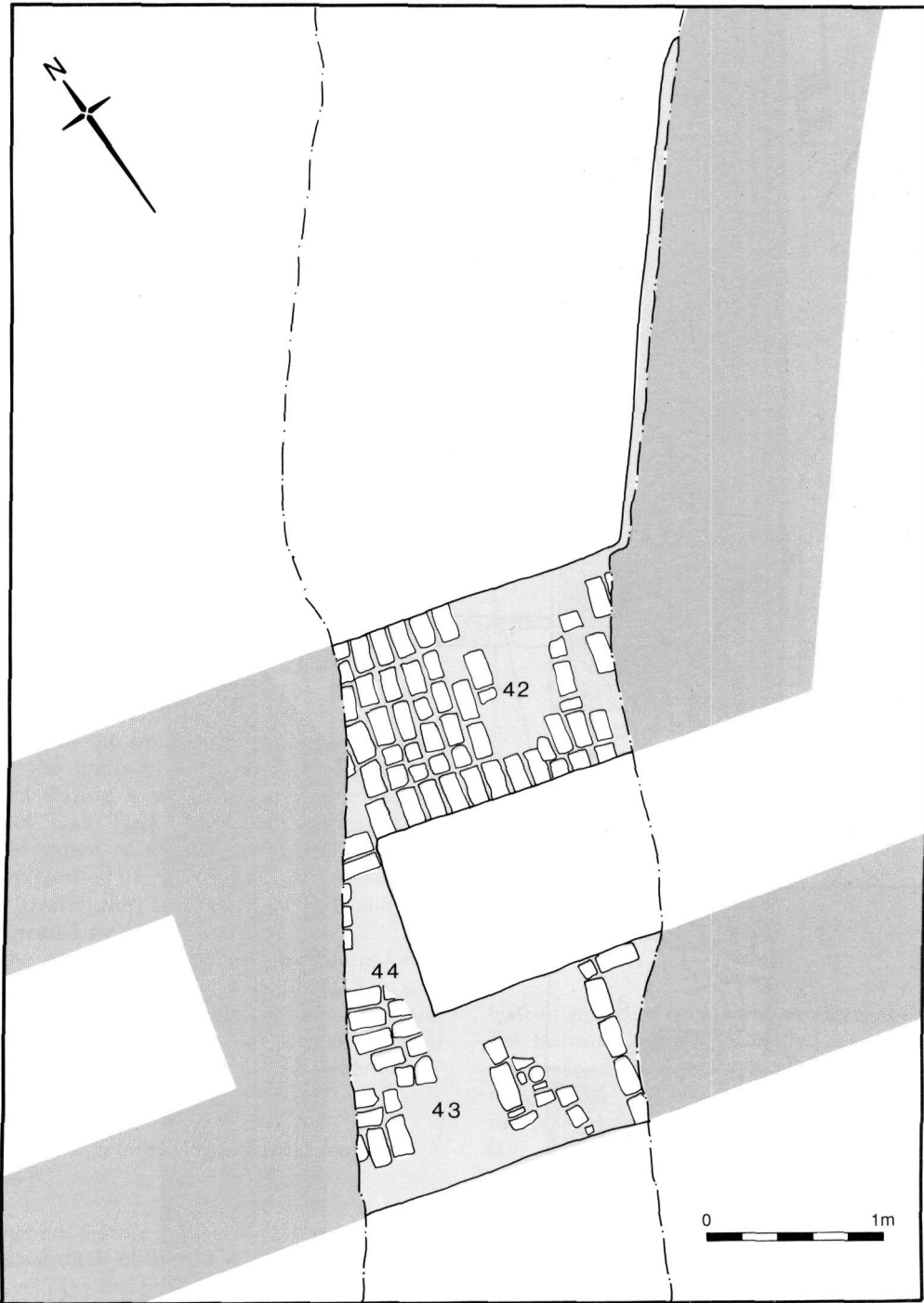


Fig 9. Bulwark walls at north end of trench. Dark tone shows projected walls and light tone shows mortar

(Fig 21, No. 24) and fragments of iron were also found within the building.

Two stake holes [58] and [59] were seen to

cut the southern end of the hearth [55], fracturing the bricks and possibly serving as foundations for a superstructure, perhaps a brazier. Hearth [55]

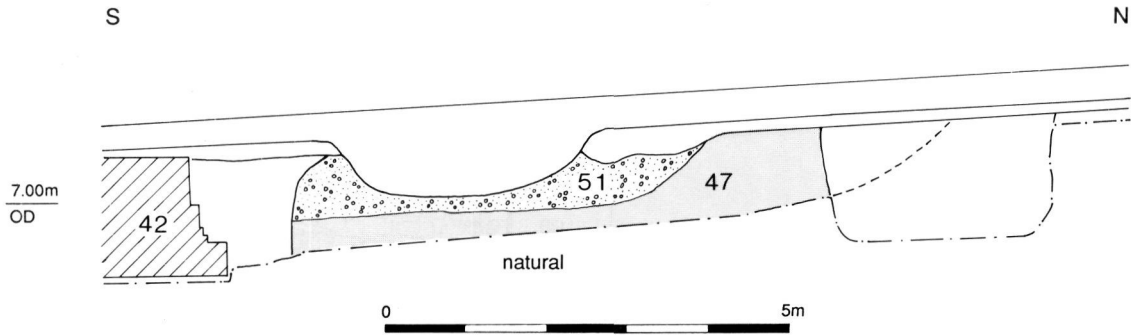


Fig 10. Section B

continued in use and a layer of burnt material [60] containing iron smithing slag accumulated over it and stake holes [58] and [59], indicating that the hearth remained in use even after the superstructure was dismantled.

Addition of a cellar to the internal building (contexts [61]–[70])

A half cellar was added to the building erected against the inside of the Bulwark and represented by wall [49]. The construction required the lowering of the floor level and the dismantling of a section of wall [38]. The alteration exposed the foundations to walls [38], [39] and [41], and also the construction backfill for the outer defensive Bulwark wall [37]. The newly exposed foundations were refaced with a single thickness of bricks; wall [38] was refaced with facing [61], walls [38] and [39] with [62], wall [41] with [63] and the construction backfill for wall [37] with [64].

Away from the Bulwark defensive walls, two new walls [65] and [66] were added to form the northern and eastern boundaries respectively. Both were trench built and were bonded to one another, though the relationship between walls [65] and [49] was destroyed by a later cut [91]. Wall [65] contained a niche with timber [67] placed at the bottom, its upper surface 200mm above floor [68]. Located centrally on this upper surface was a shallow circular depression *c.* 140mm in diameter, which could have acted as a base plate for a door pivot. Such a pivot may have been related to two holes located on the inner face of wall [49] which were 100mm × 80mm and 170mm × 120mm in size and may have

received timbers belonging to a stairway leading down into the cellar. The cellar was then given brick floors [68] and [69] which respected the refacing.

It is presumed that the area to the south of wall [40] was also given a cellar at about this time, for its floor [70] was at a similar OD height to that of floors [68] and [69], though not certainly part of the cellar represented by them. Little more is known about this cellared area as it extended beyond the limit of excavation. Many bone-working fragments were found on floor [70] and within demolition rubble [78], suggesting that the area was used as a bone workshop. The fragments included waste material and partly finished combs and knife handles, the latter dated to the 17th century.

Alterations to the cellar (contexts [71], [72])

A small internal wall [71], 240mm wide (one brick length), was added to the south end of wall [38], cutting the refacing [61] and [63] (see Fig 11). It partly filled the gap cut earlier in wall [38] but stopped *c.* 0.70m short of the southern side, creating an entrance to the area defined by walls [71], [64], [39] and [41]. The relationship between wall [71] and floor [68] was destroyed. Wall [71] had a small niche [72] cut into its western face, *ie* facing the interior of the small area (see Fig 13). The niche was positioned in the centre of wall [71], 0.65m above floor level, and is presumed to have held a candle or lamp, as soot was found on its ceiling. The use of the area defined by walls [71], [64], [39], and [41] is unknown but a large quantity of slag was found on floor [68]. The slag had collected on

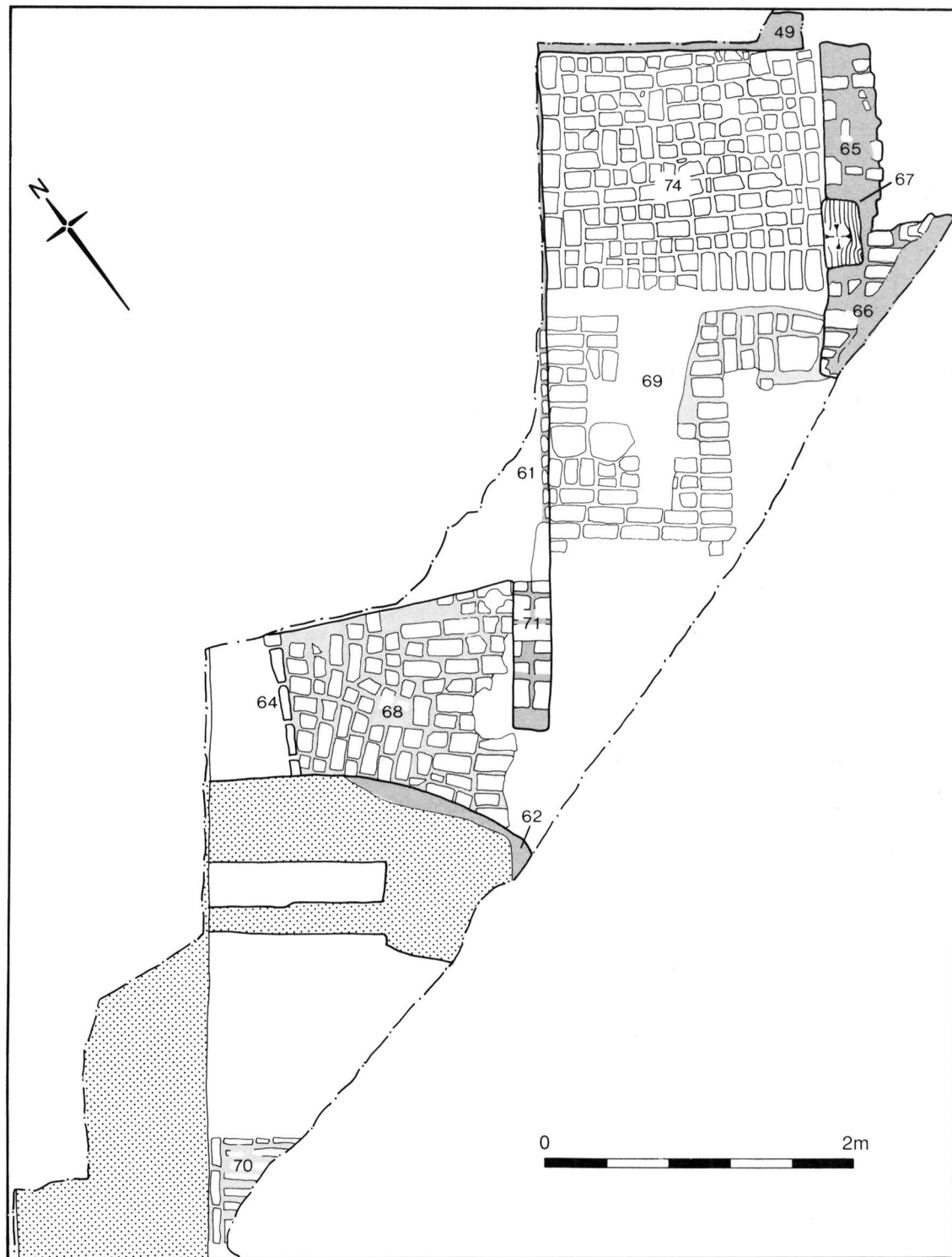


Fig 11. Plan showing walls and floors of the building attached to the inside of the Bulwark wall. Dark tone shows mortar in the walls and light tone shows mortar in the floor. The stippled area shows the earlier phase of the Bulwark defensive walls

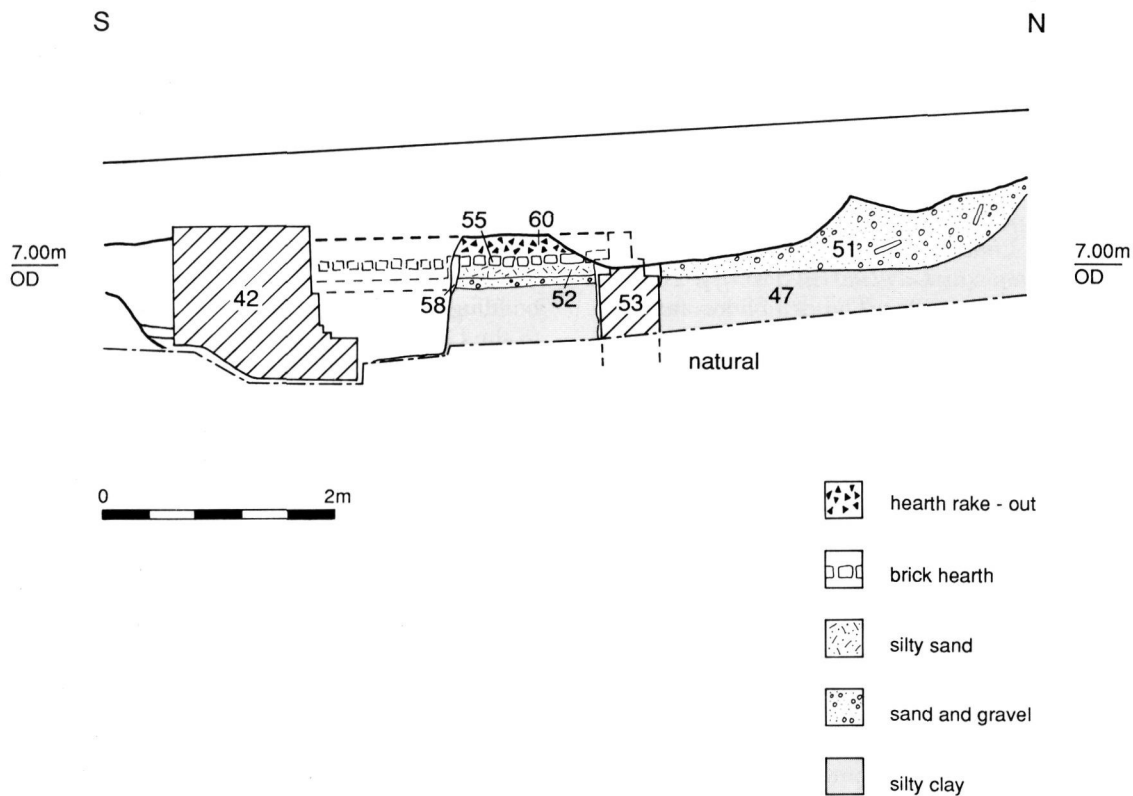


Fig 12. Section C

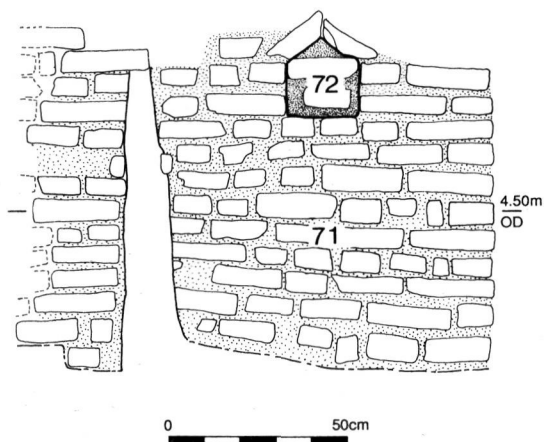


Fig 13. Wall 71 containing niche 72

the bottom of a hearth and suggests smithing. It may be that the space between the parallel defensive walls and cross-walls provided a makeshift chimney, in which case the parapet walkway

(if it had ever existed) was no longer in use. The presence of the iron slag and the nature of the ivory waste within the cellar suggest that complete knives were being produced.

The remains of a return, indicated by a single brick, ran eastwards from the southern end of the eastern face of wall [71].

Cellar repaired after damage by fire (contexts [73]–[75])

The cellar may have been damaged by fire after the construction of wall [71], which exhibited signs of scorching on its eastern face. A burnt layer [73] on cellar floor [69] was directly overlaid by floor [74]. Floor [74] was interrupted by an east-west linear feature [75], c.0.10m wide and c.0.10m deep, which ran the whole length of the floor. It was interpreted as a sill beam for a light internal partition (see Fig 11).

Great Fire demolition (contexts [77], [78])

The building at the south end of the trench was demolished and collapsed into its cellar. The demolition took place from within the Bulwark leaving the defensive walls still standing. There is ample evidence that the demolition took place in 1666 to create a 'fire break' protecting the Tower of London (PRO WO51/7 ff 158, 169; WO55/322p 46; *Cal Treas Bills 1667p* 161; *Cal SP Dom 1666-7p* 582). The demolition material, [77] and [78], consisted of building rubble, loosely compacted and containing bricks, mortar and tile fragments and one fragment of diamond paned window glass set in lead was found within the rubble. Also present in this dump was a quantity of ivory waste, both offcuts and unfinished artefacts (Fig 20, Nos 1-12; Fig 21, Nos 17-20, 23; Fig 25, No. 26).

Although areas of burnt material were found, their localised nature suggests that the building was pulled down rather than destroyed by fire. No demolition material was found in the area of the Bulwark gate and although the internal wall [50] was dismantled or robbed, it is not known if this formed part of the demolition process. The demolition layers produced a total of 72 sherds dating mainly to the second half of the 17th century, which accords with the documentary evidence.

Post-Fire reorganisation of Tower Hill

North of the Bulwark there is an apparent three or four hundred year break in the archaeological sequence between the 13th-century hillwash and

the late 17th-century cut feature [79] (see Fig 14). This discontinuity probably results from site clearance or relandscaping after the Great Fire of 1666, as is borne out by cartographic and documentary evidence. In contrast with Faithorne and Newcourt's map of 1658, which shows buildings clustered around the northern Bulwark gate and Tower moat, Hollar's engraving of Leake's map of London after the Fire (1667) shows the same area to have been cleared of buildings. After the Great Fire a royal warrant to the Ordnance Office referred to 'planeing and levelling the Place called the Bulwark' (WO55/426 entry 129), which, as excavation revealed, included the stripping of 14th, 15th and 16th-century deposits in the area. To the south of the Bulwark, however, buildings remained standing but in a state of disrepair. The scene is vividly illustrated in Johannas Spilberg's painting of 1689 (see cover picture), housed today in the Queen's House at the Tower.

After Tower Hill was refashioned, a large feature [79] was cut into the new ground surface (see Fig 14). Its eastern and western sides extended beyond the limit of excavation. The width from north to south was 7.0m, and the northern and southern sides were near vertical but slightly concave. The feature was excavated to a depth of 1.0m as far as invert level, and was filled with silts and clays and silty sands containing many fragments of tile, brick, charcoal, mortar, oyster shell and animal bone. The lower fill may represent *in situ* silting but the upper fills appear to have been dumped. Clay pipes retrieved from the fills date to between 1660 and 1680, and 16th and 17th-century sherds retrieved from fills [80] and [81] included fragments of a

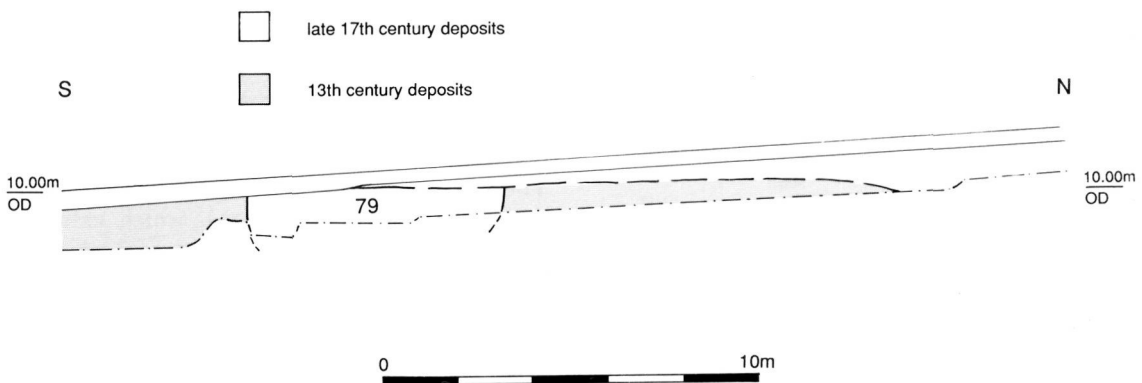


Fig 14. Section D

North Italian marbled slipware bowl and a rare Frechen stoneware chamber pot.

Although feature [79] post-dated the re-landscaping, it may represent an initial attempt to dispose of debris from the demolition of buildings surrounding the Tower moat, if not to create a fire break during the Fire then as part of the subsequent reconstruction. The latter hypothesis seems more likely as Hollar's version of John Leake's map of post-Fire London shows the buildings surrounding the landward sides of the Tower moat to have been removed.

A series of building rubble layers composed of brick, tile, stone and mortar fragments in a matrix of sandy clay [82]–[87] was dumped over the new ground surface. Some of the deposits also contained oyster shells, burnt daub and fragments of charcoal and coal. The dumping was 0.75m deep before being truncated from above by modern road make-up. A cobbled surface [82] may represent part of the original construction, but the limited extent of the feature made interpretation difficult. Overlying the cobbles was a layer of ash [83] and cinders [84], but the extent of this material was so limited that interpretation is again difficult. The general lack of burnt material within these building rubble layers, however, suggests that they were deposited later than the Fire.

Pottery and clay pipes dating to the 17th century were recovered from the rubble dumps, including two sherds of Chinese porcelain and a fragment of a chafing dish from Saintonge; a few fragments of ivory waste were also found (Fig 20, Nos 9, 13).

Modern road make-up truncated all 18th and 19th-century deposits which would have overlain the post 'Great Fire' rubble dumps and neglected Bulwark walls, including the ground surface from which several pits were cut into the underlying deposits. All the pits contained brick rubble and are interpreted as rubbish pits. Many sherds belonging to distillation vessels were found in rubbish pit [88], which may indicate the close proximity of industrial activity (Fig 17, No. 18). Two ivory combs (Fig 21, Nos 21, 22) and fragments of tin-glazed tile (Fig 18, Nos 1, 5–7, 9, 10) were also found in the pit.

Opposite Gloucester Court a late brick vault [89] of unknown function was trench-built into the underlying natural sands and gravels. Further south, pit [90] was cut through the hearth rake-out on the floor of the lean-to represented by wall [53]. Its southern and eastern sides were

formed by walls [42] and [45] respectively, and it cut part of the foundation to wall [42]. Three straight sides were observed before the cut passed beyond the western limit of excavation. The pit measured 1.0m wide and 2.0m long with near vertical sides terminating abruptly in a flat bottom lined with cobbles. The remains of two timbers were set into the cobbles; one, a plank, lay within a gap in the cobbles, and the other, a stake, was set vertically through them. The cut was filled with thick clay which may have acted as a 'plug' over which rubble was dumped. The function of the feature is unknown. The finds include a few fragments of distillation vessel.

The watching brief

A watching brief was maintained during the excavation by the contractor of several small feeder drains which extended eastward and westward from the main drainage trench.

As little time was available for this work, the drain cuts were planned and photographed. Owing to the shallowness of the cuts (between 0.30m and 0.50m below modern ground surface) little further archaeological evidence was obtained apart from the plotting of the extent of the brickwork in plan. It is possible that these excavations did not always penetrate as deep as the Bulwark, but the watching brief nevertheless contributed to its hypothetical reconstruction (see below).

Conjectural reconstruction of the Bulwark (Fig 15)

Information from the excavation, combined with documentary evidence, enables a tentative plan of the Bulwark to be made.

This can be done by relating the excavated Bulwark walls to surviving features such as the Middle Tower and the eastern side of the Lion Gate Causeway. The western Bulwark wall aligns with the western side of the access way to the Tower Pier, which is thought to have occupied the area of the quay or inlet at the western end of Tower Quay and formed the western limit of the c.1480 Bulwark. Documentary evidence provides a rough outline of the Bulwark which can then be compared with the archaeological and extant remains.

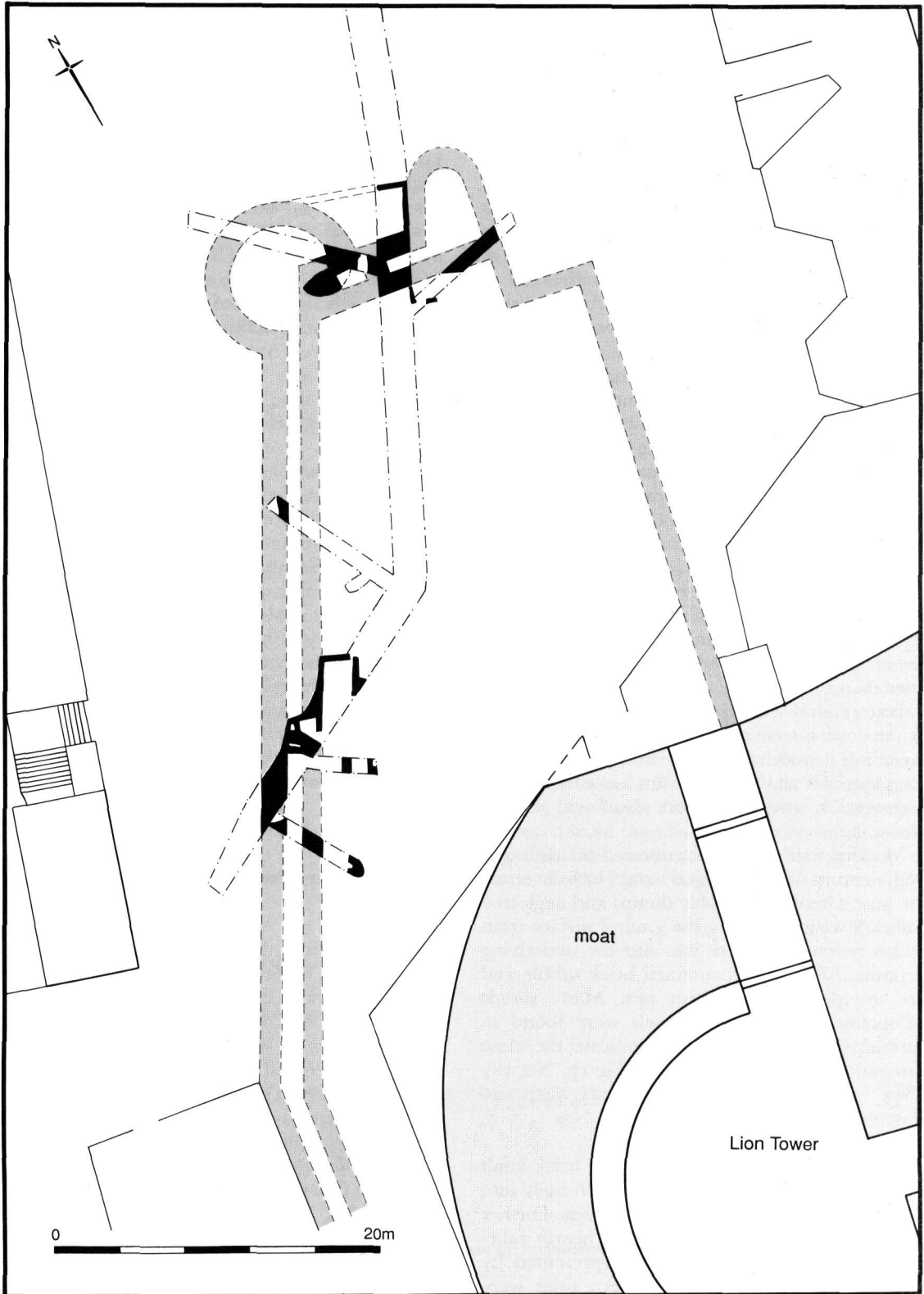


Fig 15. Reconstruction of the Bulwark with the dark tone showing the projected walls

As can be seen from the reconstruction plan (Fig 15), the archaeological evidence suggests a double defensive wall. Only the western side of the Bulwark is thought to have been built in this way however, for though the eastern side was not located by the excavation trench a double defensive wall in that position would probably have restricted access to the Lion Gate.

To the north of the Bulwark, in the area of the gate, it is possible that there were two bastions, as documentary evidence would indicate. Part of what is thought to be the eastern bastion was located by the excavation (wall [45]), while part of the western one may have been revealed during the watching brief. The disposition of the walls suggests that the western bastion was circular, and the eastern horseshoe-shaped. At a later date the northern extremities of the bastions were joined by a small brick wall [53]. This is supported by a late 17th-century plan embodying proposals for the refortification of the Tower (Parnell 1985b, 79).

No attempt has been made to reconstruct the internal Bulwark building since none of the walls attributed to this feature was sufficiently detailed.

THE FINDS REPORTS

The Roman pottery

Helen Rees

The 83 sherds of Roman pottery (2.193kg) were recorded by fabric, form and context on pottery record sheets, using the standard pottery fabric codes current in 1987. This data, together with an analysis of the material according to the original excavation trenches, forms the pottery archive, which is held, together with the finds, by the Museum of London. The distribution of the different wares in each phase is presented in Table 1, while the total sherds/weights in the different stratigraphic groups is shown in Table 2. This small scatter of Roman material is in keeping with the location of the site, which is peripheral to zones of more intensive occupation within the City and in the area now occupied by the Tower of London (Parnell 1985a, 7–22). The assemblage is thus best considered in the wider context of general Roman settlement in this particular part of the City of London. This small sample includes most of the types common in London from the 1st to the 4th centuries (see *eg*

Cameron 1985, 55–60; Green 1980; Marsh & Tyers 1978; Richardson 1986), but contains no material positively diagnostic of the 1st, rather than the 2nd, century.

Phase 2. Roman features

Two small assemblages (14 sherds, 651g) were recovered from a truncated pit [4] cut into the natural subsoil and sealed by the modern road surface, which contained material not earlier than *c.*AD 120; the small size of the sample, however, means there is insufficient evidence for certainty in dating. This group also includes a single sherd of uncertain but probably earlier Roman date (Fig 16, No. 1). This is from a jar with slight shoulder and long neck, the zone below the shoulder bearing a row of crudely impressed dots and rilling, the neck being burnished. The ware is handmade but hard-fired, rough in fracture and to the touch, with greyish brown surfaces and grey core and margins. Visible in fresh fracture are moderately frequent elongated voids of all sizes up to *c.*4mm, some with calcareous(?) traces adhering to their edges. The fabric is slightly sandy in texture, but few individual quartz grains are visible; it has a porridgy appearance, suggesting the presence of clay pellets. It is moderately micaceous. This type has not yet been recognised elsewhere in the City of London (B. Richardson, pers comm) but the fabric, form and surface treatment (burnished and rilled with stabbed decoration) is reminiscent of earlier Roman material from Canterbury (L. Blackmore pers comm; see *eg* Frere and Stow 1983, 199 No. 48).

Residual Roman pottery

Redeposited material, including pottery of both earlier and later Roman date, was confined to the northern part of the site; the absence of Roman material in the southern part of the site, however, may reflect post-Roman truncation. The distribution of sherds is shown in Table 1.

The medieval and later pottery

Lyn Blackmore

The post-Roman pottery was recorded as described above; the distribution of the stratified

Table 1. Summary of Roman pottery fabrics by sherd count and weight in grammes. For references to individual fabrics see eg Cameron 1985; Green 1980; Marsh & Tyers 1978 and Richardson 1986

Code	Fabric	Roman contexts		Residual	
		Sherds	Weight	Sherds	Weight
AHSU	Alice Holt Surrey	—	—	1	20
AMPH	Misc. amphorae	—	—	4	128
BB2	Black Burnished 2	2	48	3	63
C306	Camulodunum type 306	—	—	1	14
DR20	Dressel 20 amphorae	3	304	5	566
HWC	Highgate Wood	—	—	3	29
KOAN	Dressel 2–4 amphora	—	—	1	89
LOMI	Local mica-dusted	1	18	—	—
NVCC	Nene Valley colour-coated	—	—	3	16
OXID	Misc. oxidised	1	58	6	27
OXMO	Oxfordshire white mortarium	—	—	2	119
OXPA	Oxfordshire parchment	—	—	1	27
OXRC	Oxfordshire red-slipped	—	—	1	3
PE47	Pelichet 47 amphorae	2	157	2	34
RWS	Red and white slipped wares	—	—	2	20
SAM	Samian	1	1	10	81
SAND	Misc. sandy wares	4	65	17	210
SHEL	Shell-tempered	—	—	2	57
TSK	Thames-side Kentish greyware	—	—	1	2
VRW	Verulamium Region white	—	—	4	37
Totals		14	651	69	1,542

material (266 sherds, 16.71kg) is illustrated in Table 2, which includes the total sherd weights per stratigraphic unit. The assemblage mainly dates to the 17th/18th century, with a smaller group of 12th/13th-century date. The dating of the post-medieval pottery suggests that re-landscaping started, and was completed, shortly after the demolition of the Bulwark and associated structures. The nearest excavated assemblages are those from within the Tower itself (11th-century onwards), the Custom House (Thorn 1975: mainly 13th- to 15th-century), St Mary Graces/the Royal Mint (14th-century and later) and the Tower Postern (mainly 15th- to 17th-century); for a general survey see Blackmore 1994.

Early medieval

Development of soils ([8]–[12]: Fig 16, No. 2)

Most of the pottery was found in layer [8], which in addition to residual Roman material, produced a substantial fragment of an 11th/12th-century Early Surrey ware cooking pot (ESUR; base diameter c.300mm) and a rimsherd of Early Medieval Chalk-tempered ware (EMCH; No. 2). The latter (source unknown) has been found within the City, but is rare on sites outside the

walls, although a few sherds of chalk-tempered ware were found during excavations in 1974–75 at the Tower of London (Redknap 1983, 121). Layer [8] contained one small rim-sherd of Shelly-Sandy ware (SSW), which dates these deposits to c.1150–1200.

11th/12th-century building and rubbish pits ([13]–[27]: Fig 16, No. 3)

The pottery from this phase comprises mainly Roman material, but the demolition deposit [15] produced 55 sherds from an early medieval shell-tempered cooking pot (EMSH No. 3), while four pits [16, 17, 18, 19] together produced 18 sherds of 12th-century date. These include one small sherd in a fine buff fabric with a thin line of red paint and a splashed yellow glaze, possibly imported Andenne-type ware. A small sherd of Andenne ware (ANDE) was also found during the excavations of 1955–77 in the Inmost Ward Tower of London in the Phase X robber trench of the first Roman riverside wall, the infilling of which is dated by documentary evidence to c.1190–1220 and 1225–35 (Nelson 1985, 76). A further sherd of uncertain, but possibly early medieval, date was found in pit [20].

Table 2. Tower Hill. Distribution of the pottery in post-Roman deposits (by sherd count and weight)

Code	Fabric	Contexts									
		8-12	13-27	28-34	37-48	51-60	77-78	80	82-87	88-90	Total
LSS	Late Saxon shelly									1	1
SSW	Shelly-sandy ware	2		8							10
EMS	Early med. sandy	3	4	2					1	10	
ESUR	Early Surrey	13		1						14	
EMCH	Early med. chalky	1	4	1						6	
EMSH	Early med. shelly	55=1	2				1			4	
EMSS	Early med. sand + shell		8	1	2				1	12	
EMFL	Early med. flinty			1						1	
SHER	South Herts			18					2	20	
LOND	London-type ware			13		2				15	
MG	Mill Green fine								1	1	
KING	Kingston-type		2				2			4	
CBW	Coarse Border ware				4		2		1	7	
CHEA	Cheam white ware						2			2	
TUDG	Tudor Green								2	2	
TUDB	Tudor Brown					27	4	1	4	36	
CHEAR	Cheam Red			1						1	
GUYS	Guys ware				3		1		3	7	
PMR	Post-med. redware						35	6	1	20	
PMFR	Post-med. fine redware									14	
PMBL	Post-med. black-ware								1	2	
BORD	Fine border ware						18	8	26=2	20	
RBOR	Red Border ware									7	
TGW	Tin-glazed ware						7	11	1	46	
METS	Metropolitan slip-ware									3	
PMSL	Post-med. slipped ware									1	
STBU	Staff. butterpot						5			11	
LONS	London stoneware									2	
ANDE	Andenne ware		1							1	
LANG	Langerwehe					2		1		3	
RAER	Raeren					3			1	4	
SNTG	South Netherlands maiolica					2				2	
VALE	Valencian lustreware					5				5	
MEDM	Mediterranean maiolica									1	
DUTR	Dutch red-ware									1	
DUTSL	Dutch slip-ware					1				1	
FREC	Frechen stoneware						7	2	3	8	
NIMS	North Italian marbled							1		1	
NISG	North Italian sgraffito									1	
SPAN	?Spanish coarse ware							2=1		1	
SPOA	Spanish Amphora									1	
SAIN	Saintonge								1	1	
WEST	Westerwald								1	2	
CHPO	Chinese porcelain								1	1	
Total	MPOT/PPOT	20	19	47	7	45	72	43	13	157	
sherds	RPOT	11	15	35				2		6	
Weight	M/PPOT	1,427	321	1,174	132	1,319	3,359	1,111	487	7,376	
in	RPOT	587	375	509				41		1,542	
grammes	All	2,014	696	1,683	132	1,319	3,359	1,152	487	7,406	
										18,248	

Medieval features

Hillwash and pits ([28]–[34]: Fig 16, Nos 4–6)

The dumped deposits [30] and [32] produced 50 sherds (1,252g), of which 43 derive from layer

[30]. Much of the material is residual, of Roman or early medieval date (No. 4), but the dump is dated to the mid 13th century by sherds in London-type ware (LOND; No. 5) and from Kingston (KING; No. 6, fine sandy pinkish buff fabric). The former possibly derives from the

pedestal base of a chafing dish with applied anthropomorphic or zoomorphic decoration; this is green-glazed both inside and out, with the glaze being chipped and worn around the base angle. This form is rare in the medieval period, although examples are known from London (Pearce & Jenner 1985, Fig 73) and Bergen, Norway (Blackmore & Vince 1994, 66–7; Fig 27, No. 72). No. 6 is probably from a baluster jug in the highly decorated/North French style, with a clear glaze and applied rouletted strips in green (Pearce & Vince 1988, Figs 50, 52). The South Herts wares (SHER) include sherds of cooking pot and a jug rim with oval-sectioned handle, possibly from Pinner.

Residual sherds include an unusual vessel in Shelly-Sandy ware with a raised footring (SSW: Fig 16, No. 4, ?cooking pot or curfew), and a thumbled rim sherd from an Early Surrey ware cooking pot similar to others found during excavations at the Jewel House within the Tower of London (Redknap 1983, Fig 21, Nos 29–32).

The fill of pit 33 contained mainly Roman pottery, but also a few sherds of 12th/13th-century date.

Late medieval

Construction of the Bulwark ([51]–[60])

Only seven sherds were recovered from the backfill of the construction trenches of the Bulwark; these include part of a horizontal handle in what appears to be Cheam redware (CHEAR), with traces of slip under a patchy clear glaze with a greenish tinge. If this identification is correct, the close dating of the context to c.1480 is of some interest, as it coincides exactly with the date proposed for the beginning of early post-medieval red-ware production at Cheam (Orton 1982, 76; 82–3) and elsewhere (Nelson 1981, 101). Wall-sided dishes would appear to have been an established form by the late 15th century, and may have been introduced at a slightly earlier date (Orton 1982, Fig 24). The fabric of the Tower Hill West sherd, which contains occasional flint grits, is slightly coarser than the usual Cheam red-ware, and perhaps represents the contemporary Tudor Brown ware, if it is not a Dutch import.

Post-medieval

Lean-to outside the Bulwark ([51]–[60]: Fig 16, Nos 7–8)

The pottery from layers associated with the construction and floor of the lean-to dates mainly to the period 1480–1550, with little residual material. Joining sherds were found in layers [52] and [54]. The main fabric is Tudor Brown (TUDB), including part of a bung-hole pitcher; imports include Langerwehe (LANG) and Raeren stoneware (RAER), Spanish lustre-ware from Valencia (VALE); the lustre now almost totally invisible (No. 7), and part of a South Netherlands maiolica flower vase (SNTG; No.8). Layer [60], which sealed the hearth, contained four sherds (48g), including one of a Low Countries cooking pot with slip decoration (DUTSL; cf Hurst *et al* 1986, fig 60, no. 191). These wares are somewhat unexpected in what would appear to have been a smithy, and their significance is uncertain. The lean-to structure, however, is only a short distance from the waterfront, where foreign ships were landing at the Custom House, Wool Key, and at Galley Key (Tatton-Brown 1974; 1975, 107–110; *ibid* 1975, 110–13). A range of imports of similar source and date has been found on sites in the Tower Hill area, some of which must represent *ad hoc* waste disposal by visiting merchants (Blackmore 1994; in preparation).

Great Fire demolition ([77]–[78]: Fig 16, Nos 9, 10)

The pottery from the demolition dumps comprises a typical range of late 16th and 17th-century wares: post-medieval red-wares (PMR, RBOR), including part of a bung-hole pitcher and a jug (No. 9); sherds from two Border ware pipkins (BORD); sherds from an oval Staffordshire butter-pot (STBU); tin-glazed wares, including (TGW; No. 10) and Frechen stoneware (FREC).

Post-Fire reorganisation ([80]–[90]: Fig 16, Nos 11, 12)

The pottery in this group contains a number of residual Roman and medieval sherds. Later sherds of interest include part of a North Italian marbled slipware bowl (NIMS), a handle, probably from a costrel, also possibly from Spain (SPAN; No. 11), and part of a Frechen stoneware

chamber pot (No. 12). No. 11 is in a hard fine fabric with frequent fine white flint grits up to 1mm. The firing varies from pink to grey, with a pale creamy slipped outer surface; an olive glaze covers the upper part of the handle. No. 12 is a rare form, even in the Rhineland, and although a few other examples have been found in London, they are very unusual; a complete example has been found at Linacre Gardens in the Cathedral precincts at Canterbury (Canterbury Archaeological Trust: unpublished). Tin-glazed wares include both blue and white and polychrome designs. Layer [81] also contained two sherds of distillation vessel (see below) and two crucible fragments.

Rubble layers ([82]–[87])

The pottery from these deposits is very similar to that from the re-landscaping deposits, but includes no residual material. Imports include one sherd of Westerwald stoneware (WEST), and one from a bichrome (yellow and green) chafing dish from the Saintonge (SAIN). Examples of the latter have been found in the vicinity of this site, at the Tower of London (Nelson 1983, Fig 7, No. 1), at the Tower Postern (Blackmore in preparation) and at the Royal Mint site (Blackmore in preparation). Two sherds of post-medieval blackware (PMBL) and two of Chinese porcelain (CHPO) were also found, the latter dating this group to after 1650.

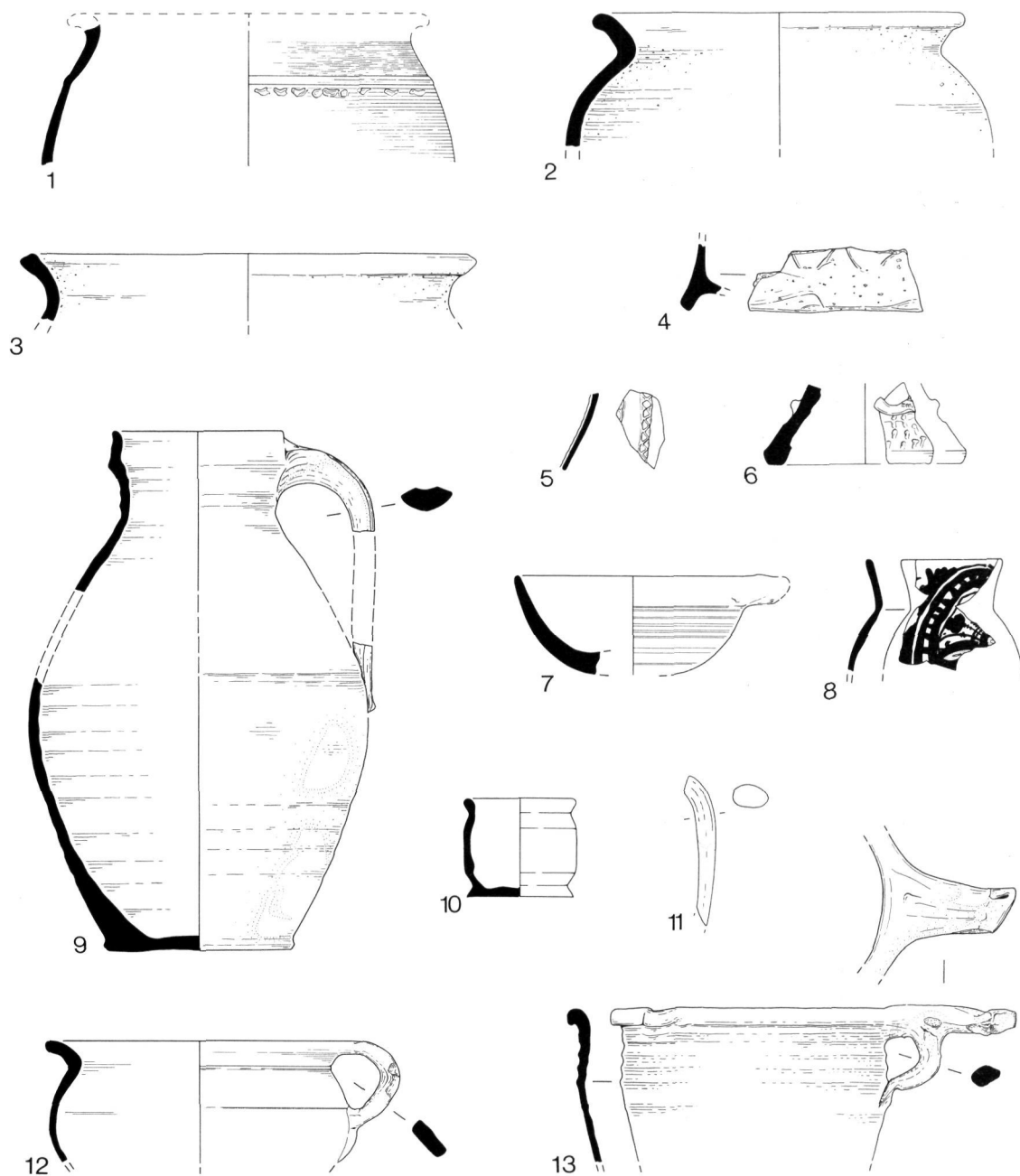
Activity outside the Bulwark ([88]–[90]: Fig 16, No. 13; Fig 17, Nos 14–18)

The pottery from the remaining contexts is discussed as one group by fabric/period, dated to after 1666. The largest amount of pottery in one context was found in pit 88, which contained an extensive dump of bottle-shaped distillation vessels (cucurbits: see below) together with PMR, BORD, TGW and FREC. The dating and origin of the distillation vessels is problematic, but they would appear to be of late 16th or 17th-century date (pre-1666). If they represent earlier activity in the area of the Bulwark, then this is most likely to have been in the external lean-to, where evidence of smithing was found, and where a few fragments from distillation vessels were found.

However, scientific analysis shows that the vessels were probably used in the parting of precious metals, and it is equally possible that the vessels were used in the mint within the Tower and discarded in the mid 17th century when new metal-working techniques were introduced, or during later refurbishments (Dyer 1988); similar vessels are known from Legges Mount, which lies at the north-west corner of the Tower, on the other side of the moat from pit [88]. The Hayward and Gascoigne map of 1597 (Fig 5) shows that this pit was probably located on the nearest available open land outside the 17th-century gateway into the area enclosed by the Bulwark. The metalworking ceramics from Tower Hill and elsewhere in London will be considered more fully elsewhere (Blackmore & Pearce in preparation).

Local pottery mainly comprises fine red-wares and white 'Border' wares. The former include part of a large 'Guy's' ware bowl (from layer [93]), and possibly part of a plant-holder. The Border wares include a saucepan with an unusual handle (No. 13), dated to 1650–1700 (Pearce 1992, 21). Tin-glazed wares include probable London dishes with Wan Li-style borders copying Chinese porcelain (Fig 17, Nos 15–17) dated to c.1650–1700. Of the imported wares, the polychrome dish No. 14, in a creamy-pink fabric with a footring, is most unusual, the geometric pattern in black, green and yellow apparently copying a Montelupo design. This is almost certainly an import, but it is difficult to assign a precise source, and the vessel is therefore classified with the group TGW in Table 2.

Other Mediterranean wares include two small 17th-century rimsherds from Pisa, North Italy. The first is from a marbled slip-ware bowl, the second one from a 'Graffita tarda' dish in a hard red fabric with a decoration of concentric rings incised through a white slip (NISG; Hurst *et al* 31). Other wares include part of a Mediterranean Maiolica jar from Italy or Spain (MEDM), glazed both internally and externally, and a strap handle from a Spanish amphora with patchy yellow glaze (SPOA). Finally, there are a few sherds of German stoneware and a late 15th or 16th-century dripping dish from the Low Countries, with typical pulled and folded straight handle and pinched feet (DUTR; cf Hurst *et al* 1986, 136; fig 61, no. 201). All these add to the picture of continuing mercantile activity along the waterfront in the post-medieval period.



0 100mm

Fig 16. The Pottery. No. 1: Roman; Nos 2-6: Medieval; Nos 7-14: Post-Medieval. Scale 1/4



Fig 17. The Pottery. Nos 14-17: Post-medieval; No. 18: Distillation vessel (composite profile). Scale 1/4

Catalogue of the illustrated medieval and later pottery

No.	Fabric	Context	Sherd	Comments/parallels
Fig 16				
1.	OXID?	4	1	Rilled, stabbed, ?Kentish <i>cf</i> Frere & Stow 1983, 199, No. 48
2.	EMCH	8	1	
3.	EMSH	81	55=1	
4.	SSW?	30	1	
5.	LOND	32	1	Green glaze, worn around base
6.	KING	32	2=1	<i>cf</i> Pearce <i>et al</i> (1988) Fig 50
7.	VALE	52	4=1	<i>cf</i> Hurst <i>et al</i> (1986) Fig 22
8.	SNTG	52	2=1	<i>cf</i> Hurst <i>et al</i> (1986) Fig 54, 1
9.	PMR	76	71=1	
10.	TGW	77	5=1	White glaze, drug jar
11.	SPAN	80	2=1	Olive glaze, jug or costrel
12.	FREC	80	1	Chamber pot
13.	BORD	90	6=1	Saucepan, clear/yellow glaze <i>(cf</i> Pearce 1992, Fig 9; Fig 30, No. 185)
Fig 17				
14.	TGW	88	5=1	?Italian or Spanish
15.	TGW	90	1	Anglo-Dutch
16.	TGW	88	4=1	London
17.	TGW	90	3=1	London
18.	RBOR	88		Distillation vessel

The distillation vessels*Richard Sewart*

The distillation vessels, which comprise by far the largest group of vessels in a single fabric, consist entirely of bottle-shaped vessels (cucurbits); no alembics or other associated forms such as dishes or crucibles were found, except for a single bone ash cupel (unstratified). The great majority were found, together with a small amount of other pottery (see above), in a single rubbish pit postdating the Bulwark phase of the site ([88], phase 7). The total rim and base EVEs (Orton) counts are 31.92 and 26.63 respectively, calculated from a total of 75 rim and 183 base sherds. A mean estimate of 30 whole vessels is therefore suggested for this sample, which weighs *c.*38 kg.

Approximately one-third of the feature was excavated, the remainder lying beyond the limit of the excavations. Assuming that it was fairly regular in plan, the quantity of pottery retrieved may approximate to a similar proportion of the total originally present. This means a possible dump of *c.*100 vessels, with a total weight of 115kg, which must represent a workshop of some size. A few sherds were also found in another rubbish pit and in a cesspit, both of which

postdate the Bulwark ([90] and [94]). A smaller group of similar vessels and associated forms is known from Legges Mount, in the Tower of London (Bayley 1992, 7; Fig 9).

Throughout the group from pit [88] the vessel forms were found to be fairly standard so that, although it was not possible to reconstruct a profile from adjoining sherds, a composite profile has been produced, using average rim and base diameters and 'overlapping' sherds from different vessels (Fig 17, No. 18). The height of the profile is therefore less reliable than the diameters. At 330mm it is slightly shorter than a similar whole 'bottle' of 360mm. The range of rim diameters is 52–58mm, giving an average of 55mm; the range of base diameters is 140–160mm, giving an average of 150mm. These figures were obtained using samples of 1,000% rim and base EVEs (10 of the 17 complete rims were irregular in shape, largely due to the knife-trimming of the underside and base angle). For this reason, no sherd of less than 20% EVEs was used in estimating the base diameter. Unlike the Legges Mount finds, which are larger and of composite manufacture with the neck luted on to the body (Bayley 1992, fig 9), the bulwark finds are made in one piece. They have obvious wheelmarks inside and ridges and grooves on the outside, presumably the result of twisting under heavy

pressure during throwing; the surfaces of the body are generally smoothed. The bases of some of the vessels show signs of blister action during use, probably the result of exposure to heat or chemical action, or both, during use. The estimated capacity of a typical vessel, based upon the hypothetical profile, is 3.8 litres.

The fabric, identified as Red Border ware, can be divided into two categories, poorly defined by superficial examination. Approximately two thirds of the sherds are in a hard, slightly soapy, buff-coloured fabric, while one third are in a harder, more highly fired, rough fabric which is either orange or grey in colour. Most of the sherds in the latter fabric have a grey core, orange margins, and grey or orange surfaces, reduced and oxidised colour combination varying within and between vessels. Both fabrics contain a moderate-to-abundant frequency of very fine mica, and sparse, ill-sorted, medium-to-coarse sub-round ironstone inclusions. Occasional voids in the fabric are due to poor preparation of the clay, to inclusion-loss during or after firing, or to heat exposure and chemical action during the industrial process. The inconsistent colouration of the harder fabric may also be due to conditions of use.

In addition to the Tower Hill finds, a cluster of sites with similar industrial and assaying ceramics is known in the Cheapside area, while scattered finds have been reported from other sites in London (Moorhouse 1972). The significance of the Tower Hill finds is briefly considered in the pottery report and below, and will be discussed more fully elsewhere (Blackmore in preparation).

Analysis of the distillation vessels

Michael Heyworth

The deposits on the insides of the distillation vessels were analysed by X-ray fluorescence, and iron and calcium were the main elements detected. The dark red deposit is likely, therefore, to be haematite, an iron sesquioxide. One vessel base fragment had a yellow deposit on the broken edge which was found to be sulphur.

These results indicate that the vessels were probably used for the distillation of ferrous sulphate to give sulphuric acid, as haematite is a by-product of this process. The technique is mentioned in documents written by medieval

alchemists who described ferrous sulphate as 'green vitriol' (Greenaway 1972, 79–81; 84–6). Sulphuric acid had no direct uses, so it was usually distilled with sodium or potassium nitrate to give nitric acid. This acid was used for the parting of precious metals, as it had the effect of dissolving silver but not gold. In the 16th century nitric acid was produced on an almost industrial scale. The fragments of distillation vessels found at Tower Hill therefore suggest the production of sulphuric, and probably nitric, acid for use in the parting of precious metals.

The distillation process was undertaken using two vessels; the ferrous sulphate was heated in a lower vessel, which was known as the cucurbit, and the sulphuric acid vapour was condensed in an upper vessel called an alembic which had a domed head and a spout. The alembics were often made of glass which would not have survived as well as the ceramic cucurbits (Greenaway 1972, 81–4; Moorhouse 1972).

The building material

Susan Degnan

Three main periods and types of material are represented: Roman material (residual), 15th-century bricks and 17th-century tile.

Roman

The Roman tile comprised broken and abraded fragments of *tegula*, *imbrex* and brick in the common London red sandy fabric (MoLAS type 2815).

Only one fragment of *imbrex* was in a stratified context [4]. A single piece of box flue tile (fabric 2815) was also found, on which a comb had been used to score a diagonal cross. Five residual Roman *tesserae* were found in three Phase 4 deposits; these vary in size from approximately 20mm × 20mm to 30mm × 22mm square, and from 15mm to 20mm thick.

Medieval brick and tile

The brick samples retained from the 1480 Bulwark vary in size slightly (c. 8½" (220mm) long × 4¼–4½" (103–112mm) wide × 2¼" (53mm) thick). They are in reddish-orange, soft, sandy

fabric, typical of the local brickearth. This is consistent with their late 15th-century date.

Section B produced a couple of fragments of flanged medieval roof tile (in fabric 2273).

17th century (Fig 18)

The 17th-century material consists mainly of pegtile and pantile; the latter (not used in London before the Great Fire), was present in pit [88], wall [39] and in pit [79] (fill [80]). A small Flemish brick measuring 165mm × 85mm × 38mm was found in the upper fill of pit [88]. Two fragments of plain glazed floor tile were found, a green one from the lower fill of [88] and a yellow one from pit [90]. In addition there were several fragments of polychrome and Delftware tile.

The polychrome tiles comprise four fragments. One has a floral design showing a rose and rose hips (No.1, [88], upper fill). Another has a medallion design with a central motif of a man, possibly on horseback (No.2; unstratified). Tiles of this type are known to have been produced both in Holland (van Lemmen 1986, 10) and in Southwark in the early 17th century. Although no precise parallel for No. 2 is known, similar tiles are held in the Museum of London collections (Britton 1987, 1723); further examples

have been found in excavations at Rectory Grove, Lambeth (see also Noël-Hume 1977, 55). The closest parallel for the fleur-de-lis corner motif on Nos 3, 4 (layer [76], the fill of the cut for sillbeam [75]; unstratified) is also on a Dutch tile dated to c.1640, although this is in blue and white, not polychrome (van Lemmen 1986, 10).

The Delftware tiles comprise 30 fragments, mainly from layers [76] (phase 5) and the lower fill of pit [88] (phase 7); these cover a date range from the early 17th-century polychrome floor tiles, to 18th-century thin wall tiles. Some were probably locally made; others may have been imported, since the only known parallels for these designs are Dutch. The two tiles depicting soldiers with pikes (Nos 5, 6, lower fill of [88]) for example, have their closest parallels in tiles from Holland (van Lemmen 1986, 7, dated to c.1625; de Jonge 1971, 43; 75, dated to 1600–1700).

A blue and white tile (No. 7, [88], lower fill) is of interest in that the interlacing design is one more commonly found on the earlier polychrome tiles, examples of which were found at the Pickleherring kiln site in Southwark (Noël-Hume 1977, 19); others are held in the Museum of London collections (Britton 1987, 175, Fig 196). This suggests that certain polychrome designs maintained their popularity even when poly-

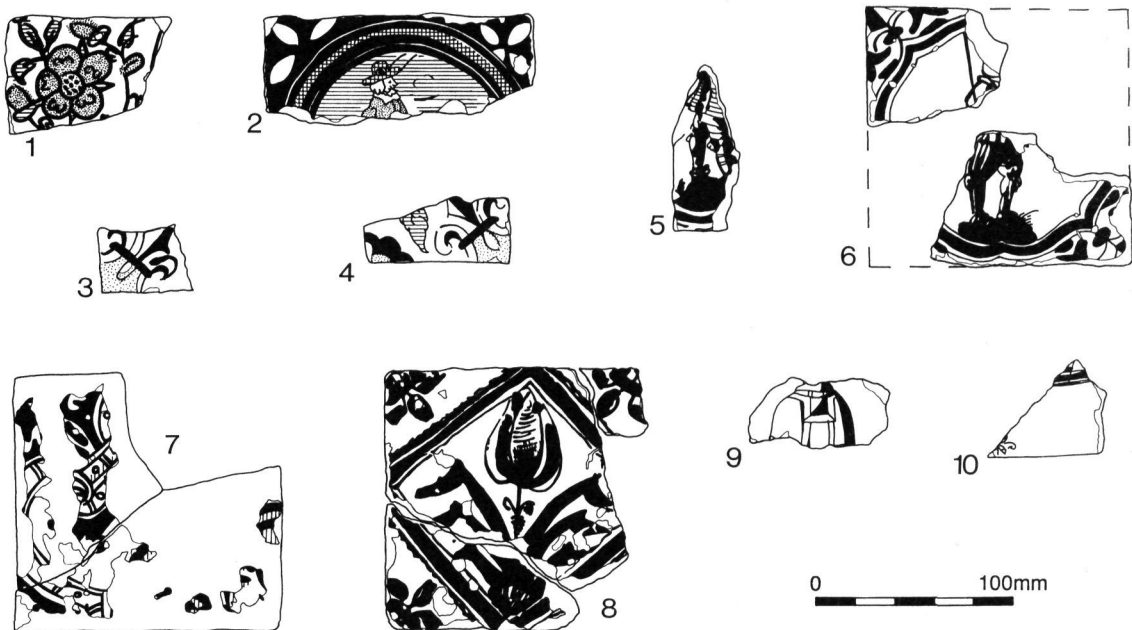


Fig 18. The tin-glazed tiles. Scale 1/4

chrome as such had gone out of fashion and blue and white tiles were in vogue. A second, more worn, example of this motif was found in pit [79] (Phase 6).

The blue and white tulip design (No. 8) is also most closely paralleled by Dutch polychrome tiles (de Jonge 1971, 38, dated to c.1600–1650). At least six examples of this design were found, all in [9]; on all but one the glaze was badly worn.

The later tiles comprise two small fragments of wall tile both from pit [88] (lower fill). One depicts a bishop (No. 9). The other (No. 10) has half a spider head corner motif known to be used on London delftware tiles of the late 17th century and 18th century (Horne 1989, 18). It shows part of a tiled floor, a common setting for indoor scenes on later tiles.

Catalogue of the illustrated building material, glass and clay pipe

No.	Context	Frag	Thickness	Comments/parallels
<i>Fig 18</i>				
1.	88 (Upper)	1	18mm	Rose and hips
2.	U/S	1	18mm	Medallion, man on horse
3.	U/S	1	15mm	Fleur-de-lis
4.	76	1	15mm	Fleur-de-lis
5.	88 (Lower)	1	11mm	Soldier with pike
6.	88 (Lower)	1	11mm	Soldier with pike
7.	88 (Lower)	1	12mm	Interlace
8.	76	1	14mm	Tulip
9.	88 (Lower)	1	9mm	Bishop
10.	88 (Lower)	1	10mm	?Indoor scene
<i>Fig 19</i>				
11.	76	1	14mm	Clay pipe with letter 'B' on bowl
12.	76	1		Glass pharmaceutical bottle

The clay pipes

Stephen Nelson

Clay pipe fragments were recovered in varying quantities from some 19 contexts. Most contexts contained only two or three fragments, the largest groups being found in the fills of pit [88] (72 pipe bowls). The condition of the pipes varies in that many are burnt or stained by cement or iron rust deposits, but most are un battered and do not appear to have been lying about for long before deposition.

The range of forms represented is surprisingly limited, and would seem to indicate a fairly limited date range of c.1660–1670 for all the post-medieval contexts. Most pipes are of Type 15 or Type 18 in the Atkinson and Oswald (1969) typology, which is still acceptable for London. Some of the Type 18 pipes are slightly more bulbous and may merge into Type 13, but the date range is the same (1660–80). It is significant that in the largest group there are no Type 19 pipes, which would be expected in a later 17th-century assemblage. Only the smaller bowls from dump [84] and pit [96] show any tendency to an early 17th-century date, while the single Type 25 in the Phase 5 demolition layer [77] may be intrusive.

The initialled pipe-bowls

Stephen Nelson and David Higgins

For some time it has been recognised that various types of marking, other than the usual stamped or moulded marks, were occasionally added to pipes. For example scratched initials have been noted on 17th-century pipes from London and Surrey (Le Cheminant 1981, 128; Higgins 1981, 280), and there is a crude burnished star on the base of another pipe from London in the Elkins collection.

The use of written ink marks, however, is very unusual. There are pipes in the Museum of London collections which have gained later written inscriptions and some late 19th-century and early 20th-century makers did use indelible ink stamps; but a contemporary owner's initial on earlier pipes is extremely rare, and until the Tower Hill West discovery only one marked fragment had been recognised amongst the thousands of clay pipes recovered from excavations in London. This is from a heel pipe dating to c.1660–80, and was found on the Billingsgate site (BIG82, 537, SF571). The marks, in red ink, comprise five short strokes on the left side of the stem, possibly intended to form the letter 'E', and the initials FA on the heel. The latter are more carefully formed, serifs having been added to the letters.

The discovery of at least three marked pipes in the Tower Hill West collection is thus of great interest and importance (Fig 19, No. 11). These are all Type 18 pipe bowls from [88], which bear the letter 'B' inscribed in a red pigment upside down on the back of the bowl (facing the smoker). These bowls differ slightly from the other Type 18 pipes only in that they show a bevelled rim (but with no milling), and would appear to have been lightly burnished all-over. There is an indication of a further 'B' on one of the Type 15 pipes, but the bowl is broken and this is very uncertain.

Although the condition of these pipes is varied, the mark, a reasonably well-formed 'B' in a flowing script, is quite distinct on at least one bowl, and would appear to be contemporary with the date of the pipe (second half of the 17th century), although clearly added after firing. It is most unlikely that a pipe-maker would employ this method of marking when marks could be quickly and neatly impressed in the traditional manner, and it seems probable that the pipes were marked by their owner. The burnishing may be significant, indicating slightly more up-market pipes that the owner wished to identify

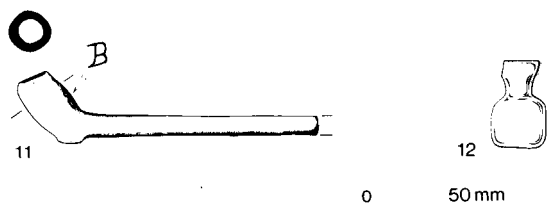


Fig 19. *The clay pipe and glass. Scale 1/2*

as his own. The fact that these are all heel pipes rather than spur pipes, moreover, suggests that they were all acquired and marked at the same time.

The worked bone and ivory

A large dump of sawn ivory fragments was found in layer [77] on the floor [70] of the cellar to the south of the Bulwark wall [40]; further fragments were found in the demolition rubble [76] over layer [77], and in rubbish pits [88] and [94], which post-date the Bulwark. A number of pieces were also collected from modern contexts. Since the dump in layer [77] continued beyond the limit of excavation, the bone assemblage must be regarded as a sample.

The assemblage falls into two groups: waste fragments, and partly finished artefacts, mainly combs and knife handles.

The waste material

Richard Sewart

The structural nature of ivory, availability of the raw material, and the problems associated with working it have been discussed by MacGregor (1985, 14–19; 38–40; 65–66), and are not repeated here.

A statistical analysis was attempted on 18kg of the 24kg of waste material collected, in order to determine what artefacts were being produced and the stage(s) in the process of manufacture represented. The remaining 6kg, comprising broken or laminated pieces which could not be assigned to any of the relevant categories, was disregarded for statistical purposes.

The great majority of the 1,152 fragments analysed have an outer (dentine) tusk surface (981 fragments, 85%). These include 13 section fragments from the root end of the tusk, and eight complete sections measuring 55mm–165mm in length and 54mm–123mm in diameter; three of the latter have holes bored through them (see Fig 20, No. 1). Totalling circumference percentages, measured on a pottery rim diameter chart, an estimated equivalent of approximately 12 whole tusks is represented. Six tusk tips are also present. The remaining 15% of the collection (171 fragments) comprises internal pieces. Both groups include pieces sawn longitudinally as well as laterally. These were grouped into cross-

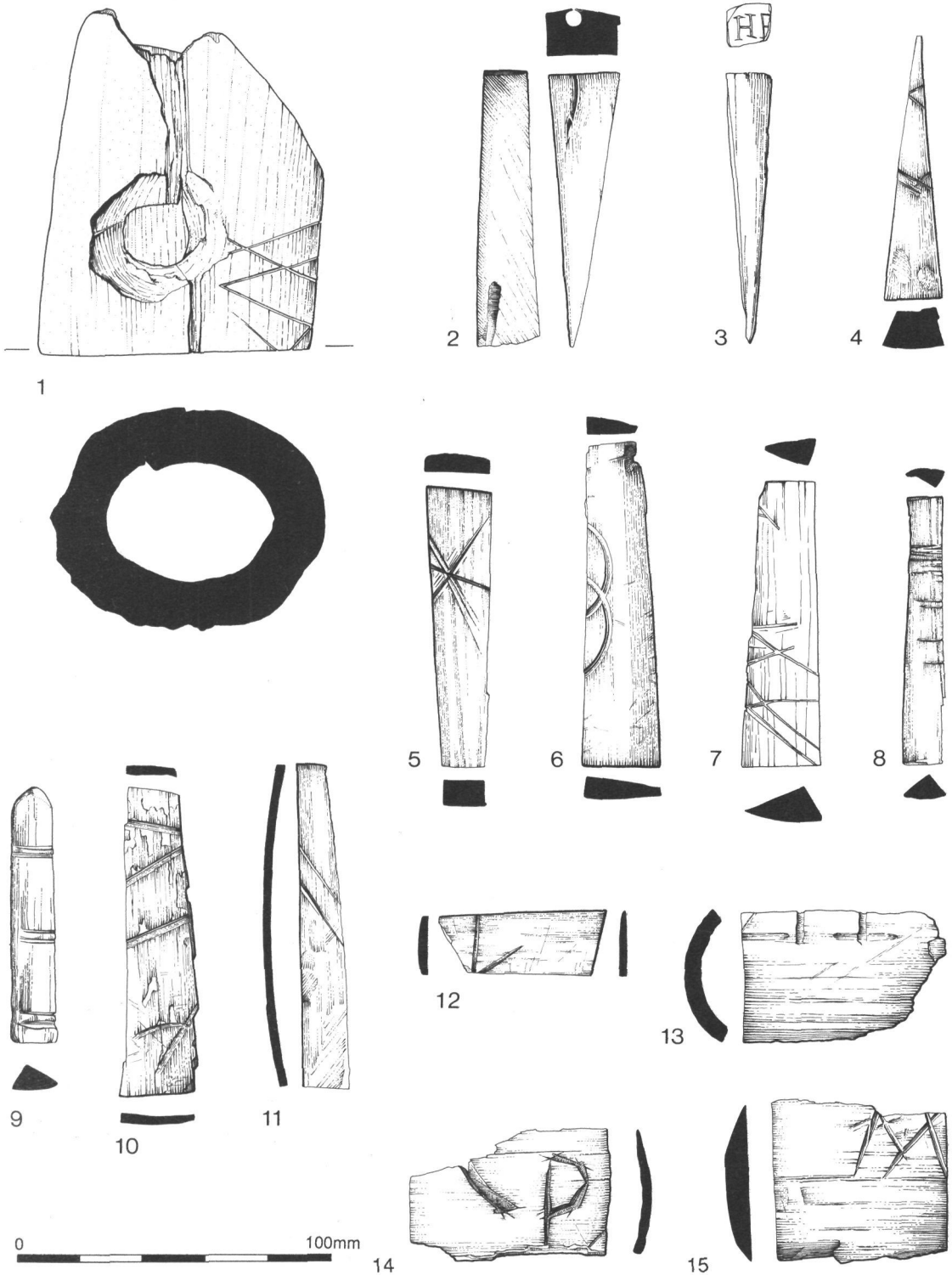


Fig 20. The ivory off-cuts and worked bone. Nos 1-15. Scale 1/3

sectional shape categories, and graded by length at 10mm intervals (see Table 3).

The off-cuts with an outer tusk surface fall neatly into one of three cross-sectional shape categories: roughly triangular, quadrilateral, and tangential. The close co-variance in length, and compatibility of form of the two categories suggests that they are the product of the longitudinal slicing of the same set of tusk sections (see Fig 22a). The 'wedges' of quadrilateral (Fig 20, Nos 2-6) and triangular cross-section (Fig 20, Nos 7-9), which taper to a point, show a similar pattern, despite the fact that they must be shorter than the sections from which they were cut. The completely different range of lengths of the tangential pieces suggests that these were cut from a different set of tusk sections (See Figs 22; 20, Nos 13-15; Fig 21, No. 16). There are no tangential wedges.

The internal pieces were grouped according to the presence or absence of the pulp cavity, and

also according to whether their maximum widths were greater or less than 30mm (the maximum width of a triangular/quadrilateral piece). The aim of this was to correlate the internal and external groups. The results (see Table 3) suggest that the group of pieces narrower than 30mm has a similar range of lengths to that of the triangular/quadrilateral group, and so is likely to have been cut from the same set of tusk sections (see Fig 22a). The 'wedges' again show a similar pattern. Those wider than 30mm however, correspond more in length to the range of the tangential group (see Fig 22b). Included in this very small group are a couple of pieces less than 5mm thick.

A sample of 94 pieces, selected from the fragments with a larger percentage of the circumference present, was taken from both the tangential group and from the triangular/quadrilateral groups. The maximum lengths of these pieces were recorded to the nearest 1mm,

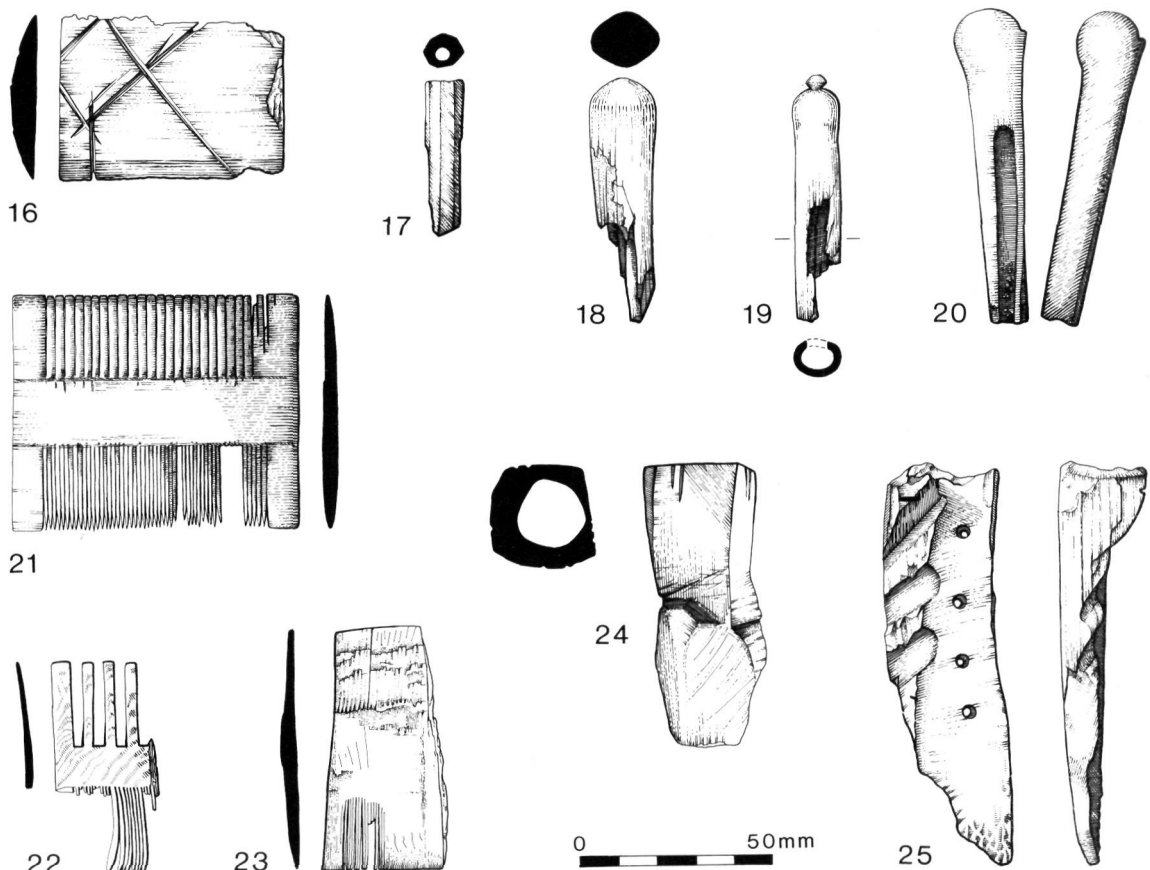


Fig 21. The ivory off-cuts and worked bone. Nos 16-25. Scale 1/3

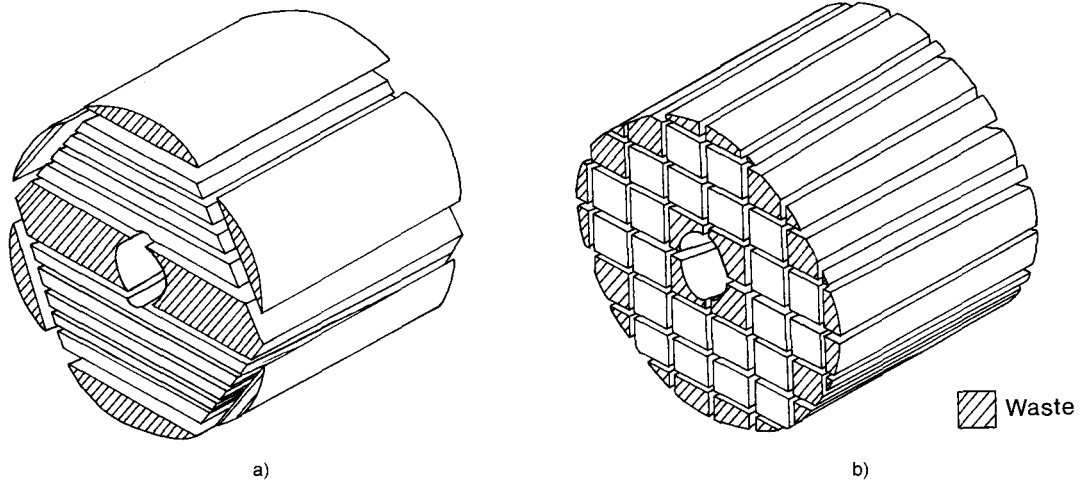


Fig 22. The ivory off-cuts: diagram showing details of tusk preparation. a) production of triangular and quadrilateral pieces; b) production of tangential pieces. Scale 1/3

and their maximum diameters to the nearest 10mm, using a pottery rim diameter chart. The results are illustrated in Fig 23.

The two ranges of lengths illustrated essentially reflect the information gleaned from the whole assemblage. In addition however, it appears that the length range of the tangential group is far more modal than that of the triangular/quadrilateral group. This indicates either the more precise cutting of the sections represented by the tangential group, or else a narrower range of length requirements. Furthermore, the tangential group appears to fall into two sub-groups.

The diameter ranges of the two groups overlap considerably, as shown in Figs 23c and d. The range of the tangential group however, is wider than that of the triangular/quadrilateral group, and in this case it is the range of the latter group that is the more modal. This suggests that selection according to tusk diameter, or tusk section diameter, was more important for the triangular/quadrilateral group.

A scatter plot of lengths against diameters is illustrated in Fig 24, which demonstrates that the major tangential group and the triangular/quadrilateral group hardly overlap at all, largely due to differences of length. A completely separate tangential group emerges, some pieces having the smallest diameters.

The waste nature of this material is borne out by the high proportion of outer surface pieces present in the assemblage, and also by the presence of pulp cavity, or staining, on most of the interior pieces. Although of inferior quality,

these pieces represent quite a large quantity of potentially usable ivory, especially taking into account the incompleteness of the assemblage. It can be inferred from this that artefact production was of such a scale, and so specialised as to make exploitation of the material discussed here uneconomical.

Following the initial trimming of the tusks, two distinct processes can now be suggested which would result in the two major groups of waste ivory. In the one case sections largely measuring between 55mm and 65mm in length were cut from the tusk; these were then sliced longitudinally as shown in Fig 22a, so as to obtain wide but thin pieces of core ivory, which could then be further shaped into comb components. The waste product of this process would be the larger of the two tangential groups of dentine-faced pieces, together with unusable core pieces of corresponding dimensions.

The other process would involve cutting the tusk into sections largely between 80mm and 105mm in length, which were then longitudinally sliced as shown in Fig 22a, so as to obtain approximately square-sectioned core pieces. The dimensions of these would be appropriate to knife handle production. The waste product of this process would be the triangular/quadrilateral group of dentine-faced pieces, together with unusable core pieces of corresponding width and length. 'Wedges' would be the result of cutting curved tusk sections.

Both hypotheses are supported by the presence

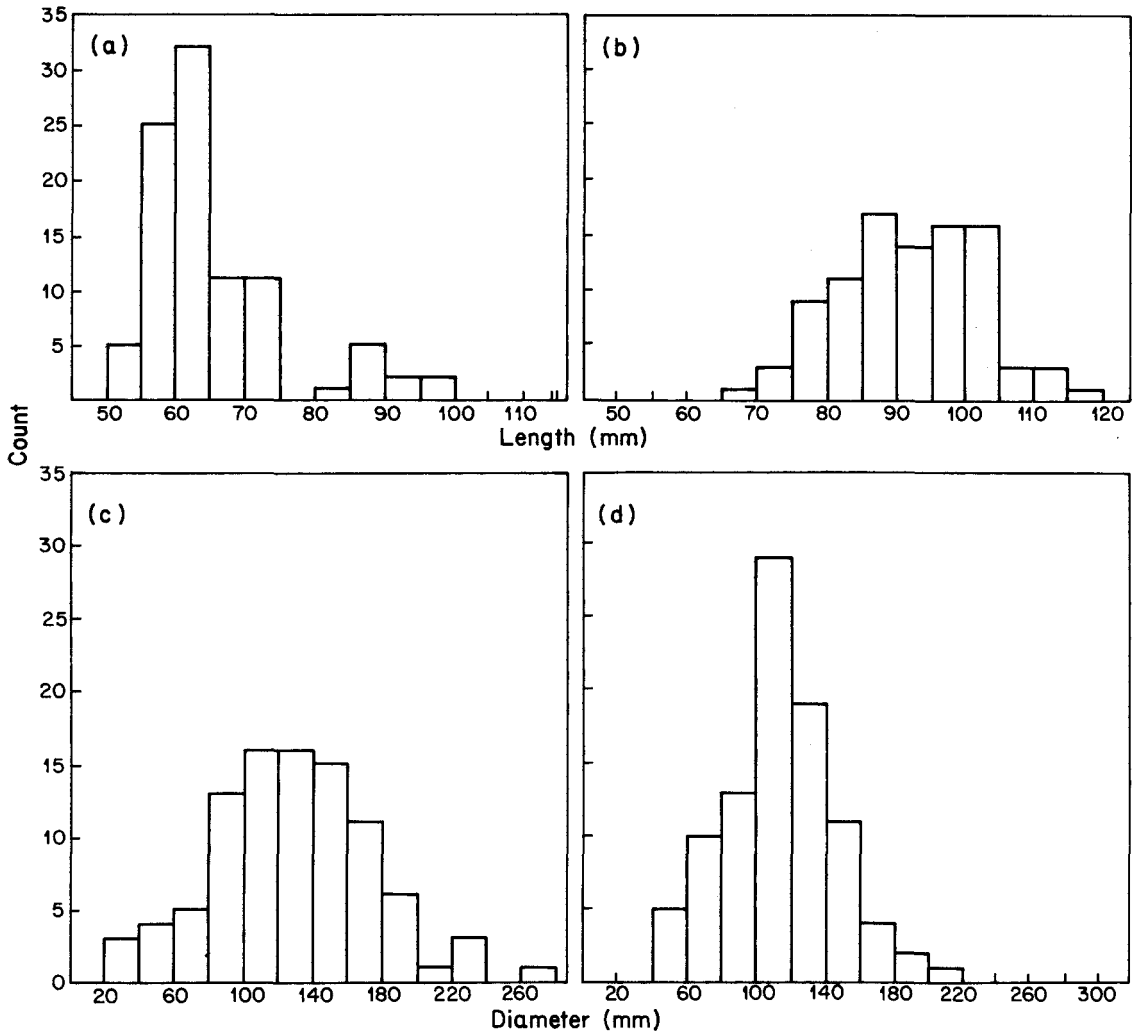


Fig 23. The ivory off-cuts: a) length of the triangular and quadrilateral cross-sectioned wedges; b) Length of the tangential fragments; c) Diameter ranges of the triangular and quadrilateral cross-sectioned wedges; d) Diameter ranges of the tangential fragments

of combs and knife handles, which are discussed below.

The worked ivory and other bone artefacts

Lyn Blackmore

Miscellaneous fragments

Amongst the assemblage of off-cuts are 26 fragments with incised markings on them. Whether these can be accurately described as trial pieces is debatable – in several cases the markings appear to have been made before the tusk was sawn up, so the original intent is

unknown, although Fig. 20 No. 9 appears to be imitating bamboo. These markings appear on all shape categories, which are illustrated in the following sequence: internal pieces with no dentine (Fig 20, No. 3), various wedge-shaped pieces with external cortex (Nos 4–12), which include some laminated fragments of cortex only (Nos 9–12) and tangentially cut fragments (Fig 20, Nos 13–15; Fig 21, No.16). Most marks are random geometric, either straight lines or arcs, but three fragments apparently bear letters, an ‘H’ carved on before the piece was cut into its present wedge-shape (Fig 20, No. 3), a ‘P’, and an ‘M’ or ‘W’, (Nos 14, 15).

A number of small cubes and rectangular

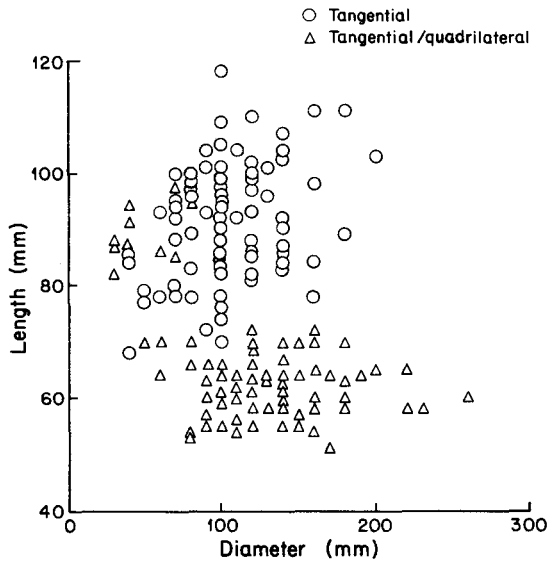


Fig 24. Ivory off-cuts. Scatter plot of length: diameter ratios of the off-cuts

blocks of various dimensions were possibly blanks for dice. One complete 'ring' and two fragments were also found, although these may simply be a

product of the sawing technique rather than unfinished artefacts.

Knife handles

Fragments of 11 handles were found, which fall into three groups: faceted or angular, cylindrical and flat. Unless stated, all were found in layer [77]. All are of solid form rather than plates secured by rivets. Dating of knives relies heavily on the form of the blade, of which none were found, but these handles appear to be of earlier 17th-century date, when the handle was normally half the length of the knife-blade or less (see MacGregor 1985, 170).

Of the three faceted handles, two are unfinished beyond the initial shaping, and the surfaces bear rough diagonal striations. One has a lozenge-shaped cross-section, another (Fig 21, No. 17) has an irregular octagonal section with sawn ends; this was probably designed to have a metal ferrule and cap, as seen on a finely worked knife with a faceted ivory handle in the Victoria and Albert Museum (Somers Cocks & Blair 1979, 13, fig 4, no. 39, dated to c.1650-73). The most exotic handle (Fig 25, No. 26) is decorated all

Table 3a. The distribution of the ivory off-cuts by shape and length (external pieces)

Lengths	4.1-5.0	5.1-6.0	6.1-7.0	7.1-8.0	8.1-9.0	9.1-10.0	10.1-11.0	Sub-Total	Total
Triangular	0	0	6	42	194	175	44	461}	846
Quadrilateral	0	0	3	18	116	108	34	279}	
Tangential	0	44	50	2	6	4	0	106}	
Triangular wedge	0	3	1	9	11	7	0	31}	114
Quadrilateral wedge	0	5	11	19	26	22	0	83}	
Sub-total		52	71	90	353	316	78	960	

Table 3b. The distribution of the ivory off-cuts by shape and length (internal pieces)

Lengths	4.1-5.0	5.1-6.0	6.1-7.0	7.1-8.0	8.1-9.0	9.1-10.0	10.1-11.0	Sub-Total	Total
Internal pieces <3 cm max width									
Pulp Cavity	0	0	5	5	18	17	7	52}	85
No Pulp Cavity	0	2	3	10	9	9	0	33}	
Wedges <3 cm max width									
Pulp Cavity	0	3	4	13	8	2	0	30}	76
No Pulp Cavity	3	6	9	14	10	4	0	46}	
Internal pieces >3 cm max width									
Pulp Cavity	1	4	2	0	0	1	0	8}	10
No Pulp Cavity	0	2	0	0	0	0	0	2}	
Totals	4	17	23	42	45	33	7		171

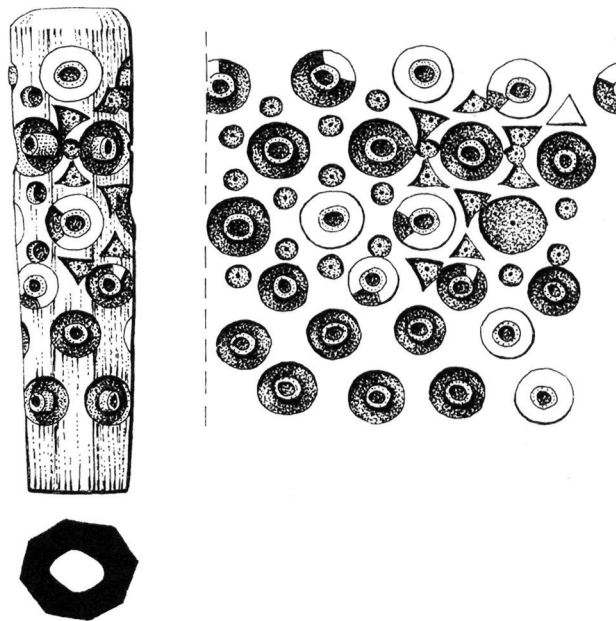


Fig 25. Ivory knife handle with amber inlay. Scale 1/2

over with incised ring and dot motifs of two different sizes, interspersed with simple incised dots. The rings were inlaid with amber, some of which still remains *in situ*. The inlaid handle comes at the end of an earlier 16th-century tradition which lasted for some one hundred years; the use of amber, however, was most common in the period 1610–1630.

Five cylindrical handles were found, apparently finished, of which the most delicate (Fig 21, No. 19) has a finial at the terminal. Four others have a simple rounded end, slightly swelling at the terminal as seen on No. 18. A close parallel for this form in the Museum of London collection (80.153/1) has a blade with a symmetrically pointed end, and dates to c.1630–50. Two handles have split longitudinally into two unequal parts, in one case probably as a result of the iron tang which has corroded *in situ*. A complete handle in this group also has an iron tang. These handles are all undecorated, but finely carved examples are known, for example a conical bone handle with carved interlace decoration (no inlay) in the Victoria and Albert Museum, dated to the early 17th-century (Somers Cocks & Blair 1979, 12; fig 4, no. 29).

The flat handles comprise three sub-rectangular rough-outs, tapering from the terminal to the shoulder, and one more finished piece (No. 20) which has laminated longitudinally

into two unequal parts. This handle appears to be of a slightly later date, having a flat upper edge with a slight kick at the terminal, and a curved lower edge which swells at the terminal in the manner of the later 'pistol grip' handles. A similar example in the Museum of London (A893, slightly squarer handle-end) has a square-ended blade and is dated to the mid 17th century.

The combs

Four combs were found, one finished but obviously badly made (Fig 21, No. 21), one possibly finished but broken (No. 22), and two trial pieces. Of the latter, only No. 23 was found in the main dump of off-cuts [76/77]; the others were in later deposits. No. 22 has the normal close spacing on one side, but large, widely spaced teeth almost 3mm apart on the other. A similar, finished comb (length 110mm+, width 60mm) with closely-spaced teeth on one side and wedge-shaped teeth 2mm apart on the other was found in 1978 at Goodman's Yard, Tower Hill (Whytehead 1980). The trial piece No. 23 is of interest in having several 'layers' of saw marks on one side, and a short length of normally sawn teeth on the other. A similar trial fragment was found at the Tower Postern in 1979 (Stevenson in preparation).

Other worked bone and shell

This comprises a pinner's bone (Fig 21, No. 24), here possibly used in the preparation of copper alloy wire or rivets associated with the cutlery, and a fragment of cow mandible with perforations (Fig 21, No. 25; function unknown). Two shells with mother of pearl suggest that this was being used for decorative inlay in knives or buttons. Mother of pearl was also found at the Tower Postern (Stevenson in preparation).

Discussion

The cutlery trade comprised four main areas of work; those of the bladesmith, the hafter, the sheather, and the cutler, who assembled all the component parts. In the larger cutleries some or all of these activities were carried out in the same workshop. In the 17th century, the high point of English knife-making, handles were made of more varied materials than at any other time (bone, ivory, metal, glass, stone, or combinations thereof), and were probably commissioned from specialist craftsmen. At this time the fork had not come into regular use and knives were normally carried everywhere on the person in a leather case, rather than provided by the host. As such, the knife was not only functional, but also a means of showing personal taste and wealth

(Somers Cocks & Blair 1979, xii-xiii). Knives of the period 1600-1650 were generally small and delicate, often decorated with a finial at the terminal; this feature continued until c.1700 and dating generally relies more on the shape of the blade than the handle. Bone was used for knife handles in the 16th century (Somers Cocks & Blair 1979, 4, fig 3, no. 11, dated c.1519); carved ivory handles were popular from 1600-1625, but it has generally been thought that they were not made in England between c.1625 and c.1675, reappearing c.1670-80. Hayward (1957, 8) suggests that this was probably due to the absence of skilled craftsmen in England rather than to a change in fashion.

The evidence from Tower Hill West, however, shows conclusively that ivory was being worked, and that knives and other artefacts were being assembled on or near the site in the early-mid 17th century. This is supported by further finds of ivory waste and worked bone recovered from post-medieval deposits near Tower Hill underground station (comb waste and a bone fragment used for button manufacture), at the Royal Mint (Goffin in preparation) and at the Tower Postern, where ivory waste was found together with mother of pearl (Stevenson in preparation). Whether the ivory was worked by immigrant or English craftsmen, and for whom it was intended (clients within the Tower, the City, or both) is not known.

Catalogue of ivory and bone

No.	Context	Acc no.	Comment
<i>Fig 20</i>			
1.	77		Tusk fragment with bored hole
2.	77	<40>	Quadrilateral wedge with pulp cavity
3.	77		Quadrilateral wedge with letters 'HP'
4.	77	<41>	Quadrilateral wedge
5.	77	<39>	Tapering quadrilateral wedge
6.	77	<42>	Triangular wedge
7.	77		Triangular wedge
8.	77	<43>	Triangular wedge
9.	87	<69>	Triangular wedge
10.	77	<72>	Triangular wedge
11.	77	<56>	Outer cortex only
12.	77	<78>	Outer cortex only
13.	87	<64>	Tangential section
14.	U/S	<61>	Tangential section with letter 'P'
15.	U/S	<62>	Tangential section with letter 'M' or 'W'
16.	U/S	<60>	Tangential section
17.	77	<75>	Facetted handle
18.	77	<37>	Cylindrical handle with finial
19.	77	<74>	Cylindrical handle

No.	Context	Acc no.	Comment
<i>Fig 20</i>			
20.	77	<35>	'Pistol grip' handle
21.	88	<1>	Double-sided comb, complete
22.	88	<19>	Double-sided comb, fragment
23.	77	<67>	Trial piece
24.	52	<12>	Pinner's bone, cow
25.	131	<70>	Cow mandible, perforated
<i>Fig 25</i>			
26.	77	<13>	Facetted ivory handle with amber inlay

The other finds

Lyn Blackmore

Finds of other materials are few in number, and mostly derive from layer [76]. These include a fragment of window glass in a lead came and a small pharmaceutical bottle made in a clear yellowish glass (Fig 19, No. 12). Two other pieces of lead came and a few unidentifiable copper alloy objects were also found. The remaining finds are nails or fragments of iron building materials.

The coins

Michael Hammerson and Peter Scott

1. Copy of antonianus of the Gallic emperor Tetricus I, dating to c.270–300. Although apparently cast (flan slightly small, edges rather rough from the unfinished coin mould, easily visible remains of sprue from where the metal entered the mould, and reverse type a normal one of Salus with altar and sceptre, taken from an original produced c.270–73, the legend is very garbled as in a 'normal' irregular copy with a badly inscribed legend. It may be that the coin was produced from an irregular mould of a regular coin, where the legend has been amended. [32], SF18.

2. Jetton, incomplete, corroded, but appears to be O: Shield of France modern R: Field of France ancient French jetton of second half of 15th century. [90], SF23.

3. Jetton, copper alloy O: Winged lion of St Mark, fictitious legend R: Reichsapfel, fictitious legend. Diameter 28mm. Jetton probably manufactured in Nuremburg, early 16th century although possibly earlier (Archibald 1985, 182). [95], SF4.

4. Charles I Rose farthing token, type 2. 1635–44. [89], SF6.

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Tony Dyson edited this paper; Figures 1–4 and 7–15 were drawn by Michael Hutchinson with Lesley Dunwoodie. The small finds were mainly illustrated by Dorrie Orchard; Fig 19, No. 11 and Fig 20, Nos 1, 3, 7 were illustrated by James Bennett. The pottery was mainly illustrated by Richard Sewart; Figs 16, Nos 1, 5, 6, and 11 were drawn by Lyn Blackmore. The tiles were drawn by Amy Grey. The diagrams and histograms are the work of Alison Hawkins.

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