London and Middlesex Archaeological Society Transactions, 67 (2016), 99–131

THE MEDIEVAL CITY DITCH AT BISHOPSGATE, HERON TOWER, LONDON EC3

David Sorapure

With contributions by Ian M Betts, Lyn Blackmore, Lynne Keys, Alan Pipe, Natasha Powers, Beth Richardson, Rob Scaife, Amy Thorp and Virgil Yendell

SUMMARY

In 2007 excavations in advance of the construction of Heron Tower revealed a number of scattered Roman pits. The excavations were situated in the area just beyond London's former Roman and medieval city wall, adjacent and to the east of Bishopsgate. Current projections of the line of the Roman city wall suggest that it ran north-west to south-east across the southern edge of the site. No traces of the Roman defences were discovered; any trace of the city wall and its associated ditch were apparently removed by the extreme truncation caused by the construction of the modern basements.

The main feature of archaeological interest on site was a significant cross section of the truncated medieval city ditch. Two trenches were excavated across the line of the city ditch. Fieldwork revealed that the ditch was 17–20m wide and aligned east to west. Sections cut through the infilled ditch revealed that some of its lower fills were waterlogged and possibly waterlain. Within the upper fills there were frequent episodes of recutting and clearing, whilst medieval pottery and environmental analysis revealed deposition sequences of refuse, rich in organic material, interspersed with periods of relatively sterile deposition.

The earliest phase of this ditch dates to the mid-11th to later 12th century. The initial infilling of the ditch began slowly, then it gradually increased after a major recutting event in the early 13th century, to reach a peak during the 14th to 15th centuries. From the late 15th century to the mid-17th century the city ditch in this area underwent a fairly rapid process of infilling as it fell out of use. Over time its width was progressively reduced by successive recutting events.

INTRODUCTION

In the autumn of 2007 in advance of the construction of Heron Tower, Museum of London Archaeology (MOLA) undertook archaeological excavations at the property formerly known as Kempson House, 25–37 Camomile Street and Bishops House, 106–126 Bishopsgate, London EC3 (NGR 533250 181450, site code KPH05). The site is bounded by Houndsditch to the north, Bishopsgate to the west, Outwich Street to the east and Camomile Street to the south (Fig 1). Earlier fieldwork conducted in 2000 (CMI00) and 2005 (KPH05) revealed negative evidence for the presence of the Roman city wall.

The excavation consisted of two trenches (Fig 2). Trench 1 was located in the basement of Kempson House and Trench 2 in the basement of Bishops House, built in 1960 and 1976 respectively. Due to the extensive modern truncation and the basements of the two buildings, the top of the truncated natural deposits lay at *c.*11.02m OD in Trench 1 and 11.16m OD in Trench 2, whilst ground level adjacent to the site was approximately 15.4m OD. The medieval city ditch was identified in both trenches, 17–20m wide, running west to east across the site. Deposit survival over much of the site was compromised by modern concrete ground beams and the 19th-century Irongate sewer, which ran west–east across the site, through Trench 1 and running just south of Trench 2 (Fig 2). This resulted in the

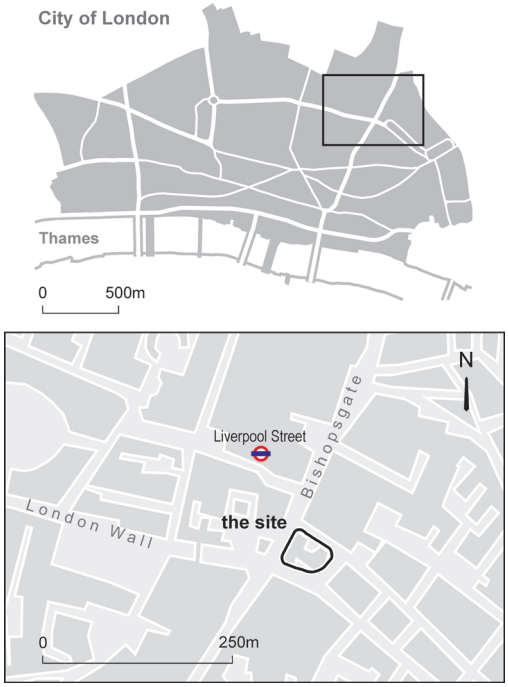

Fig 1. Site location (City of London scale 1:50,000, site plan 1:10,000)

decision to excavate where possible between the concrete ground beams and the Irongate sewer. Trench 1 was therefore unable to take the form of a single, continuous open trench and was modified to take the form of an open trench to the north with a series of bays (Areas A, B, C and D) and smaller slots to the south (Slot 1, Slot 2 – which was abandoned due to truncation – and Slot 3, Fig 2). Despite the modern intrusions, the width of the medieval city ditch was exposed in Trench 1. The ditch fills were excavated and recorded in section (see Figs 6 and 7), east facing in Trench 1 and west facing in Trench 2. After the section had been recorded each distinct deposit, or context, was removed and pottery and other finds recovered.

The site archive will be deposited under the site code KPH05 in the Museum of London's Archaeological Archive,[1] Mortimer Wheeler House, 46 Eagle Wharf Road, London N1 7ED, where it may be consulted by prior arrangement. The analysis of the excavation resulted in a series of specialist research archives which will be deposited as part of the archive. The results of assessed strata and all assemblages of artefacts, environmental and osteological remains were recorded on the MOLA Oracle database. This article employs standard Museum of London codes for ceramics and building materials; complete lists of these codes, their expansions and date ranges are available online.[2] Expansions of pottery codes are given at

Fig 2. Location of Trenches 1 and 2 (scale 1:1000)

the first mention in a text section. Context numbers are denoted by square brackets [1] and accessioned finds are shown in angled brackets <1>. Certain categories of finds have been given illustration numbers preceded by a letter denoting their category, for example pottery, <P1>. The context details concerning the illustrated finds are given in the figure captions. Land-use entities consist of Open Areas (OA) and Structures (S). Site codes referenced in this article relate to MOLA investigations.

DRIFT GEOLOGY (PERIOD 1)

The drift geology consisted of compact, sandy Pleistocene, Thames river terrace gravel (highest point 10.66m OD), overlain by brickearth, comprising a moderate to compact sandy silt varying in colour from orange and brown to light yellow or pinkish brown (highest point *c.*11.16m OD) (OA1, not illustrated). The presence of a possible palaeochannel flowing in a south-westerly direction was indicated by current bedding of silts and sands at the southern end of Trench 2. These deposits probably date to the Late Devensian (*c.*25,000–*c.*11,500 BP). In general, the natural deposits dipped southward lying between 9.60m and 8.82m OD in Trench 1 and 9.60m to 8.67m OD in Trench 2. No prehistoric deposits or finds were discovered at Heron Tower.

ROMAN ACTIVITY, *c.*AD 120–200 (PERIOD 2) AND *c.*AD 200–400 (PERIOD 3)

Roman Ground Level

Judging by the recorded height of Roman ground level from sites within the vicinity of Heron Tower, it appears that the modern truncation of the Roman ground surface on site was at least *c.*2m. At 58–60 Houndsditch (HSD89), 55m to the south-east of Heron Tower, the base of the Roman city wall was discovered at *c.*11.95m OD and the extramural Roman ground level at 12.26m OD. At Heron Tower the maximum height of surviving natural brickearth was at *c.*11.16m OD. Therefore, even to the south of Trench 1, no evidence for the Roman city wall is likely to have survived the construction of the modern basements of Bishops House and Kempson House.

Roman Period Background

The site of Heron Tower lies outside and adjacent to part of the Roman city wall, which was constructed during *c.*AD 180–225 (Maloney 1983; Sankey & Stephenson 1991; Fig 3). The landward portion of the Roman city wall was just over 2 miles (3.2km) in length with six gates and incorporated elements of an earlier fort at Cripplegate. At the site of Heron Tower, the wall ran on a north-west to south-east alignment and the southern edge of the site lay close to the known line of the Roman wall (Figs 3 and 4). This is confirmed by a conjectured alignment of the Roman wall, based on extending the wall's line from locations nearby where its remains were observed in 1876 (see below; Price 1880, 28) and through archaeological fieldwork, including investigations at 27–29 Camomile Street (COT88), 58–60 Houndsditch (HSD89) and 63–71 St Mary Axe (BUN88).

Surviving sections of the wall are protected as Scheduled Ancient Monuments and the Scheduled Monument Constraint Area extended into the south-western corner of the site, but did not continue across the entire site (Fig 4). The reasons for this are uncertain but may be based on a reference to the demolition and removal of a bastion and a 18.29m-long stretch of the wall above plinth level in 1876 (RCHME 1928, 86).

One of the Roman city wall's six gatehouses became Bishopsgate, which was located across what is now Bishopsgate road immediately outside the south-western corner of the site. It is probable that the Roman gatehouse at Bishopsgate was of a similar design to the one at Newgate and consisted of a double entrance flanked by rectangular guard rooms. In 1905 part of the gatehouse was recorded at the northern side of the junction of Wormwood Street and Bishopsgate Street (RCHME 1928, 97–8). On the outside of the Roman city wall was a berm (between 2.7m and 5.2m wide), beyond which was a V-shaped defensive ditch, *c.*4m wide and up to 2m deep (Maloney 1983, 101). This ditch was found 170m west of the site at 90–94 Old Broad Street and 63–64 New Broad Street (BRO90). An east–west Roman ditch, about

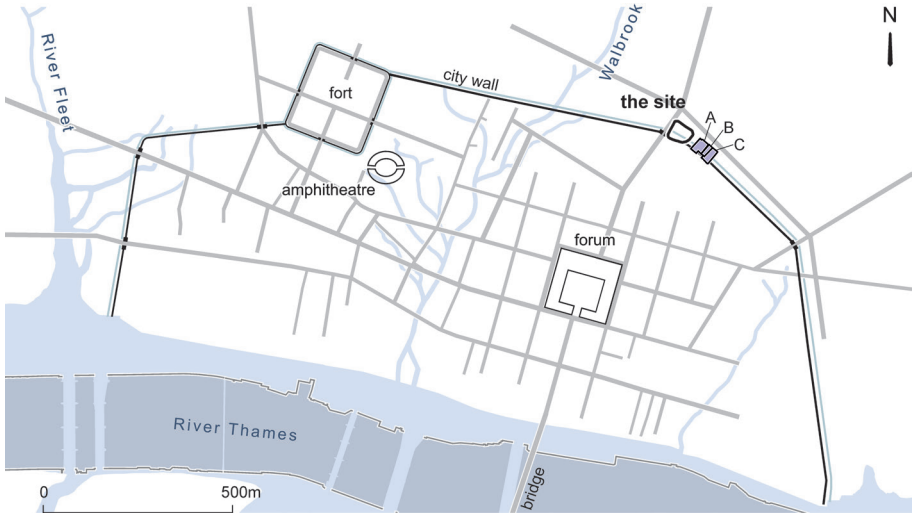

Fig 3. Location of the site in relation to Roman London. Archaeological evidence for the Roman wall has been found on three nearby sites to the east: A, 27–29 Camomile St (COT88); B, 58–60 Houndsditch (HSD89); C, 63–71 St Mary Axe (BUN88) (scale 1:20,000)

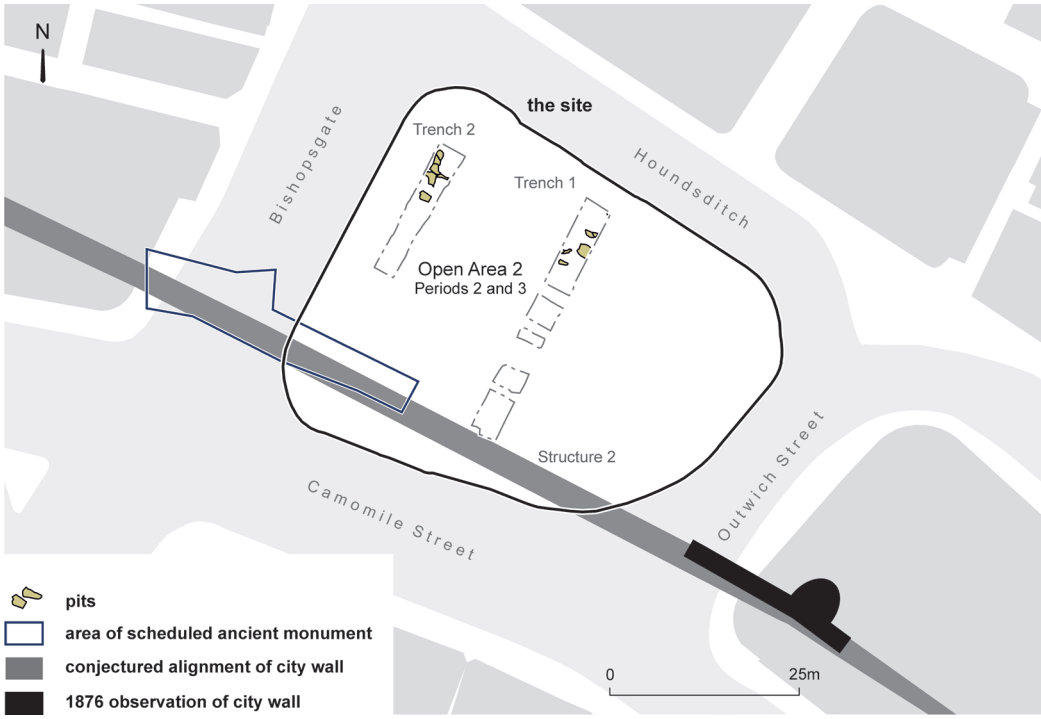

Fig 4. Conjectured alignment of the Roman city wall and its relationship to Roman pits (OA2) (scale 1:1000)

4m wide and up to 2m deep, with an 'ankle-breaking' slot along the base was also found at the Baltic Exchange site, 30 St Mary Axe (BAX95), approximately 170m south-east of the Heron Tower site, although this may have marked the city boundary prior to the construction of the city wall. During the 4th century AD a series of bastions was added to the outer face of the eastern portion of the city wall. One of these bastions and a length of the city wall were recorded to the east of the site at 33 to 27 Camomile Street by J E Price in 1876, immediately prior to its demolition (RCHME 1928, 100; Fig 4). He noted sculptures incorporated into its construction, which were likely to have been salvaged from nearby sepulchral monuments (Price 1880, 28), possibly originally situated in the adjoining Roman cemetery. In 1935 the core of the city wall was exposed at 28–30 Houndsditch (GM79), roughly 300m to the south-east of the Heron Tower site, while in 1905 a substantial portion of the Roman wall up to 14 feet (4.3m) in height was discovered during building work behind 58 and 60 Houndsditch (GM350).

The Roman forerunner of modern Bishopsgate Street (Ermine Street) was flanked by part of the northern extramural cemetery, which is known to have extended from immediately outside the city wall to at least the Spitalfields area. It contained at least 181 inhumation burials most of which date to the 3rd or 4th centuries AD (Hall 1996, 64–73; Barber & Hall 2000, 108–9). Excavations at Spitalfields (SRP98), about 400m north of the Roman city wall, have revealed a Roman cemetery of *c.*150 inhumation and cremation burials (Thomas 2004, 28). Closer to Heron Tower excavations at Devonshire Square (CDV99), 117m to the east of the site, revealed 36 Roman burials, many of which were aligned almost parallel to the city wall, suggesting that they post-dated its construction (Sankey & Connell 2007). Within this extramural area quarry pits were also dug at various locations including Houndsditch (HOU11) adjacent to the north of the site (A Daykin, pers comm).

Early to Late Roman Activity

The projected line of the Roman city ditch (conjectural S1, not illustrated) and wall (conjectural, S2, Fig 4) ran north-west to south-east across the southern edge of the site, to the south of Trench 1. Here within Area E at the southern end of Trench 1 (Figs 2 and 4) the modern concrete basement slab lay directly above truncated natural brickearth. No trace of the foundation of the city wall was found at Heron Tower during the 2007 fieldwork, apparently due to the depth of the truncation caused by previous development (see above).

At the northern end of both Trenches 1 and 2 (OA2, Fig 4) were the basal portion of numerous truncated pits cut into the natural brickearth, and they contained only Roman material. The earliest securely dated pits on site were backfilled during the early 2nd century AD (Period 2) (see Thorp below). These pits contained fragments of building material including ceramic roofing tiles and 2nd-century AD box-flue tiles (see Betts below). A number of late Roman (Period 3) pits ([513], [515] in Trench 2; [533], [581] and [587] in Trench 1) were identified. It is probable that these pits were dug to extract brickearth and gravel, and then used to dispose of domestic rubbish and other waste materials.

Late Roman deposits also survived where they had slumped into the northern edge of the later medieval city ditch in Trench 1 (Fig 6). Substantial amounts of late Roman pottery with a date range of *c.*AD 270–400 were recovered from this slumped material (from contexts [596], [601], [600] and [599]). The feature from which this Roman material originated is likely to have been another pit. Finds of residual fragments of fine grained laminated sandstone paving and Roman ceramic building material, recovered from medieval pits (OA3) to the north of the city ditch, are probably of late Roman date.

Despite the extensive loss of Roman archaeological deposits at Heron Tower, the conjectured alignment of the city defences allows some interpretation of the site in terms of land use in Periods 2 and 3. The Roman pits within Open Area 2 can be assigned to extramural activity, in close proximity to and within sight of the city defences. This area may have lain to the south of an extramural road, as projected on the latest map of Roman London (MOLA 2011). Despite the close proximity of an extensive Roman cemetery to the north (see above), no burials

were present at Heron Tower (although a small amount of redeposited human bone was recovered from Period 2 contexts). This may be because burials were intentionally confined to the area to the north of this extramural road (see Powers below).

THE EARLIER MEDIEVAL CITY DITCH AND EXTRAMURAL ACTIVITY, *c.*1050–1170 (PERIOD 4)

Historic Background

The Anglo-Saxon Chronicle states that in AD 886 'King Alfred occupied London fort', which he entrusted to Ealdorman Æthelred to hold (Swanton 2000, 80–1). As the landward Roman city wall and its gate-houses were reused as part of the Saxon fortifications, the position of any 9th-century AD external defensive ditches can be expected to have followed the approximate line of the later phases of the city ditch and, therefore, any 9th-century AD ditches were probably destroyed by the subsequent recutting of the ditch. At St Bartholomew's Hospital the earliest phase of the medieval city ditch is of pre-11th-century date (Wroe-Brown 2017, see this volume). Elsewhere in the City of London the construction of the

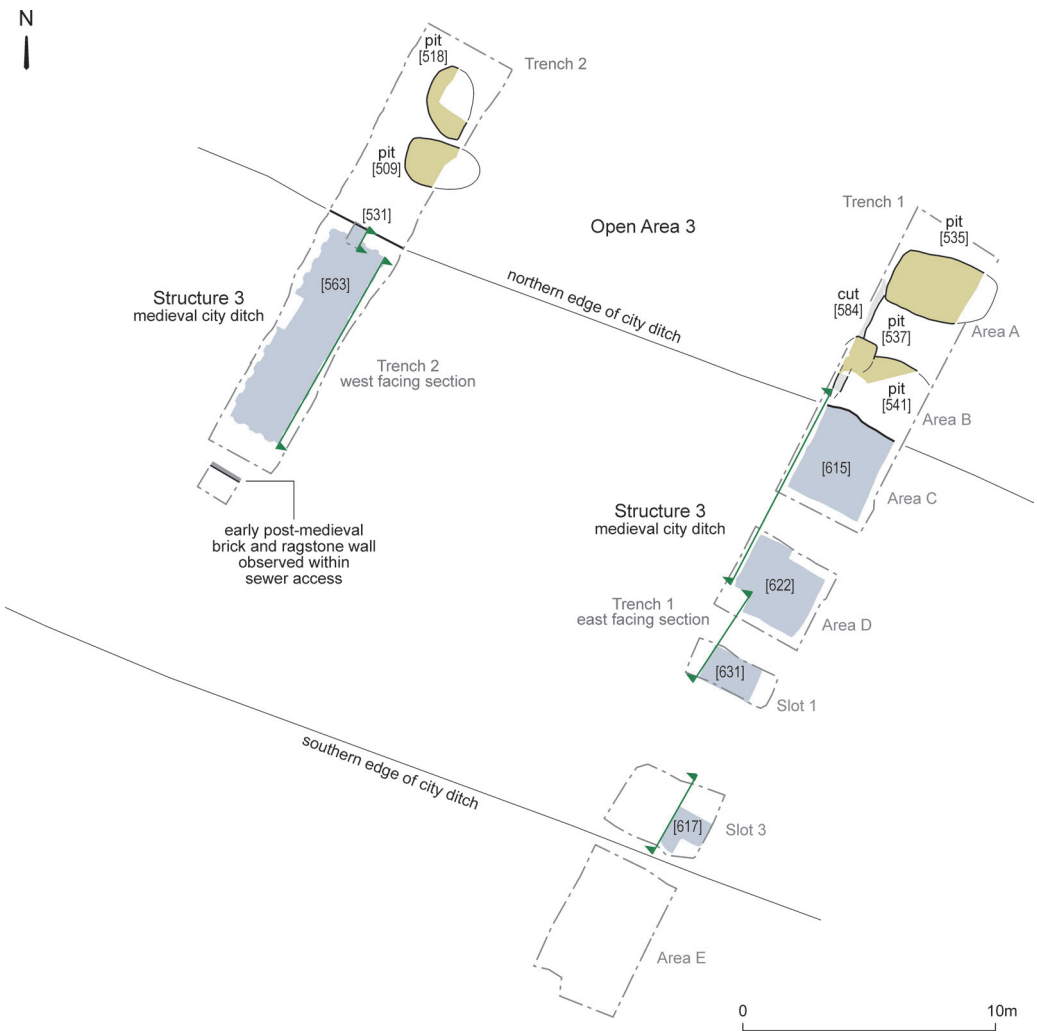

Fig 5. Medieval archaeological features, the city ditch (S3) and extramural features in Open Area 3 (scale 1:300)

earliest phase of the medieval city ditch has been dated to *c.*1000–80 at sites including Heron Tower, Aldersgate (Butler 2001), Cripplegate (Milne 2001, 35), Houndsditch (Maloney & Harding 1979), Ludgate (Rowsome 2014), Newgate (Lyon 2007, 55) and Old Bailey (Askew 2014). In 1009, according to the Anglo-Saxon Chronicle, 'London town' repelled a series of Viking attacks, so it must have possessed substantial defences including external ditches by this date (Swanton 2000, 139).

The City Ditch

At Heron Tower the earliest phase of the city ditch is dated by associated pottery to the mid-11th to later 12th century (S3, Fig 5). By comparison, the earliest phase of the western medieval ditch at St Bartholomew's Hospital was found to date to AD 900–1000 (BOJ10). The earliest phase of the medieval ditch at Heron Tower had entirely removed any traces of an earlier Saxon one. It was aligned roughly north-west to south-east with a width of *c.*17–20m (Fig 5). The base of the ditch in Trench 1 sloped gently from north to south for a depth of nearly 2m and was recorded at 10.64m OD at its highest point, to 8.71m OD at its lowest. The southern edge of the ditch was revealed in Trench 1 as a stepped cut, [617], into the natural brickearth with a height at its surviving top of 10.54m OD. The truncated southern edge of the ditch was separated from the projected line of the city wall by a berm, about 7m wide. The profile of the medieval ditch cut was best revealed in Trench 1, where, despite the interruptions of sewers and ground beams, the feature was visible for its full width (Fig 6). However, the northern edge of the ditch cut, [531], was more prominent and clearer in Trench 2. In Trench 1, slumping of a Roman cut feature, [615], had occurred on the northern edge of the medieval ditch. If a notional medieval ground level of 12.5m OD is considered,

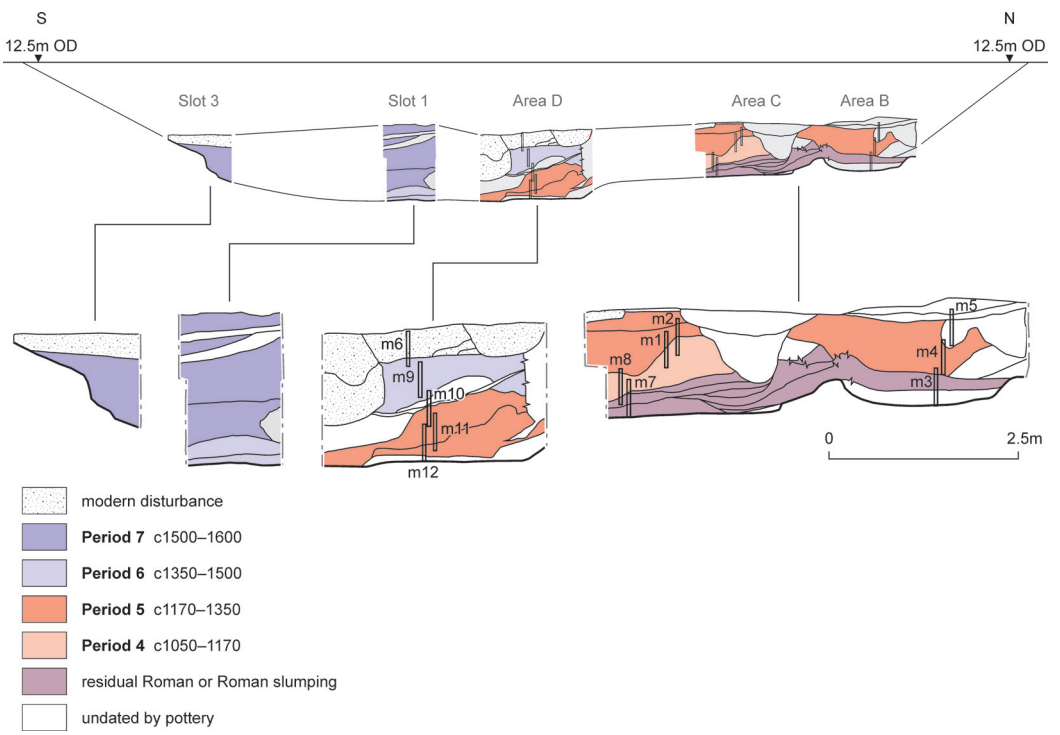

Fig 6. A composite east-facing section of Trench 1 showing the city ditch deposits dated by pottery. Details of the excavated portions of the city ditch are related to (inset) the conjectured cross section of the medieval city ditch and the notional medieval ground level (12.5m OD) (scale 1:100)

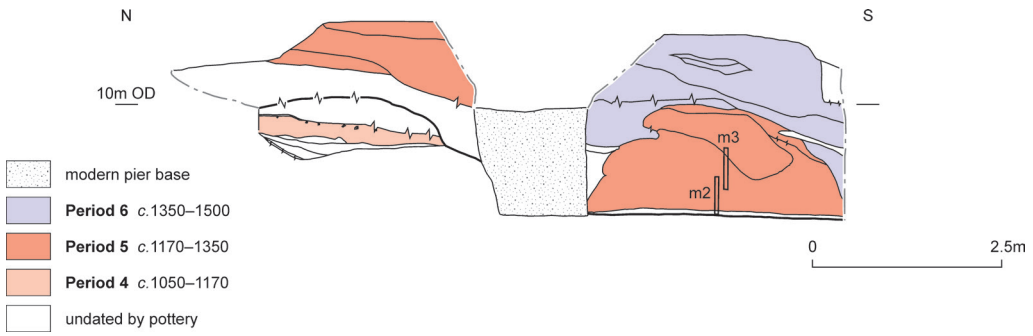

Fig 7. A composite west-facing section in Trench 2 showing city ditch deposits dated by pottery (scale 1:100)

Fig 8. Recording of a section through the medieval ditch deposits in Trench 2, looking north

the degree of truncation at Heron Tower is in the region of 2m, with the upper fills and the upper part of the ditch cut having been removed by modern basements. The composite section inset on Fig 6 shows the 'found' and 'conjectured' extent of the ditch.

Towards the northern edge of Trench 2 the Period 4 dated fills of dumped material overlay waterlain deposits at the bottom of the sequence (Figs 7 and 8). A later (Period 5) recutting and clearing episode left this pocket of Period 4 deposits over the original ditch cut, whilst the later recut, [563], truncated by a modern pier base reached a depth of *c.*8.6m OD.

A total of 89 sherds of pottery were recovered from contexts assigned to Period 4, with 24 of these recovered from ditch fills, the remainder coming from extramural pits. Towards the ditch's northern edge fills and associated pottery provided a consistent medieval date in both trenches, with material from a recutting or cleaning episode in Trench 2 dating to the end of this period. After the initial waterlain deposits were laid down, the ditch began to be gradually filled from the north with domestic debris and food waste, including numerous bones of sheep/goat, horse and cattle (Table 1; see Pipe below). Worked bone included two skates, <17> and <40>, and a solid conical piece of horn for use as a toggle button or gaming piece (see Richardson below). Bone skates, usually fashioned from horse metatarsals, are a common find in medieval city ditch contexts, and could indicate that the ditch formed a clear expanse of water (perhaps due to flooding), suitable for people to skate on (Butler 2001, 47–8; Wroe-Brown 2017, see this volume). However, the discarding of bone skates into the ditch may also explain their presence as it is likely that there were better places to skate. In his *Description of London*, written between 1170 and 1183,

William Fitz Stephen says that 'When the great marsh that laps up against the northern walls of the city is frozen, large numbers of the younger crowd go there to play about on the ice.' He goes on to describe the use of bone skates, stating 'they equip each of their feet with an animal's shin-bone, attaching it to the underside of their footwear; using hand-held poles reinforced with metal tips, which they periodically thrust against the ice, they propel themselves along as swiftly as a bird in flight or a bolt shot from a crossbow' (Riley 1860).

The Extramural Pits

Both trenches revealed a number of truncated pits situated to the north of the city ditch (OA3, Fig 5). As the original depth of these pits would have been several metres greater than their surviving extent, it is possible they were dug to quarry brickearth and gravel, and subsequently were used to dispose of refuse. Finds from these pits included cattle and horse bones plus pottery with a date range of *c.*1050–1150 ([535], [541] and [537] in Trench 1; [509] in Trench 2). A shallow linear cut, [584], interpreted as a gully and running north–south, was excavated in Trench 1, directly north of the city ditch (Fig 5). Pottery recovered from its fill dated to *c.*1050–1170.

One pit, [537], truncated this gully (Fig 5), and within its fill was found a fractured but virtually complete, rare 12th-century spouted tripod pitcher in coarse London-type ware with calcareous inclusions (LCOAR CALC) (Fig 14, <P1>). It was decorated with white slip panels on the body and a herringbone pattern impressed on the handle. It is likely to date to the second quarter of the 12th century, but could be as late as *c.*1150–70 (see Blackmore below).

The Heron Tower site lay outside the city wall within the parish of St Botolph Without Bishopsgate, which was in existence by the late 12th century (Carlin & Belcher 1989, 86). The parish church, which still survives, is situated on the western side of Bishopsgate. It is documented that the former Roman gate at Bishopsgate was functioning again by 1086, and it was rebuilt in 1479 (*ibid*, 66). It seems likely that during Period 4 extramural settlement locally consisted of ribbon development along the eastern side of Bishopsgate, hence the scatter of rubbish pits described above. Excavations along the western side of Bishopsgate have revealed that this area was not reoccupied until the middle of the 11th century (Swift 2003, 26). The pollen analysed from the ditch fills at Heron Tower shows a dominance of wild grasses and weeds, which corresponds to the mixture of cultivated and waste ground thought to have existed outside the City at this time (see Scaife below; *ibid*).

LATE 12th- TO MID-14th-CENTURY CITY DITCH, *c.*1170–1350 (PERIOD 5)

The absence of extensive early medieval suburban development to the north-east of the walled city allowed certain monastic orders to acquire large enough sites to establish new premises here during the 12th and 13th centuries (Fig 9). The priory of St John the Baptist at Holywell was founded between 1152 and 1158, roughly 850m to the north of the site, on land that originally consisted of 3 acres (*c.*1.2 hectares) of 'moor' (Lewis 2010). The priory and hospital of St Mary Spital, founded in 1197, was situated roughly 500m to the north of the city wall (and from the Heron Tower site). It was situated on the eastern side of Bishopsgate Street and within what had formerly been agricultural land (Thomas *et al* 1997, 14–19). Suburban development outside of the City continued during the 13th century, with ribbon development extending all along all major routes. Outside the city wall at Bishopsgate in 1247, the priory of St Mary Bethlehem was founded, *c.*50m to the north-west of the Heron Tower site. Within the city walls, *c.*250m to the south-east, the Holy Trinity Priory at Aldgate was founded in 1108. By 1215 the priory of St Helen had been established within the city walls, approximately 150m to the south of the site (Carlin & Belcher 1989, 77, 87).

By 1275 it is documented that there was an extramural road known as 'Hondesdich' following the northern edge of the city ditch (Carlin & Belcher 1989, 77; Fig 9). According to John Stow, Houndsditch had acquired its name due to the fact that there had been 'much filth (conueyed forth of the Citie) especially dead Dogges were there layd

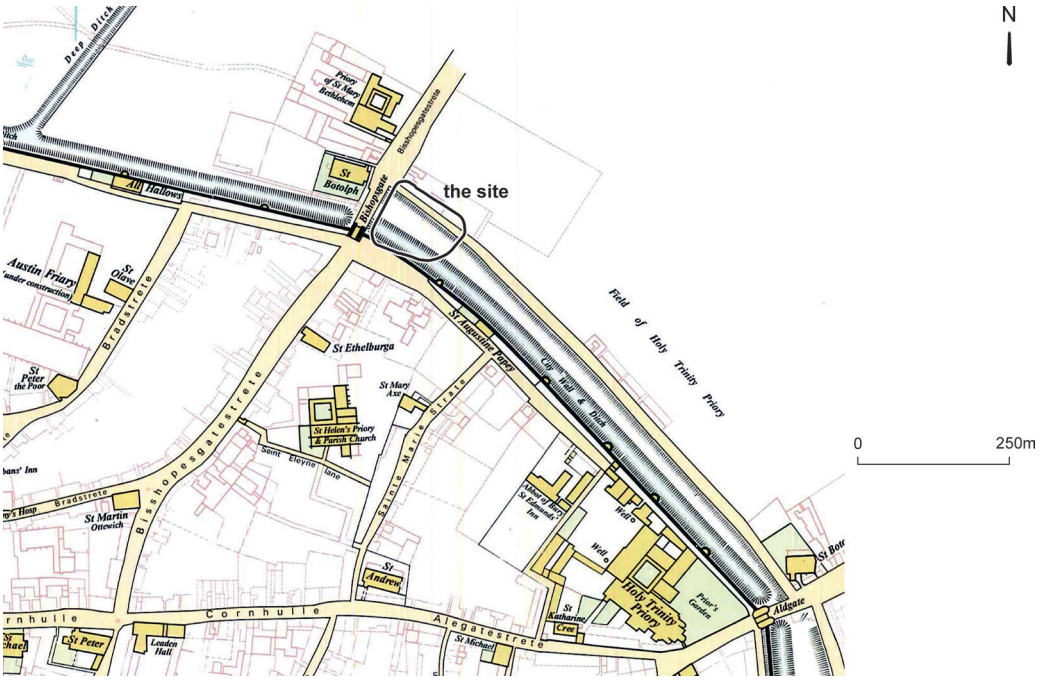

Fig 9. The site in relation to a plan of medieval London c.1270 (after Lobel 1989) (scale 1:12,500)

or cast' (Stow 1908, 120–9). Though dog bones were present in the faunal assemblage of domesticate animal bone from Heron Tower, perhaps less than could be expected were found (Table 1).

At Heron Tower, Period 5 saw the continued use of the city ditch (S3) and the external space to the north of the ditch (OA3), although perhaps with less frequency as only one pit, [518], was datable to this period (1270–1350) (Fig 5, Trench 2). A recut, [563], into the deposits of the earlier Period 4 city ditch was visible at the ditch's northern edge, also in Trench 2. It was overlain by fills suggesting an early 13th-century date for the recutting activity, apparently quite soon after the digging of the ditch, suggesting it may quickly have become neglected.

Sequences of fills were seen to be interspersed with evidence of recutting or clearance events, forming a complex sequence (Figs 6 and 7). This pattern has been detected during many investigations of the medieval city ditch within the City of London, showing there was periodic maintenance of the ditch until it finally fell out of use. At Moor House, there appeared to be at least three recuts within the 13th and 14th centuries (Butler 2006, 149). At the Merrill Lynch Financial Centre, excavations showed that soon after the city ditch was recut during the 13th century it quickly became a rubbish dump (Lyon 2007, 148). By 1250, the city ditch at St Bartholomew's Hospital was already out of use, having experienced a steady infilling of both natural silt deposits and rubbish (Wroe-Brown 2017, see this volume). Environmental evidence at Heron Tower (see Yendell below) and at other sites has shown that the city ditch contained stagnant, standing water for much of the time (Askew 2014; Wroe-Brown 2017, see this volume), which when flooded would have been accessible to skaters along much of its length. In the later medieval period, the ditch appears to have been treated like an open sewer (Lyon 2007, 148).

The pottery from Period 5 amounts to 300 sherds in total and the bulk of the pottery dates to the 13th/14th centuries (see Blackmore below). The assemblage comprises typical domestic rubbish from City of London properties and it seems likely

that most sherds were redeposited, possibly several times, before being dumped in the ditch. Numerous leather artefacts were also discarded in the ditch during this period, including shoes and boots plus an almost complete leather costrel dated *c.*1270–1350 (Fig 15, <32>; see Richardson below).

At the northern end of the ditch Period 5 deposits (generally datable to 1270–1350) were separated from the Period 4 deposits by a recut, which ran from north to south. At the southern end of Trench 2, on the other side of the pier base, a group of Period 5 fills overlay the base of the ditch, presumably the same Period 5 recut. These dated to 1180–1350 and were in turn overlain by Period 6 fills (1350–1500) (Fig 7).

Correspondingly in Trench 1, a group of Period 5 deposits were recorded overlying earlier fills at the northern edge of the ditch (Fig 6), though in this area the evidence for recutting was less clear as there had been a degree of slumping of both natural gravels and earlier Roman deposits, as well as later material containing medieval pottery.

MID-14th- TO 16th-CENTURY CITY DITCH, *c.*1350–1500 (PERIOD 6)

A further clearing or recutting episode (or episodes) within the city ditch occurred between the late 14th and mid–late 15th century. The continued clearing of the city ditch during the 14th to 15th century was also detected at Moor House (Butler 2006, 53), unlike the Merrill Lynch Financial Centre where, although a full ditch sequence survived, there was no evidence that it was cleared or recut at this time (Lyon 2007, 75). Within Trench 2 at Heron Tower the dates assigned to Period 6 layers overlying the earlier Period 5 deposits were significantly later in date and contained pottery with a date range of *c.*1480–1500 (Fig 7). The lack of late 14th- and 15th-century pottery within this area may be due to the later recutting of the ditch, and although a corresponding recut line was not visible perhaps this area had been disturbed by the modern concrete pier base. Similarly, a possible recutting episode appeared in Area D of Trench 1 (Fig 6), and associated pottery suggests a similar date for this event. The first datable deposits in Area D were between *c.*1170 and *c.*1350, then a thin band of yellow clay overlay these fills, perhaps indicating the line of a recut and the exposure of waterlain sediments. Above this deposit the pottery sequence continued providing dates of *c.*1400–1500, before modern disturbance ended the sequence. Stow mentions nine cleaning episodes of the city ditch undertaken between 1354 and 1595. How extensive these various episodes were is not clear, but in 1477 the whole ditch was apparently cleaned (Stow 1908, 19–20). Penn tiles from this period were recovered from the ditch including one with a previously unpublished design (Fig 13, <16>). These tiles probably came from a nearby church or monastic building, such as the parish church of St Botolph Bishopsgate or the priory of St Mary Bethlehem (see Betts below).

No features dating to this period were found in the area to the north of the ditch (OA3). Truncation by the modern basements may have destroyed any evidence of activity.

16th- TO 17th-CENTURY CITY DITCH, *c.*1500–1600 (PERIOD 7)

By *c.*1559, the copperplate map shows that the city ditch still existed here as an open feature, now apparently demarcated by fencing or walling. The northern side of Houndsditch was lined with buildings, behind which were gardens and fields (Fig 10). No properties are shown on the south side of Houndsditch, which like the berm of the city wall was still open space. The copperplate map also shows 'Bisshoppes Gate' and the line of the city wall.

By Stow's lifetime (1525–1605) the maintenance of the city ditch was much

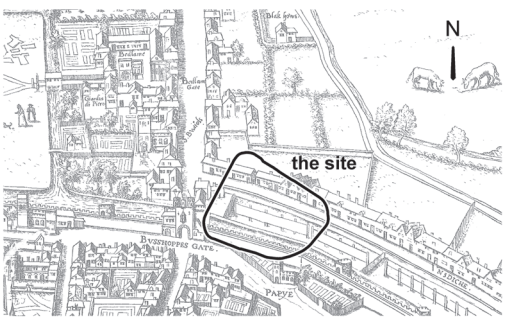

Fig 10. Detail from the copperplate map of c.1559 (Margary 1981)

neglected, and he recorded that its course was now either reduced to a 'very narrow … filthy channel, or altogether stopped up for gardens planted and houses built thereon' (Stow 1908, 19–20). According to Stow, directly opposite the site on the north side of Houndsditch was the Dolphin Inn, founded in 1513, for the receipt of travellers, though the building pre-dated the establishment of the inn (*ibid*, 163–75). Stow also describes two further buildings to the east of the Dolphin Inn, one with pleasure gardens and bowling alleys, whilst he goes on to describe how many new and fair houses occupied the area to the north of Houndsditch. These were presumably built after the copperplate map was produced. Stow also described houses known as 'Petty France' on the western side of Bishopsgate, adjoining St Botolph's church, which had encroached upon the line of the city ditch. He also says that the city ditch here was now reduced to a 'narrow channel, and almost filled up with unsavoury things', a situation which he considered to be very insanitary (*ibid*).

In total 120 sherds of pottery were recovered from the 16th-century ditch fills. Vessels used for cooking or for food preparation/serving are the main forms represented; also present are sherds from nine jars, six jugs, one mug, two flower pots and two sprinklers. Imported wares are the second most common post-medieval group, with 53 sherds (see Blackmore below). These Period 7 deposits at Heron Tower represent the rapid filling up of the city ditch and its abandonment as the Bishopsgate area became increasingly built-up. They also represent the last major surviving stratigraphic group of deposits within the city ditch, as all the later material and features had been removed by modern truncation.

A possible early post-medieval feature was found in the form of a substantial brick-built structure, running west to east, with brick in an irregular bond with occasional ragstone blocks. It was observed outside the limit of excavation, to the south of Trench 2, when an access to the late 19th-century Irongate sewer was opened by the contractors; the masonry was noted 0.35m beneath the concrete slab of the modern basement in the north side of the slot (Fig 5). Probably dating to the Tudor or early post-medieval period, this feature represents an early stage of building over the site of the now disused city ditch. It is documented that in 1553 the 'town ditch' from Newgate to Aldersgate (on the City's western side) was 'stoppyed up with bryke and made playne [with the] erthe' (Sloane & Watson 2004, 186) and evidence for a 16th-century brick culvert constructed within the infilled city ditch was found in this area during 1999 archaeological work at the Merrill Lynch headquarters (Watson 2000, 10). Perhaps a similar contemporary structure was present within the city ditch at Heron Tower. However, the limited access to this feature and its location outside the area of excavation prevented its full extent being determined.

17th- TO 19th-CENTURY ACTIVITY, *c.*1600–1800 (PERIOD 8)

During the Stuart period London rapidly expanded beyond the walled city. In 1637 a survey revealed that during the previous 34 years 1,360 new houses had been built outside the walled city, and of these 404 (29.7%) had been erected to the north of the City including some at Bishopsgate (Brett-James 1935, 116).

There was little archaeological survival from this period at Heron Tower, due to modern truncation. However, documentary and cartographic evidence confirms that the area became increasingly built-up during this period. On Faithorne and Newcourt's map of 1658, this portion of the city ditch was now completely built over and the city wall was obscured by buildings, apart from the gatehouse at Bishopsgate, which was retained until 1760 (Fig 11). Some evidence survived from Area C in Trench 1, in the form of a small west–east ditch, possibly used for drainage or as a boundary (not illustrated). This small ditch also cut through a thin compact layer of pebbles within a grey clay matrix at the very top of the surviving ditch sequence. Although only a fragment survived, the smooth surface of the pebbles suggests that it was a consolidated surface, such as a pathway, laid on top of the infilled medieval ditch after it had gone out of use. The date of a single fragment of clay tobacco pipe stem recovered from the fill of the small ditch cannot be refined beyond *c.*1580–1910.

Fig 11. Detail from the Faithorne and Newcourt map of 1658 showing buildings on the south side of Houndsditch covering the Heron Tower site, superimposed (Faithorne & Newcourt 1658)

At St Bartholomew's Hospital the disuse of the largely infilled city ditch during *c.*1250–1500 was marked by the construction of a metalled surface, perhaps intended as a roadway or yard (Wroe-Brown 2017, see this volume).

DISCUSSION

Many of the larger investigations of the city ditch have been undertaken in the north-western part of the City, such as at Aldersgate (Butler 2001), Ludgate (Rowsome 2014) and Newgate (Lyon 2007). In addition, the reappraisal of the data from excavations at Cripplegate, conducted by W F Grimes between 1946 and 1968, revealed similar sequences to those seen at Heron Tower (Milne 2001, 35). The sequence of ditch deposits at Heron Tower corresponds closely to those seen to the east; however, differences are present, in particular in the evidence for earlier activities within the city ditch area at Bishopsgate.

Roman Burials

The site at Heron Tower was situated between the northern boundary of the Roman walled city and the northern extramural cemetery (Barber & Hall 2000, 108–9). While no *in situ* Roman burials were discovered at Heron Tower, a small amount of redeposited human bone was recovered, some from Period 2 deposits, indicating that Roman burials occurred within the vicinity. The human remains are likely to have found their way into the medieval city ditch via the reworking of adjacent ground in which the graves lay, or because the ditch provided a convenient location for the disposal of stray finds of bone.

Roman City Defences

It is conjectured that both the Roman city wall and its associated ditch originally existed within the southern part of the site, but both have been destroyed by modern truncation (discussed above). A later phase of the Roman city ditch is dated to the 4th century AD; it was deeper and wider than its predecessor and therefore could have survived the modern truncation. It was also situated further away from the line of the city wall, presumably because of the addition of a series of new bastions (Maloney 1983, 115). This could indicate that the Roman deposits found at the northern end of the ditch at Heron Tower (Fig 6) may in fact be remnants of the 4th-century AD ditch. However, this seems improbable as the distance between this feature, [549], and the projected line of the Roman wall would have been about 25m. Assuming that the 4th-century AD Roman ditch berm was 8m wide here, and allowing another 10m for the notional width of the ditch, the distance of 25m is too great for these deposits to represent the northern edge of the 4th-century AD ditch.

The extramural Roman activity at Heron Tower is similar to that seen at other sites, such as 7–12 Aldersgate Street (ALG84), where the earliest features included a series of flat-bottomed Roman ditches outside the city boundary and respecting its alignment (Schofield 1998). From archaeological evidence such as that found to the south-east of Heron Tower at Baltic House, 14–32

St Mary Axe (BAX95), it appears that this area of the Roman city was not extensively developed until the early 2nd century AD, but that activity continued until *c.*AD 400 (Howe 2002, 16–25).

Medieval City Defences

At Heron Tower, the digging of the medieval city ditch had removed any evidence of the late Roman and Saxon ditches. The earliest surviving phase of the city ditch on site dated to *c.*1050–1170 (Period 4). Contemporary extramural activity consisted of pit digging. Finds from these features included a near-complete, spouted tripod pitcher, probably dating to the early to mid-12th century (Fig 14).

The pottery recovered from excavations along London's medieval city ditch has the potential to provide a chronology for each site. In addition, it may give clues as to the nature and intensity of occupation or activity in the immediate vicinity of the City's defences. At Cripplegate (WFG18; Milne 2001) the earliest phase of post-Roman ditch contained a large amount of early medieval pottery, most of which was datable to *c.*1050–1200 (Pearce 2001b, 19). A Saxo-Norman ditch at Aldersgate also yielded a large assemblage of 765 sherds dating to between *c.*1050 and *c.*1150 (Butler 2001, 52). However, at Heron Tower, by comparison, there was much less ceramic evidence for activity before the mid-12th century. This is similar to the pottery evidence from Newgate, where the earliest ditch fills contained only a small assemblage dating to *c.*1150–1200 (Lyon 2007, 55). There are various conclusions that can be drawn from this lack of evidence. One possibility is that the periodic recutting or clearing of the city ditch removed most of the finds from this period. Alternatively, the lack of pottery in comparison to other sites may indicate a low density of contemporary urban development. It appears that the low level of early medieval development in the north-eastern part of the walled city and the adjoining extramural area allowed the establishment of various monastic houses here during the 12th and 13th centuries (see above).

The geoarchaeological analysis of the primary Period 4 ditch fills at Heron Tower indicate a build-up of waterlain sediments, which probably accumulated on a seasonal basis and sometimes dried out (see Yendell below). The nature of these early fills matches those at 1–6 Aldersgate Street (AES96), and similar fills suggesting an early clear ditch were noted at 47–56 Houndsditch (HOU78), to the south-east of Heron Tower, and again outside Ludgate at 42–46 Ludgate Hill (LUD82). It seems likely, therefore, that on the whole the early medieval ditch was not used for rubbish disposal to the same extent as it was in later periods, which could explain the lack of pottery from the 11th and 12th centuries at Heron Tower and other sites.

However, the faunal evidence from Period 4 (*c.*1050–1170) indicates that the ditch was being used for the disposal of domestic and industrial waste and for the disposal of whole animals. In Period 5 (*c.*1170–1350), deposits of non-consumed species such as dog, cat and horse, with some butchering (of horse and dog) and a small amount of bone-working waste predominate. Context [606], Period 6 (*c.*1350–1500), contained cattle horn core with tool marks.

Some indication of the nature of the area outside the City during the medieval period was given by excavations at Jubilee Gardens, Houndsditch (JBL86), approximately 60m east of the site, where thick agricultural soil horizons were found representing the agrarian usage of the site until the late medieval period. The pollen data from Heron Tower are comparable with this and other studies of London's city ditch fills, showing a dominance of grasses (see Scaife below).

Stow claimed that construction of the London city ditch was begun in 1211 and completed in 1213. However, this event was presumably a major recutting episode, probably prompted by the political instability of King John's reign (Stow 1908, 19–20). Interestingly, evidence of ditch recuts of broadly 13th-century date, which were invariably followed by extensive episodes of infilling, have been identified at Heron Tower, as well as at Aldersgate (Butler 2001, 53), Cripplegate (Milne 2001, 35), Ludgate (Rowsome 2014, 6), Newgate (Lyon 2007, 59), Old Bailey (Askew 2014) and 41–42 Trinity Square (CST85; Schofield 1998). This event is the first significant recut visible

in the medieval city ditch sequence at Heron Tower and suggests that the upkeep of the ditch had been neglected since the 11th century.

Milne's reappraisal of Grimes's excavations show that the early 13th-century recut was closer to the city wall than the Saxo-Norman ditch. This recut ditch had a narrower berm, *c.*1.2m from the face of the city wall (Milne 2001, fig 14), whilst at Newgate the 13th-century berm was in the region of 4m in width (Lyon 2001, fig 61). At Cripplegate the recut ditch was *c.*20m in width (Milne 2001, fig 18), as it was at Heron Tower and Newgate (Lyon 2007, fig 61), while at Aldersgate it was 17.5m wide (Butler 2001, 54). At Heron Tower the berm was impossible to measure accurately due to lack of survival of the city wall, but the distance from the southern edge of the ditch cut to the probable line of the wall would have put the width of the berm in the region of 8m. When the evidence from comparative sites is considered, it seems likely that there was some variation in the width of the early 13th-century berm.

At Newgate the later medieval ditch fills (*c.*1300–1500) occupied a band *c.*9m in width within the partly infilled ditch (Lyon 2007, 66–7). The later medieval ditch had therefore been reduced by approximately half its 13th-century width by dumping from its outside edge. This deposition pattern was identical to that seen at Heron Tower, with the earliest deposits lying along the ditch's northern edge furthest from the line of the city wall, with deposits becoming progressively later in date towards the southern edge. Excavations at 1–6 Aldersgate Street also showed rapid deposition and silting occurred from the mid-14th century, possibly due to the dumping of refuse as the ditch was close to the road at Aldersgate (Butler 2001, 67). At Heron Tower an increase in the amount of pottery recovered from the ditch from *c.*1350 onwards suggests a higher level of discard, perhaps due to the increased density of suburban settlement along Houndsditch.

Post-Medieval

According to the 16th-century historian Stow, Houndsditch was first paved in 1503, showing it was now a significant thoroughfare. He recounted that in his youth situated along this street were 'some small cottages' which were almshouses. During the latter part of Henry VIII's reign a gun foundry was established in the fields behind these cottages. Stow also stated that here the city ditch had been enclosed by 'a mud wall' to try and stop people discarding 'filth' into it, but that this had failed and the ditch was now largely infilled (Stow 1908, 120–9).

There was no ceramic evidence at Heron Tower for any industrial activity, but there was some possible kiln material (see Betts below). A small amount of ferrous slag was recovered, probably smithing waste, datable to the medieval to early post-medieval periods (see Keys below). Other investigations of the post-medieval city ditch have produced evidence of industrial activity. For instance, at both Aldersgate and Cripplegate 16th-century industrial vessels such as distillation bottles and cucurbits were found (Jarrett 2001, 69–70; Pearce 2001b, 22–3). These reflect local industries in the area of Gresham Street, whilst at Moor House evidence of late 16th- to early 17th-century pottery production was found during excavations, along with late 16th-century sherds from industrial vessels (Edwards 1974, 56; Haslam 2006, 67–8; Sudds 2006, 84–6, 95–6). Similarly at 42–46 Ludgate Hill (LUD82) industrial waste suggestive of Fleet Valley industries was found (Schofield 1998). The site is shown as an open area on the copperplate map of *c.*1559, with no buildings situated between the city wall and the Houndsditch thoroughfare (Fig 10).

As with the deposits dated to the medieval period, Period 8 deposits (*c.*1600–1800) contained a large group of butchered cattle and horse bones and horn preparation waste (Pipe 2010). This evidence indicates that the ditch was continually used for the disposal of both domestic and industrial waste throughout the medieval and post-medieval periods.

Having been slower to urbanise during the medieval period, the eastern fringe of the City also seems to have differed in its urban character in the early post-medieval period. Imported wares are the second most common post-medieval group at Heron Tower in the early post-medieval period and over half of these are Dutch red wares. This assemblage fits with a number of other sites around the eastern fringe of London that would

appear to reflect the arrival of immigrants fleeing religious persecution in the late 16th century. Some were potters who settled in the former precinct of Holy Trinity Priory (Edwards 1974, 8, 77–8; Noël Hume 1977, 1, 3, 107; Britton 1987, 20, 27–9; Blackmore 2005, 237–42, 246–7). Others were Jews who moved into the same area (Blackmore 2006b, 138), while other immigrants would appear to have settled in the Finsbury area, where Dutch and Spanish wares are common (Malcolm 1997; Blackmore 2009, 54–6, 58–9).

Evidence for the abandonment of the city ditch from excavations along its route is again variable. At King Edward Street and Newgate Street the late medieval ditch had been reduced to a gully with a revetment along its inner edge, and infilling was complete comparatively early by *c.*1500 (Lyon 2007, 75). Alternatively, other city ditch sites show a very different sequence, with a substantial 16th-century recut datable to 1580–1620, evident at Cripplegate (Milne 2001, 35). It was *c.*4m in depth with a width of 24m and thought to correspond to the threat of Spanish invasion during the late 16th century. Again a flat-bottomed cut was evident at Aldersgate (Butler 2001, 57), smaller than that found at Cripplegate at 10.9m in width with a depth of 1.37m. Pottery provided dates to the backfill of late 16th to early 17th centuries. Further to this both the Cripplegate and the Aldersgate site had 17th-century recuts, suggestive of a final short-lived feature, to defend London during the English Civil War. At Cripplegate the Civil War period ditch was rapidly backfilled when no longer needed, at some point before 1648 (Milne 2001, 18). By 1658 the Faithorne and Newcourt map shows that the site had been completely built over (Fig 11).

At Heron Tower modern truncation had removed the upper portion of the ditch fill, whilst ground beams and sewers had also disturbed the remaining portion of the sequence. However, the southernmost deposits in Trench 1 showed that deposition within the ditch was still occurring between 1500 and 1600, and the concentration of deposits of this date range suggest that the ditch may have been rapidly and systematically infilled during either the late 16th or early 17th century.

SPECIALIST REPORTS

Ceramic and Stone Building Materials

Ian Betts

A total of just over 52kg of ceramic and stone building materials was recovered from the site, over 70% of which is Roman in date. The remaining material is of medieval and post-medieval date.

Roman (Residual)

Large amounts of mostly residual Roman ceramic and stone building materials were recovered from the fills of the medieval city ditch. The majority of Roman building material consists of ceramic roofing tiles and bricks of 1st- to mid-2nd-century AD date (fabric group 2815). These probably originated in London or from tileries situated along Watling Street between London and St Albans (Hertfordshire). There are also a few fragments from north Kent (fabric 2454) and Radlett, also in Hertfordshire (fabrics 3023, 3060), and a small number of roofing tiles and bricks characterised by fine moulding sand (fabric 2459B). These fine sanded tiles and bricks were probably made in either north-east London or south Essex around AD 120–250. All these fabric varieties are commonly found on sites in London. One of the bricks has a worn base, indicating reuse as paving, whilst a tegula has had its edges chipped to form a crude circular counter or gaming piece (Fig 12, <24>). Another tegula

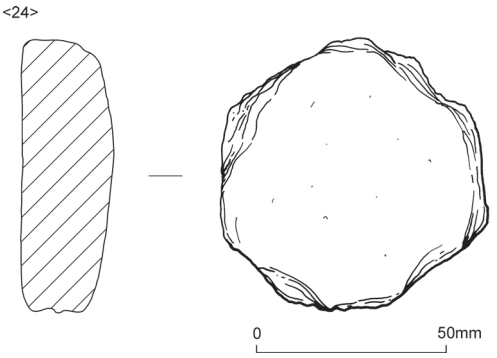

Fig 12. Residual Roman tegula <24> with edge chipped to form a crude counter or gaming piece, from [602] slumped into the city ditch (Period 2–3) (scale 1:2)

has part of a paw print and what may be straw marks.

There are a small number of ceramic box-flue tiles, almost certainly derived from masonry buildings with hypocaust heating systems, and a solitary tessera. Most of the flue tiles are combed, but there are two relief-patterned examples from Open Area 2. One tile is keyed with what appears to be die 29, whilst the other is keyed with die 12. Both die patterns have been found on other London box-flue tiles, as well as on tiles from other locations in south-east England (Betts *et al* 1994, 80–2, 102).

The majority of combed and relief-patterned box-flue tiles probably date to the early–mid-2nd century AD. The only flue tile of uncertain date from Open Area 2 (Fig 4) is a combed example, made using a slightly silty clay (fabric 3238?). This tile, which is from an unknown tilery, has small white organic inclusions in the base. A similar combed flue tile, probably from the same tilery, has been identified at 20 Fenchurch Street (FEU08).

Two fragments of fine grained laminated sandstone were recovered from pitting in the area to the north of the medieval ditch (OA3, Fig 5). Although from medieval and post-medieval contexts, they were found with Roman ceramic building material indicating a possible late Roman date. Both pieces have a fairly smooth top surface suggesting they were employed as paving. This stone type was predominantly used in late Roman London.

Also present on the site are a few pieces of Roman daub of uncertain function, a soft, fine to medium grained, reddish-brown sandstone and 13 residual fragments of painted wall plaster. The pieces of wall plaster are mainly plain white, although one white piece has a 3mm-wide painted black strip.

Medieval

Most of the medieval ceramic building material consists of London-made roofing tiles. Present are three pieces of roofing tile, at least one of which is a curved tile, dating to *c.*1120–1220 (fabric 2273) and a number of peg and ridge tiles of *c.*1180–1480 date (fabrics 2271, 2586, 2587). The roof tiles in fabrics 2271 and 2587 are splash glazed whilst those in fabric 2586 have a covered glaze, a difference noted on other central London sites. Presumably the roof tiles in fabric 2586 derive from a separate tilery to these in fabrics 2271 and 2587.

The peg tiles are of typical London area type with two round nail holes near the top edge and glaze often covering the bottom-third of the top surface. Some tiles have a splash glaze whilst others have a more uniform glaze covering.

At least seven medieval floor tiles were found in the fills of the medieval city ditch (Period 6). These tiles almost certainly came from a church or monastic building. Perhaps the nearby parish church of St Botolph Bishopsgate or the priory of St Mary Bethlehem (see Period 6 discussion above). Three are decorated tiles made at Penn, Buckinghamshire, in the second half of the 14th century (fabrics 2894, 3076). These are decorated with Eames (1980) designs 1846 (Hohler 1942, design P153?) and 2232 (*ibid*, design P44), whilst the third tile may have part of an unpublished design (Fig 13, <16>). There are also two plain brown glazed and one yellow glazed floor tile which may be of Penn origin, although a Low Countries origin cannot be totally excluded. These are all made with slightly silty clay (fabrics 2894, 3246) characteristic of certain Penn as well as Low Countries floor tiles.

One floor tile from the city ditch can be recognised as a definite Low Countries import by the presence of a 2mm square nail hole in the surviving top corner (fabric 2320). This tile, which has a plain green glaze above a thin layer of white slip, is probably medieval, although an early 16th-century date cannot be entirely discounted.

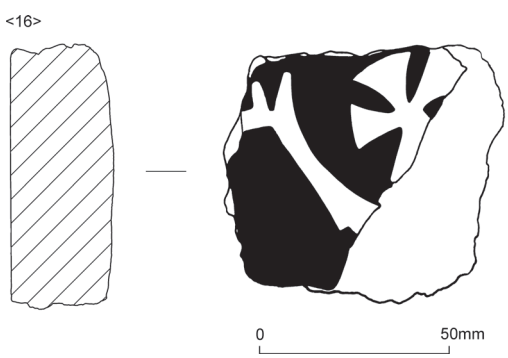

Fig 13. Penn floor tile <16> with a possible new design, from the city ditch, [627] (Period 6) (scale 1: 2)

Post-Medieval

The size (a length/breadth of over 170mm) and fabric (types 2504, 3082) of two glazed Low Countries floor tiles recovered from the city ditch (Period 7) suggests they are of *c.*1480–1600 date. One has a yellow and brown mottled glaze, whilst the other has a plain green glaze. These would have come from a chequerboard floor with yellow glazed tiles alternating with the green glazed examples. Plain unglazed tiles are believed to have been first used in London around 1580–1600. At Heron Tower, an unglazed example from the city ditch was found associated with pottery of *c.*1580–1600.

The first unglazed tiles were brought in from the Low Countries. Since the fabric of the Heron Tower example lacks any distinctive features, it is uncertain whether it is an import from this source or an English-made tile. The tile was made with very fine sandy clay similar to fabric 3268, but lacks the scatter of red iron oxide normally associated with this fabric type. Peg roofing tiles (fabrics 2276, 2816, 3090) continued to be used in large quantities until at least the end of the 18th century, although they were no longer glazed.

A number of London-made post-medieval red bricks are present on the site. None are well dated, but most would appear to be 16th–19th century (fabrics 3032, 3033). Probably slightly earlier are three bricks (fabrics 3030, 3033) from Structure 3 measuring 103mm in breadth by 47–56mm in thickness. They are probably mid-15th to mid-16th century in date.

Other post-medieval building material includes a Victorian floor or wall tile and a cornice moulding cut from oolitic limestone, plus what appears to be highly fused and vitrified daub or brickearth recovered from the city ditch. This fused material, which may represent the remains of some sort of kiln or oven structure, was found with pottery dating to the period *c.*1580–1600.

Roman Pottery

Amy Thorp

The Period 2 pit fills containing Roman pottery at the northern end of Trench 2 (Fig 4) indicate that these features were backfilled during the early 2nd century AD. Pit fill [519] provides the closest date to the Hadrianic to early Antonine period (AD 120–60) from the combined presence of sherds of black-burnished wares and Highgate Wood ware C (HWC) products. The remaining pit fills (contexts [514] and [529], from cuts [515] and [513]) from Trench 2 date to the later Roman period (Period 3). The former, [514], contained mixed Roman pottery, but a single sherd of Roman late 'calcite-tempered' ware (CALC) suggests a 4th-century AD date. A single sherd of Portchester ware D (PORD) dating to *c.*AD 350–400 from context [529] supports this idea.

The pit fills, [538], [578], [588] and [590], and trample layer, [582], from the northern end of Trench 1 (Fig 4), as with those from Trench 2, date to the 2nd century AD (Trench 1 pits [539], [579], [589] and [591] respectively). Pottery from contexts [578] and [588] again give indications that backfilling occurred during the Hadrianic to early Antonine period with sherds from black-burnished wares and HWC vessels.

The pit fills ([532], [580], and [586], from pits [533], [581] and [587]) from later activity in Trench 1 date to the mid-3rd to 4th century AD. The most consistently late Roman group is from context [532], dated *c.*AD 250–400 on the presence of several sherds of Alice Holt/Farnham ware (AHFA), but it also contained sherds of late Oxfordshire types (generic) and sand-tempered forms. A trample layer, [593], at the north end of Trench 1 is also dated AD 250–400 by a single sherd from an AHFA bowl; this layer otherwise contained mostly residual pottery.

The Roman deposits from the northern edge of the medieval city ditch contained reasonable quantities of 4th-century AD pottery, with a substantial residual early Roman component. Contexts [601] and [602] are entirely late Roman and the small number of sherds from several Oxford red/brown colour-coated ware (OXRC) vessels give a date of *c.*AD 270–400.

Medieval and Post-Medieval Pottery

Lyn Blackmore

Medieval

The post-Roman pottery amounts to 776 sherds (389 vessels, 28.526kg). The bulk of

the material is of medieval date, with 569 sherds (245 estimated number of vessels (ENV), 21.165kg) from 36 contexts, mainly fills of the city ditch; most groups date to the 13th/14th centuries. On the whole the collection is in good condition, with some substantially complete vessels.

A total of 89 sherds of pottery (36 ENV, 3.752kg) were recovered from contexts assigned to Period 4. The earliest pottery from the ditch comprises 24 sherds from fills assigned to Period 4. One piece of 9th- or 10th-century date may be residual, but the majority of sherds date to the 12th century; allowing for silting and cleaning, this suggests that the ditch was cut in the late 11th or early 12th century.

Much more pottery was discarded in the ditch during Period 5, and although some is residual 12th-century material the main period of dumping was in the 13th/14th century. Overall, there is a clear chronological progression from the 12th to late 13th/14th century in different parts of the ditch that were investigated, and the amounts of pottery discarded in the ditch also increase over time. The amount of pottery declines slightly in Period 6, when there is again a progression from 15th-century ware types to those used in the early 16th century. The uppermost fills (Periods 6 and 7) appear to date to the period 1580–1600, but could be a little later.

The overall pattern suggests that the ditch filled gradually over time, but there are also concentrations in the dates of the pottery which might point to episodes when it was cleaned out and others when it was less well maintained and used as a convenient place for rubbish disposal. The uppermost fills indicate that the ditch may have been filled as a controlled operation in the late 16th or early 17th century.

Of the medieval wares London-area pottery (Pearce *et al* 1985) is the most common group, with 263 sherds from *c.*91 vessels (11.878kg) that range in date from *c.*1080 to *c.*1500. The earliest, dating to between *c.*1080 and *c.*1200, comprise coarse London-type wares (LCOAR and LCOAR CALC, 50 sherds) and calcareous London-type ware (LCALC, 2 sherds). London-type ware (LOND, 202 sherds) has a date range of *c.*1080–1350, while late London ware (LLON, 2 sherds) and late London-type slip-coated ware (LLSL, 7 sherds) both date to *c.*1400–1500.

The medieval pottery assemblage comprises rubbish that is typical of the City of London and most sherds may have been redeposited several times before arriving in the convenient hollow of the ditch. In a few cases, however, more complete pots were discarded, such as those from context [522] within the Period 5 city ditch deposit, which must represent primary deposition. The same applies to a fragmented but virtually complete tripod pitcher from pit [537], Period 4, by far the most important ceramic find (Fig 14, <P1>). It is a lop-sided spouted tripod pitcher in coarse London-type ware with calcareous inclusions (LCOAR CALC, height 300–400mm); this is a form that is seldom found (Pearce *et al* 1985, 39–40, fig 21, nos 40–2, fig 85), and such complete examples are extremely rare. The upper body has neatly executed panels of white slip decoration in the style of early rounded jugs. The rod handle has an impressed herringbone pattern down the back, while the applied feet are of tubular form. In these features the vessel closely resembles a find in the Bank of England collections (*ibid*, fig 21, no. 43). It is likely to date to the second quarter of the 12th century, but could be as late as *c.*1150–70. There are also sherds from nine jugs, mainly of early rounded form and of mid- to later 12th-century date.

A range of jug forms is present in the finer fabric LOND, with three in the early rounded style, six in the North French style (LOND NFR) and one in the Rouen style (LOND ROU). From the presence of similar jug sherds found in consolidation deposits for the masonry phase of London Bridge, it can be confirmed that these styles were in use before 1209 and possibly before 1176, when construction commenced (Pearce 2001a, 197). Baluster jugs are quite common, with up to 28 examples, 24 of which are from the city ditch fills; several are represented by complete or near-complete bases and handle fragments. Also present are sherds from a few squat jugs and one in the highly decorated style (LOND HD; *c.*1240 or later).

Forms associated with food preparation are less common but include 23 sherds from a large cauldron, found in pit [518] and

Fig 14. Coarse London-type ware with calcareous inclusions (LCOAR CALC) tripod pitcher <P1>, found almost complete in pit [537] (Period 4), to the north of the city ditch (scale 1:4)

the ditch, which has angled handles and long legs (internal length 110mm, external *c.*120mm; Pearce et al 1985, fig 69, no. 367). Pit [518] also contained 29 sherds from a large cauldron and part of a cauldron leg with four thumbings around the junction with the base, while the rim of a dripping dish was found in the fill of the city ditch, context [572].

For the medieval period, jugs and pitchers are the most common forms, with 326 sherds from up to 124 examples. Forms associated with cooking are the second most common group, with 229 sherds from up to 112 vessels, of which 97 are cooking pots. In the post-medieval period forms associated with cooking food are the main category, with 89 sherds from *c.*54 vessels. These include two cauldrons, 35 cauldrons or pipkins, four cooking pots, four pipkins, eight tripod pipkins and one skillet; of these seven cauldrons/pipkins and the skillet are in Dutch red earthenware (DUTR); the others are mainly in red ware fabrics. Forms associated with drinking and food preparation and serving are the next most common groups, with 30 and 35 vessels respectively. The former comprise 14 drinking jugs, one goblet, four mugs and 11 jugs. The latter comprises four bowls, 25 dishes, four porringers and two colanders again mainly in red ware fabrics. Other functions include storage/transport, display, lighting and pharmaceutical wares. The only other forms are two flower pots (from fill [616] above the southern ditch cut, [617], in Trench 1, and fill [627] in slot 1).

Together, the different white wares form the second most common group of medieval pottery, totalling 170 sherds from *c.*80 vessels (5.367kg). These comprise Kingston-type ware (KING) and the slip-coated variant (KINGSL), dating from *c.*1250 to *c.*1400 (61 sherds), Earlswood-type ware (EARL), dating from *c.*1200 to *c.*1400 (nine sherds), coarse Surrey-Hampshire border ware (CBW), dating from *c.*1270 to *c.*1500 (91 sherds) and Cheam ware (CHEA), dating from *c.*1350 to *c.*1500 (18 sherds).

With the exception of a cooking pot and pipkin, all sherds of KING are from jugs, the most impressive of which is a substantially complete conical jug in the highly decorated style (*cf* Pearce & Vince 1988, 25, fig 13) from ditch fill [522], Period 5. This is represented by *c.*60% of the base and body, with the profile from base to neck; the lower handle joint is present but the rim is missing. The decoration comprises a rough lattice of applied strips, each lozenge containing a lentoid shape defined by two curved strips that meet in a point at each end. The same context also contained the handle from a metal copy jug and part of a rounded jug in KINGSL (also internally slip-coated) with two rows of repoussé decoration, both alternating pendent shells and fleur-de-lis-

type stamps (*ibid*, 42–4). The base and lower body of a baluster jug were found in [606].

Cooking pots are much more common in CBW than in KING (35 ENV); four examples have bifid rims, while the most complete find, from Trench 2 ditch fill [567], is the base of a large cooking pot pitcher or pitcher with external soot and brown residue inside (base diameter 290–300mm). Three jars or jugs have bungholes and ten other vessels were probably also cisterns, five of which have red slip decoration on the shoulder. Ten other jugs are also represented.

In addition, 28 sherds (17 ENV, 758g) fall into the category of non-local glazed wares. Most are of Mill Green ware (MG, MG COAR, 23 sherds) from Essex, which dates from *c.*1270 to *c.*1350/1400 (Jenner & Vince 1983), with four sherds of late medieval Hertfordshire glazed ware (LMHG, dated *c.*1340–1450; Pearce *et al* 1982) and the ribbed handle from a Scarborough ware (SCAR) jug dating from *c.*1200 to *c.*1350.

Imports amount to 22 sherds. The earlier types comprise red-painted ware from the Rhineland (REDP, dating *c.*AD 900–1250) and North French monochrome ware (NFM, dating *c.*1170–1300). Later types dating to the 14th and 15th centuries comprise the rim of a Paterna blue ware (PATB) bowl from near Valencia, Spain (*cf* Hurst *et al* 1986, 40) from ditch fill [574], the complete externally sooted base of a Saintonge ware (SAIN) jug from near Bordeaux, France, from slot 3 ditch fill [616], three sherds of DUTR and two of Rhenish stonewares comprising part of a funnel-necked beaker from Siegburg (SIEG) from Area D, ditch fill [606] (Fig 5), and the rim of a jug in Langerwehe stoneware (LANG) from context [569].

Post-Medieval

Post-medieval pottery was found in 13 contexts, eight of which date to *c.*1480–1600, while the remainder date to after *c.*1580. It was less common than medieval material, with a total of 207 sherds. London-area red wares, most probably from Woolwich (Blockley 1978), Deptford (Jarrett 2004) and Moorgate (Blackmore 2006a; Sudds 2006), are the dominant category, with a total of 102 sherds (81 ENV, 4.215kg). The most common type is early post-medieval red ware (PMRE), which dates to *c.*1480–1600 (64 sherds, 57 ENV, 2.345kg). Other 16th-century wares comprise post-medieval bichrome red ware (PMBR; six sherds) and early post-medieval calcareous red ware (PMREC; one sherd). The latest fabric type is post-medieval red ware (PMR), introduced *c.*1580 and the dominant red ware thereafter, which amounts to only nine sherds; this suggests that although post-medieval slipped red wares (PMSR; 22 sherds, 19 ENV, 13.7kg) have a longer date range of *c.*1480–1650 most probably date to before *c.*1580. Vessels used for cooking or for food preparation/serving are the main forms represented; also present are sherds from nine jars, six jugs, one mug, two flower pots and two sprinklers.

Essex red wares, which began to reach London *c.*1580, are very much in the minority, while Surrey-Hampshire border wares are the third most common group (39 sherds, 25 ENV, 876g), with two sherds of early Surrey-Hampshire border white ware (EBORD, dating *c.*1480–1550) and 32 of the later white ware (BORD, dating *c.*1550–1700); only five sherds are in the red ware fabric (RBOR, dating *c.*1550–1900). Tripod pipkins and drinking vessels are the main form types (6 ENV each); the other sherds are from four dishes, four porringers, a colander, a costrel, a basket-handled jar in RBOR ([623]) and a candlestick.

Only four sherds of English tin-glazed ware (TGW) are present, three from Period 6 and one from Period 7. As these wares were introduced *c.*1570 and were becoming increasingly common by *c.*1630, this reflects the late 16th-century date of the main activity on the site; two sherds from an albarello and one from a dish with a band of overlapping arcs may be from Antwerp or early London products from Holy Trinity Priory, Aldgate (*ie* of the 1570s; *cf* Blackmore 2005, 240, fig 203, <P51>, <P53>). In addition, there are three vessels of English stonewares (Midlands purple ware – MPUR) each represented by between three and six sherds only.

Somewhat unusually for a site away from the waterfront, imported wares are the second most common post-medieval group, with 53 sherds (27 ENV, 1.809kg). Over half of these are Dutch red wares, with 27 sherds from between nine and 11 vessels (1.235kg); six sherds that are probably from the same

bowl and cauldron were found in slot 1, Trench 1 ([623] and [624]). Other types comprise Raeren and Frechen stoneware (RAER, 17 sherds; FREC, five sherds; see Gaimster 1997; Hurst *et al* 1986, 194–208, 214–22), one sherd of Spanish olive jar (OLIV; *ibid*, 66–7) and part of a tin-glazed albarello with berettino-style blue on blue floral decoration in the Venetian style, which is from Liguria, Italy (LIGU; *ibid*, 26–30) or the South Netherlands (SNTG; *ibid*, 117–19).

The medieval period imports amount to only *c.*4% of the total assemblage, but in the post-medieval period this rises to *c.*26%, although the number of sherds is in itself not high. This is partly due to the expansion of trade and construction of new docks downstream from the City in the late 16th and 17th centuries, which brought a wider range of imported wares within reach of the average consumer. However, it may also reflect the arrival of immigrants fleeing religious persecution in the second half of the 16th century.

Accessioned Finds

Beth Richardson

Roman

The six stratified Roman registered finds were all retrieved from the fill of a pit (cut [533], filled by context [532]) and trample layers ([592] and [593]) in the north end of Trench 1 (Fig 4). They consist of fragments of vessel glass and unidentifiable iron and copper-alloy objects. Three further Roman finds, a glass bead, <18>, part of a plain shale bracelet, <34>, and the shaft from a bone hairpin, <8>, were residual material in medieval deposits.

The three pieces of blue-green vessel glass are walling fragments, and come from a bottle, <4>, an unidentifiable vessel, <5> (both from fill [532]), and a cup, <9>, from [593]. A curved piece of iron, <10>, and some concreted iron fragments, <20>, were also found in [532] and [593], and a small slightly curved piece of copper alloy, <21>, was found in [592]. They are all too small or fragmentary to identify, and were found with small amounts of Roman pottery of mixed date. The residual Roman objects are in better condition; they are all relatively common finds types on Roman domestic, public, religious and cemetery sites, and it is not possible to suggest their original provenance. The shale bracelet, <34>, is annular with a distinct interior rib; it could date to any time within the Roman period, although bracelets of all materials are generally most common during the 4th century AD. The small rectangular bead, <18>, is square-sectioned and made from opaque turquoise blue glass. It would have come from an item of jewellery such as a necklace or earrings.

Medieval

There are 24 registered finds from the city ditch, three of which are residual Roman, three are medieval floor tiles and eight are too corroded or fragmentary to identify. The remaining eight finds from Periods 4–7 are leather, bone and metal objects dating from the early medieval to the early post-medieval periods. They include a substantially complete leather costrel, and there is also bulk leather consisting of two boxes (approximately 70 pieces) of undiagnostic shoe parts dating from the 12th to the 16th centuries and a small quantity of thick hide waste.

The earliest finds are two bone skates, <17> and <40>, both from the Period 4 city ditch, dated *c.*1050–1170. One, <40>, was found with a small group of pottery dating from *c.*AD 970 to *c.*1100 and the other, <17>, with residual Roman pottery. Bone skates have been recorded from early and later medieval contexts in London (Pritchard 1991, 208–9, 266, nos 253–9; Egan 1998, 294–5, fig 223). Many are found on urban sites some distance from the Thames, suggesting use on any available area of frozen water, or loss or disposal at home or work (see Period 4 discussion above). In this case the skates may have been used in the marshy extramural area or simply discarded into the city ditch with other domestic rubbish.

There are three registered leather finds and 60 pieces of bulk leather from the continuing use and recutting of the city ditch which took place between *c.*1170 and *c.*1350 (Period 5). A near-complete leather costrel (Fig 15, <32>) and part of a toggle-fastening shoe (<33>) were retrieved with fragments of one- and two-piece soles with pointed toes, rand, and pieces of vamp and

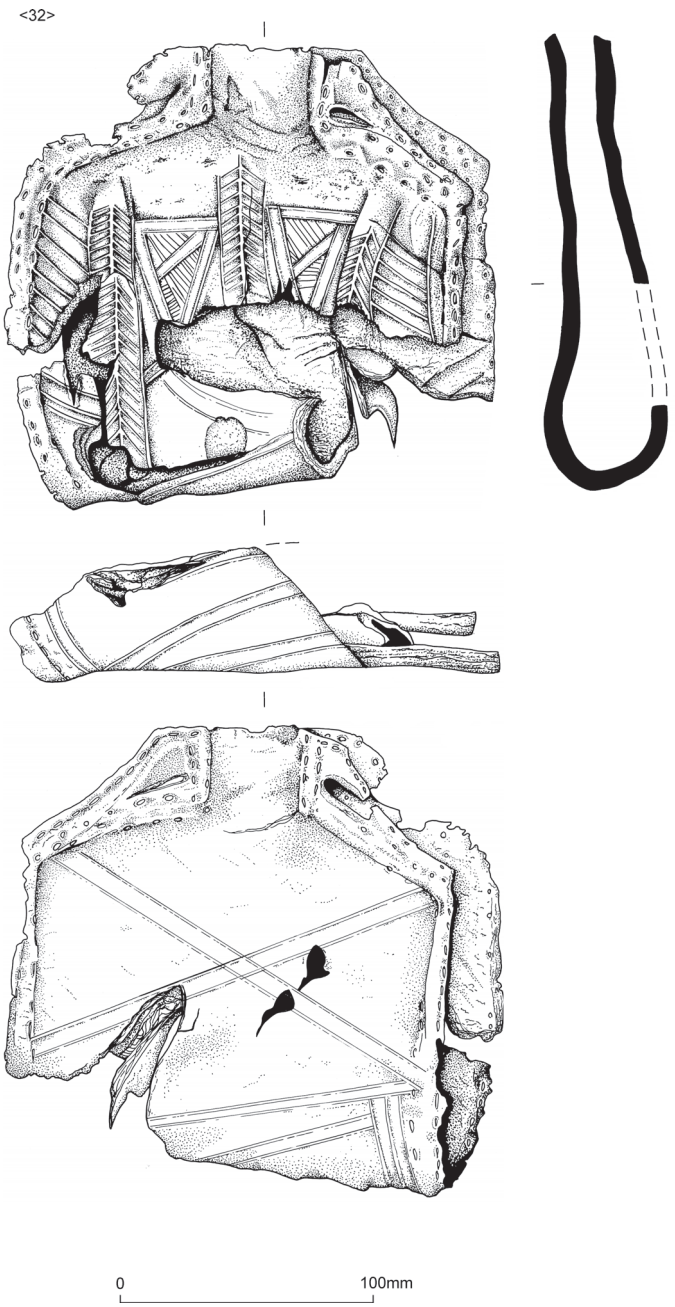

Fig 15. Leather costrel <32>, from fill [567] of the medieval city ditch (Period 4) (scale 1:3)

insets from a high shoe or boot from the fills of a recut ([567], [572]), dated *c.*1270–1350. The front section of a 13th- or 14th-century patten sole (<37>), fragments of upper, rand and one- and two-piece pointed sole parts were retrieved from a broadly contemporary recut ([610]), dated to the second quarter of the 14th century.

The costrel, <32>, is a particularly fine example of its type (Fig 15), and one of only two decorated medieval costrels known from London, with a close parallel from Baynard's Castle (BC72), Queen Victoria Street, City of London, dated *c.*1350–1400 (Egan 1998, 239–40). It is made from thick cattle hide moulded into a classic barrel shape, with

slots for two missing straps. There is moulded ribbing on the front face, decorated with scraped, opposed, oblique hatching to each side of a central line and dividing the face into four panels, two of which are decorated with incised shields and two with double oblique lines; the lower section is damaged but also decorated with double oblique lines. The arms on the two shields (two right to left incised oblique lines and left to right scratched lines darkening the two triangular fields) have no obvious parallel and are probably non-specific decoration. The back face is more simply decorated with an incised diagonal 'saltire' cross, and the base is outlined with a rectangle of double incised lines. It is dated *c.*1270–1350 by a sizeable group of pottery from the context. The sub-rectangular insert with two toggles (<33>) from context [572], is from a mid- to late 13th-century toggle-fastening style of ankle shoe or boot (*cf* Grew & de Neergaard 1988, 22–3, figs 33 and 34).

A copper-alloy sheet strap mount, <3>, was found in a later recutting of the ditch, dated *c.*1400–1500 by ceramics ([606]). The mount has a flat circular terminal at one end with a central hole for a nail or rivet and a small tapering spur, and the strip-like strap extends into a trifurcated end with (broken) curving outer branches. Its function is unknown but it is most likely to be a mount from a lid, casket or piece of furniture (*eg* J Brenan in Egan 1998, 65–84). A iron rotary key, <30>, with a kidney-shaped bow, flattened oval shank and a bit with symmetrical clefts was found in one of the last recuttings of the ditch, dated *c.*1580–1600 ([627]) with mixed 14th- to 16th-century pottery. The shape of these large rotary keys changed very little in the late medieval to early post-medieval period; this key is almost identical to a late 14th-century rotary key from London and other 14th- and 15th-century keys (*eg* Egan 1998, 327, fig 91), but also similar to examples from late 15th- and early 16th-century waterfront sites (Egan 2005, 73–4). The dark waterlain deposits also contained bulk leather, including a near-complete 16th-century shoe of turn-welt construction with a broad rounded toe, lacking fastening details and (back) quarters ([629]) and two pieces of thick tread sole from another broad rounded 16th-century shoe ([628]).

Iron Slag

Lynne Keys

A very small (just under 1.5kg) assemblage of iron slag was retrieved and examined from five contexts, [525], [530], [545], [547] and [627]. All are medieval or early post-medieval (16th century).

The slag was examined by eye and categorised on the basis of morphology and colour. Each slag or other material type in each context was weighed, except for smithing hearth bottoms which were individually weighed and measured to detect any micro-slags: none were present.

The assemblage represents slag from secondary smithing which had been dumped into the city ditch in periods ranging from early medieval to post-medieval. None of the slag could be used to locate a focus of smithing – especially since there appears to be no micro-slags associated with it. The ditch represented a convenient cut feature into which pieces of slag and vitrified hearth lining (probably from domestic hearths) could be discarded; some of the slag may even be redeposited material from earlier activity elsewhere.

The assemblage has no significance other than to confirm iron slag was being disposed of in the ditch from the early medieval to post-medieval periods.

Pollen Analysis

Rob Scaife

The city ditch at Heron Tower produced a typically diverse range of pollen types adding to the small corpus of urban ditch studies (Scaife 1998; 2000; 2001; 2003). Samples were taken from a monolith column from Area D in Trench 1 (Fig 6) and Trench 2 (Figs 7 and 16) using standard extraction techniques (Moore & Webb 1978; Moore *et al* 1991). Herbs were dominant throughout, whilst there was a range of trees and shrubs though small in number. Of the herbs, wild grasses were dominant with cereal pollen (rye (*Secale cereale*), wheat/barley (*Triticum/Hordeum* sp) also present. These were associated with weeds typical of cultivated and waste ground. There was a moderate diversity of tree and shrub types and almost

Fig 16. Geoarchaeological samples being taken from the section through the city ditch fills in Trench 2, looking south

a continuous record of birch (*Betula* sp), oak (*Quercus* sp), walnut (*Juglans regia*) and hazel (*Corylus avellana*) along with sporadic occurrences of pine (*Pinus* sp), poplar (*Populus* sp), beech (*Fagus* sp) and holly (*Ilex* sp).

There was little evidence of wetland plants with only small numbers of sedges (*Carex* spp), bulrush or bur reed (Typhaceae) being the only pollen types recovered, indicating the lack of suitable conditions for such plants. There were small numbers of fern spores, liverwort (Marchantiophyta) and *Sphagnum* moss. A small number of intestinal parasite worm cysts were recorded which include mawes worm (*Ascaris*) and whipworm (*Trichuris*).

The substantial numbers of cereal pollen and associated weeds imply the use of cereals; however, this could be secondary derivation coming from refuse, including human and animal ordure, straw floor coverings, roofing materials, waste food and the by-products of cereal crop processing (Robinson & Hubbard 1977). The presence of intestinal parasites indicates that there is a faecal component in the deposits and it is likely that cereal pollen was present in food, passing through the gut of humans or animals. It is also possible that slaughterhouse offal may also have been disposed of in ditches and river/stream channels as at Broad Sanctuary, Westminster (Scaife 1982a).

Unfortunately it was impossible to distinguish between the hop and hemp pollen, although both were of importance. Hemp (*Cannabis sativa*) cultivated for fibre is diagnostic of Saxon and medieval periods, whilst hops (*Humulus lupulus*) indicate beer making and consumption, again passing through the gut. This also applies to the grape (*Vitis vinifera*) pollen from the late medieval period.

The data from Heron Tower is comparable with other studies of London's city ditch fills, though there have been few analyses of

such profiles. The results show a very great diversity of herb pollen taxa with few trees. The taxonomy of the pollen from urban contexts has been shown to be complex with substantial numbers of grains coming from secondary sources (Greig 1981; 1982; Scaife 1982a). This especially includes cereals and associated arable weeds but also possibly hop and grape from beer and wine respectively. Apart from the background woodland elements coming from regional and long distance sources, there are interesting records of walnut throughout the sequence, which was introduced as an ornamental tree or for medicinal cures, and found consistently but in small numbers in sites dating to the Roman and later periods (Scaife 1982b). However, most records are for later periods, including Saxon sediments at Cromwell Green, Westminster (Greig 1992), the medieval period from the Tower of London Moat (Scaife 2004) and Spitalfields medieval hospital, Tower Hamlets (Scaife 2006), and post-medieval sediments at Broad Sanctuary (Scaife 1982a).

Animal Bones

Alan Pipe

A total of 716 fragments of animal bone were recovered from Periods 2 and 4–8, with totals ranging from a minimum of eight fragments (Period 2), to a maximum of 326 (Period 5) (Table 1). The bone fragments were in good condition with little difficulty in the identification of species, skeletal element, body side and other diagnostic features.

For each period, the bulk of the material was provided by the major domesticates, cattle, sheep/goat and pig, with cattle proving the largest count for each period. Recovery of fish, poultry and game was extremely sparse; only Periods 5 and 6 produced poultry, and only Periods 5–7 produced game. Fish were represented only by a fragment of cod skull from a Period 8 ditch fill. This scarcity is probably due to lack of recovery and should not be considered as a genuine indication of absence or dietary bias.

Except for Period 2, each period produced large counts of non-consumed domesticates: cat, dog and particularly horse. In the cases of Periods 5 and 8 these exceeded the fragment counts for cattle. Scavenger and pest species were virtually absent from the whole assemblage, confirmed by the complete lack of recorded rodent gnawing, although there was evidence for canine gnawing from Periods 5, 6 and particularly 7.

The domestic birds and mammals included chicken, goose, mallard or domestic duck, ox (cattle), sheep, goat, pig, horse, cat and dog. Wild 'game' species from the ditch fills included hare, probably brown hare, from Period 5, rabbit from Periods 5 and 6 and fallow deer from Period 7. Although currently one of the most familiar British deer, fallow deer are an introduced species into Britain, possibly by the Normans (Buczacki 2002, 455).

Rabbits, originally native to southern France and the Iberian Peninsula, were probably introduced to Britain also by the Normans in the 12th century. Prior to this, there is no firm record of them in Britain (Buczacki 2002, 490–1). Other wild species were represented by only fragments of rat, probably black rat, from the ditch fill of Period 5 and the only recovery of pest species from the recorded assemblage.

For each period, the fragment counts indicate a meat diet derived from beef, mutton and pork with minor contributions of poultry and game. For the larger period assemblages, Periods 4–8, fragment counts consistently show dominance of cattle/cattle-sized bone (21.4–52.8%) with smaller counts of sheep/goat/sheep-sized (12.3–23.0%) and consistently smallest counts (1.6–11.2%) of pig. There was only a single recovery of a fragment of adult goat horn core from the Period 5 ditch fills and therefore no evidence for consumption, rather than preparation of goat horn for manufacture. For all periods, poultry and game were either not recorded or present at very low levels – never more than 2.8% of the fragment count.

For cattle, sheep/goat and pig in Periods 4–8 there was a range of carcase parts including areas of prime, moderate and poor meat-bearing quality with a consistently high proportion of head elements and feet. Recovery of phalanges (toe joints) was negligible for these major food species with the exception of cattle, perhaps because the carcase parts reached the site as prepared joints or as dressed carcases after removal

Table 1. Total recovery as species and fragment counts

Common name	Latin name	Period						Total
		2 (c.ad 50–200)	4 (c.1050–1170)	5 (c.1170–1350)	6 (c.1350–1500)	7 (c.1500–1600)	8 (c.1600–1800)	
Cod	*Gadus morhua*						1	1
Chicken	*Gallus gallus*			5	3			8
Goose	*Anser anser*			2				2
Mallard/domestic duck	*Anas platyrhynchos*			1				1
Ox (cattle)	*Bos taurus*	5	23	53	49	39	30	199
Cattle-sized		2	7	15	7	25	7	63
Sheep	*Ovis aries*		2	19	6	8	8	43
Goat	*Capra hircus*			1				1
Sheep/goat	*Ovis aries/ Capra hircus*		3	18	6	15	6	48
Sheep-sized		1	5	29	1	9	3	48
Pig	*Sus scrofa*		1	25	5	3	12	46
Horse	*Equus caballus*		18	112	23	1	35	189
Dog	*Canis lupus familiaris*		3	31	5	5	5	49
Cat	*Felis catus*			4		1		5
Deer, fallow	*Dama dama*					1		1
Hare, brown	*Lepus europaeus*			1				1
Rabbit	*Oryctolagus cuniculus*			1	1			2
Rat, unidentified	*Rattus sp*			9				9
Total		**8**	**62**	**326**	**106**	**107**	**107**	**716**

of the skin, rather than as intact slaughtered carcases or as animals 'on the hoof'.

Non-consumed mammalian domesticates, particularly horse and to a lesser extent dog, produced large components for Periods 4–8; cat produced only five fragments from the whole recorded group, four from Period 5 and one from Period 7. Total recovery of horse, dog and cat from Periods 4–8 respectively provided 34%, 46%, 26%, 22% and 37% of the fragment counts for these assemblages, in most cases exceeding the fragment counts of sheep. Butchery evidence from horse indicates disarticulation of the carcases, perhaps as food for domestic carnivores; knife cuts on an adult dog humerus (upper fore leg) from a ditch fill in Period 5 may indicate skinning.

Only two fragments of bone showed evidence for bone working. A fragment of ice skate from the ditch fill of Period 4 was identified as the mid-shaft of a horse metapodial. An ox metatarsal (hind-foot) from Period 5 ditch fill had been sawn around and snapped through at the mid-shaft, probably during preparation of a section of the mid-shaft for further manufacture.

Evidence for preliminary removal of cattle, sheep and goat horn from the horn cores was more extensive from the ditch fill of Periods 4–7, with tool mark evidence indicating use of a range of tools and techniques and different intended 'products' ranging from the solid horn tips, used as toggles, to the thin proximal layers for pressing into sheets for thinner items like buttons, counters, lantern windows and inlays.

A range of techniques were in use for removal of the horn sheath. Periods 4–6 showed detachment of cattle horn cores from the skull by transverse chops at the base; single cattle horn cores from Periods 4 and 5 showed knife cuts around the base. Both techniques would have allowed removal of the complete horn sheath, probably after soaking in water to loosen it.

Horse bones produced evidence of pathology from the ditch fill of Periods 5, 6 and particularly 7: pitting of the proximal metatarsal from a Period 5 example; lipping of the lumbar vertebra in a ditch fill from Period 5; pitting and lipping of the sacrum in a Period 6 ditch fill; and exostoses (extra bony growth) on atlas and thoracic vertebrae in a Period 7 ditch fill. All these pathologies are to be expected in working horses and their recovery may suggest local slaughter and disposal of horses at the end of their working lives.

The main faunal bone evidence derives from disposal of preparation, butchery, post-consumption and other domesticate waste, with few environmental indicators. Such 'indicator' evidence usually derives from invertebrates, amphibians, birds and small mammals, particularly those from steep-sided, open feature fills showing a 'pit-fall trap' effect. There was no recovery of freshwater fish, amphibians or small mammals, with the exception of rat from Period 5 suggesting that the city ditch did not contain permanent standing water.

The ecological requirements of the wild 'game' species recovered from the hand-collected assemblages allow the interpretation of local exploited habitats. There was no recovery of wild 'game' birds, with the possible exception of mallard from Period 5; and the wild mammal assemblage included only very sparse recovery of 'game' species, fallow deer, brown hare and rabbit, with no recovery of scavenger species such as pigeon, house mouse, raven or red kite, but the game species differ in their abilities to tolerate disturbance and pollution. In general, although the sparse recovery of game suggests that a variety of accessible habitats were exploited within the environs of London, including agricultural land and woodland, it does not allow analysis of inter-period differences in the character of the urban or rural landscape. The negligible recovery of scavengers suggests that there was very limited exposure of carrion and domestic refuse to scavenger activity.

Highly esteemed wild game mammals, rabbit, brown hare and fallow deer, were recovered in such small numbers that it is probable that they were only very occasional dietary inclusions and each of these is likely to have been present on local land. Fallow deer prefer woodland as an ideal habitat and recovery suggests that woodland was available for 'game' exploitation within range of London. In summary, the vertebrate fauna suggests that there was negligible refuse exposure, preventing exploitation by bird and mammal scavengers, indeed the incidence of

rodent gnawing is also negligible, and that although there was farmland and woodland in at least some degree of proximity to the City, they appear to have made a definite but minimal dietary input.

Human Bone

Natasha Powers

A small group of human remains was recovered from 11 contexts dating from the early Roman to late post-medieval periods. Although assigned to the period from which the context in which the remains were located was dated, it is likely that much of the bone was redeposited within the reworked fills of the city ditch and the date of death of the individuals in question remains speculative.

Early Roman (Period 2)

A fragmentary occipital bone (rear of the skull) from an adult probable male was recovered from [532], the fill of a pit within Open Area 2 (Fig 4). This deposit was described as trample and it is interesting that the remains were well preserved and showed little evidence of breakage in antiquity. Given the early date of the remains, it is likely that they originate from disturbance of a Roman burial in the vicinity.

Earlier Medieval (Period 4)

The majority of the human bone found in context of this period originated from the fills of the city ditch (S3). A small fragment of adult fibula mid-shaft (lower leg) was found within [546]; a fragment of possible adult parietal (skull) from [554], a layer over a gully within Structure 3; a fragment of adult right frontal bone (forehead) from [600]; the anterior portion of a well-preserved right proximal and adult mid-femur (thigh bone) and a left femoral mid-shaft fragment from a second adult from [602]; and an adult proximal and left mid-femur with a heavily eroded cortex from [603]. The remains represent a minimum of two adults.

In addition, the left humerus (upper arm) of a full term neonate (*c.*40.5 weeks gestation), an adult distal right femur and a much degraded possible femoral shaft fragment were found within pit fill [534], Open Area 3 (Fig 5). These remains seem most likely to represent the disturbance of earlier burials.

Late 12th–Mid-14th Century (Period 5)

The proximal and mid-shaft of an adult right ulna (forearm), which had been broken in antiquity, was found within pit fill [562].

Two fills from the city ditch also contained human bone. Fill [610] contained an adult right humerus and right mid-tibia (lower leg), in different states of preservation (the humerus was better preserved). An extremely well-preserved adult left humerus was recovered from context [611]. These remains represent a minimum of one adult, though differential preservation suggests that there were at least two present.

Mid-14th–16th Century (Period 6)

City ditch fill [606] contained the proximal right femur of a robust adult.

17th–19th Century (Period 8)

A notably well-preserved adult right tibia and a complete right ulna with occasional green concretions on the distal end (probably reflecting damp organic-rich deposits) were recovered from the fill of the city ditch, context [547].

Discussion and Conclusions

Based on the repetition of elements, the remains from all periods represented a minimum of two adults and one neonate, though the actual number of adults present is likely to be higher, particularly once differential preservation is considered.

The recovery of remains from Period 2 indicates that Roman (or even pre-Roman) burial was occurring in the vicinity and the site lies not far from the currently known limits of the 'northern' cemetery (see discussion of Period 2 above).

Whilst it is possible that the ditch was used as a location for the clandestine or informal disposal of the dead, the absence of articulated remains suggests this to be unlikely. The human remains recovered are most likely to represent redeposited stray finds of bone.

The remains were generally well preserved but with missing joint surfaces, supporting the interpretation that they were disturbed (perhaps on several occasions) before their final deposition. If this were the case, the remains may originate from a wide geographic area. The exception to this is the bone from Period 8. Here, the completeness and state of preservation suggests that the bone had not been previously exposed and therefore implies that it did not originate from much earlier burials, although one cannot definitively state that this is the case.

Geoarchaeology

Virgil Yendell

Geoarchaeological work undertaken during the excavation consisted of a transect of eight auger holes across the width of the city ditch fill in Trench 1, along with overlapping monolith tins in three appropriate locations in Trench 1 (Fig 6) and in one location in Trench 2 (Fig 7). The northern and southern ends of the ditch differed in character with the northern part more than a metre shallower and filled with mixed, historic anthropogenic backfill. These deposits became increasingly later in date further south and further from the north edge of the ditch cut. At the deeper southern end of the ditch naturally deposited waterlain and standing water sediments were present, with inputs of discarded or in-washed anthropogenic material.

The monolith tins taken from Trench 1 Area D were also subjected to loss-on-ignition analysis (LOI) which was used to measure the total organic carbon content of monolith samples spread over six contexts ([606], [607], [608], [610], [611] and [620]), beginning at the base of the ditch with pottery dates from *c.*1170 to *c.*1350 and ending at the top of the sequence with dates of *c.*1400–1500. The technique consists of accurately weighing, heating and igniting the volatile organics and carbonates to detect signs of buried soil horizons not visible in section. The results give a clear view of periods of natural waterlogging and evaporation, and possible indicators of ditch clearance, interspersed with periods of anthropogenic dumping.

The primary fill of the city ditch in Area D (context [620]), had a low percentage of LOI, around 8% rising to 13% (Period 5). This can be considered the background organic level of the primary ditch fill, with slight increases in organic accumulation, possibly by seasonal waterlain sedimentation with slight periods of drying out. This sedimentation may have been due to run-off from newly exposed ditch sides.

The deposit above the primary fill (context [611]) dated to *c.*1170–1350, and LOI readings peaked at around 16% then reduced to around 8%, suggesting an increase then a reduction in organic input back to the background level of the ditch (again Period 5). The results may indicate an increase in sedimentation or waterlogged conditions, but with no great evidence for sustained dumping of organic material.

Next in the sequence the LOI readings revealed a regular and significant input of organic matter indicative of the dumping of refuse, with LOI fluctuations between 8% and 17% indicating longer periods between the sedimentation. The pottery dates were confined to *c.*1340–50 (context [610], late Period 5), indicating a rapid period of rubbish deposition within the ditch during the mid-14th century. Evidence for little evaporation or bacterial action also suggests an increase in sedimentation, dumping and waterlogged conditions.

The next context in the sequence (context [608]) showed a steady drop in organic input and a reduction in the organic content of the waterlain sedimentation. The carbonate levels also indicate an extended period where evaporation and bacterial activity took place. This indicates a clearing or recutting episode in the ditch sequence, probably sometime in the mid- to late 14th century, and a reduction of deposition, long enough to allow evaporation and bacterial activity to occur on the deposit's surface.

Next in the sequence is evidence of a return to regular and significant input of organic matter, indicating the dumping of refuse (context [607], Period 6). The carbon levels drop drastically showing less evaporation and bacterial activity, suggesting a return to episodes of dumping, although no pottery dates were obtained from this or the previous context.

The final deposit from Area D (context [606]) showed a variation in organic levels, suggesting periods of organic input followed by periods of sedimentation where organic input was reduced. The evidence shows these periods of non-organic sedimentation accumulated at slow enough rates to allow for drying out and bacterial activity. Pottery from this context provided a date range of *c.*1400–1500 (Period 6). This corresponds with the stratigraphy and pottery dates from Area D, Trench 1, which suggests a recutting episode in this late medieval period.

ACKNOWLEDGEMENTS

Heron Property Corporation Ltd generously funded the fieldwork and post-excavation programme as commissioned by Mace on behalf of the client. MOLA would like to thank Kathryn Stubbs, Assistant Director Historic Environment at the City of London for archaeological advice and support. The author wishes to thank the Historic Towns Trust for the use of Fig 9. In particular the author wishes to thank Peter Ponsford and Gavin Phipps, for their assistance, along with MOLA specialists and field archaeological staff including Isca Howell, Tony Mackinder, Tim Braybrooke, Sam Pfizenmaier, Hazel Cooley, Rebecca Kelly and the geoarchaeology team in particular Mary Ruddy and Craig Halsey, for their help and contributions with the excavation of Trenches 1 and 2. In addition Steve Turner, Jez Taylor, Bob Cowie and David Sankey monitored test pits, mini piles and undertook watching briefs and evaluations at the site. Maggie Cox took the site photographs. Thanks go to Judit Peresztegi, Carlos Lemos, Juan Jose Fuldain and Hannah Faux who produced the illustrations. The project management team were Nick Bateman and Mark Beasley.

dsorapure@mola.org.uk

NOTES

[1] Museum of London Archaeological Archive, www.museumoflondon.org.uk/collections/other-collection-databases-and-libraries/museum-london-archaeological-archive (accessed 22 August 2016)

[2] MOLA Resource Library, www.mola.org.uk/resource-library (accessed 22 August 2016)

BIBLIOGRAPHY

Askew, P, 2014 'The western stream, Roman city wall and medieval city ditch at 7–10 Old Bailey, London EC4' *London Archaeol* 14, 11–18

Barber, B, & Hall, J, 2000 'Digging up the people of Roman London: interpreting evidence from Roman London's cemeteries' in I Haynes, H Sheldon & L Hannigan (eds) *London Underground: The Archaeology of a City*, Oxford, 102–20

Betts, I, Black, E W, & Gower, J, 1994 'A corpus of Roman relief-patterned tiles in Roman Britain' *J Roman Pottery Stud* 7, 1–167

Blackmore, L, 2005 'The pottery' in J Schofield & R Lea *Holy Trinity Priory, Aldgate, City of London* MoLAS Monograph Series 24, London, 194–200, 227–47

Blackmore, L, 2006a 'The medieval and post-medieval pottery' in Butler 2006, 72–83

Blackmore, L, 2006b 'Medieval and post-medieval pottery' in R Bluer & T Brigham with R Nielsen *Roman and Later Development East of the Forum and Cornhill: Excavations at Lloyd's Register, 71 Fenchurch Street, City of London* MOLA Monograph Series 30, London, 123–40

Blackmore, L, 2009 'Medieval and post-medieval pottery' in K Pitt with J Taylor, *Finsbury's Moated Manor, Medieval Land Use and Later Development in the Finsbury Square Area, Islington* MOLA Archaeological Study Series 20, London, 49–61

Blockley, K, 1978 'The pottery report' in S Pryor and K Blockley 'A 17th-century kiln site at Woolwich' *Post-Medieval Archaeol* 12, 43–85

Brett-James, N G, 1935 *The Growth of Stuart London*, London

Britton, F, 1987 *London Delftware*, London

Buczacki, S, 2002 *Fauna Britannica*, London

Butler, J, 2001 'The city defences at Aldersgate' *Trans London Middlesex Archaeol Soc* 52, 41–112

Butler, J, 2006 *Reclaiming the Marsh: Archaeological Excavations at Moor House, City of London* PCA Monograph 6, London

Carlin, M, & Belcher, V, 1989 'Gazetteer to the c.1270 and c.1520 maps with historical notes' in Lobel (ed) 1989, 63–99

Eames, E S, 1980 *Catalogue of Medieval Lead-Glazed Earthenware Tiles in the Department of Medieval and Later Antiquities British Museum*, London

Edwards, R, 1974 'London potters circa 1570–1710' *J Ceram Hist* 6, Stafford

Egan, G, 1998 *The Medieval Finds from Excavations in London: Vol 6, The Medieval Household, Daily Living c.1150–c.1450*, London

Egan, G, 2005 *Material Culture in London in an Age of Transition* MoLAS Monograph Series 19, London

Faithorne and Newcourt, 1658 'An exact delineation of the cities of London and Westminster and the suburbs thereof together with the Borough of Southwark' reproduced in Margary, H, 1981 *A Collection of Early Maps of London* Margary in assoc Guildhall Library, Kent

Gaimster, D, 1997 *German Stoneware 1200–1900: Archaeology and Cultural History*, London

Greig, J R A, 1981 'The investigation of a medieval barrel-latrine from Worcester' *J Archaeol Sci* 8, 265–82

Greig, J R A, 1982 'The interpretation of pollen spectra from urban archaeological deposits' in A R Hall and H Kenwood (eds) *Environmental Archaeology in the Urban Context* Council for British Archaeology Research Report 43, London, 47–65

Greig, J R A, 1992 'The deforestation of London' *Rev Palaeobot Palynol* 73, 71–86

Grew, F, & de Neergaard, M, 1988 *Medieval Finds from Excavations in London: Volume 2, Shoes and Pattens*, London

Hall, J, 1996 'The cemeteries of Roman London: a review' in J Bird, M Hassall & H Sheldon (eds) *Interpreting Roman London: Papers in Memory of Hugh Chapman* Oxbow Monograph 58, Oxford, 57–84

Haslam, J, 2006 'The development of Moorfields [London], the historical background' in Butler 2006, 45–50, 67–8

Hohler, C, 1942 'Medieval paving tiles from Buckinghamshire' *Rec Buckinghamshire* 14, 1–49, 99–132

Howe, E, 2002 *Roman Defences and Medieval Industry: Excavations at Baltic House, City of London* MoLAS Monograph Series 7, London

Hurst, J G, Neal, D S, & van Beuningen, H J E, 1986 *Pottery Produced and Traded in North-West Europe 1350–1650* Rotterdam Papers 6, Rotterdam

Jarrett, C, 2001 'The post-Roman pottery' in Butler 2001, 65–70

Jarrett, C, 2004 'The pottery' in D Divers 'Excavations at Deptford on the site of the East India dockyards and the Trinity House almshouses, London' *Post-Medieval Archaeol* 38, 89–120

Jenner, A, & Vince, A, 1983 'A dated type series of London medieval pottery: part 3, a late medieval Hertfordshire glazed ware' *Trans London Middlesex Archaeol Soc* 34, 151–70

Lewis, H, 2010 'From prehistoric to urban Shoreditch: excavations at Holywell Priory, Holywell Lane, London EC2' *London Archaeol* 12, 249–54

Lobel, M D, (ed) 1989 *The British Atlas of Historic Towns Volume III, the City of London*, Oxford

Lyon, J, 2007 *Within These Walls: Roman and Medieval Defences North of Newgate and the Merrill Lynch Financial Centre, City of London* MoLAS Monograph Series 33, London

Malcolm, G, 1997 'Excavations at island site, Finsbury Pavement, London EC2' *Trans London Middlesex Archaeol Soc* 48, 33–58

Maloney, J, 1983 'Recent work on London's defences' in J Maloney & B Hobley (eds) *Roman Urban Defences in the West* Council for British Archaeology Research Report 51, London, 96–117

Maloney, J, & Harding, C, 1979 'Dukes Place and Houndsditch – the medieval defences' *London Archaeol* 3, 347–54

Margary, H, 1981 *A Collection of Early Maps of London* Margary in assoc Guildhall Library, Kent

Milne, G, 2001 *Excavations at Medieval Cripplegate, London, Archaeology after the Blitz, 1946–68*, Swindon

MOLA, 2011 *Londinium: A New Map and Guide to Roman London*, London

Moore, P D, & Webb, J A, 1978 *An Illustrated Guide to Pollen Analysis*, London

Moore, P D, Webb, J A, & Collinson, M E, 1991 *Pollen Analysis* 2nd edn, Oxford

Noël Hume, I, 1977 *Early English Delftware from London and Virginia* Colonial Williamsburg Occasional Paper in Archaeology 2, Williamsburg

Pearce, J E, 2001a 'Medieval and later pottery from excavations at Fennings Wharf with a reassessment of the Toppings Wharf material' in B Watson, T Brigham & T Dyson *London Bridge: 2000 Years of a River Crossing* MOLA Monograph Series 8, London, 193–205

Pearce, J E, 2001b 'Pottery sequence from the city ditch at Cripplegate buildings (WFG18)' in Milne 2001, 19–24

Pearce, J E, & Vince, A G, 1988 *A Dated Type-Series of London Medieval Pottery Part 4: Surrey Whitewares* London and Middlesex Archaeological Society Special Paper 10, London

Pearce, J E, Vince, A G, & Jenner, A, 1985 *A Dated Type-Series of London Medieval Pottery Part 2: London-Type Ware, London* London and Middlesex Archaeological Society Special Paper 6, London

Pearce, J E, Vince, A, & White, R, with Cunningham, C, 1982 'A dated type series of London medieval pottery: part 1, Mill Green ware' *Trans London Middlesex Archaeol Soc* 33, 266–98

Pipe, A, 2010 *Animal Bone from Heron Tower, Kempson House, 35–37 Camomile Street and 106–126 Bishopsgate, London EC3, City of London* KPH05 MOL unpub report

Price, J E, 1880 *On a Bastion of London Wall, or Excavations in Camomile Street, Bishopsgate, London*, London

Pritchard, F, 1991 'Small finds' in A Vince (ed) *Aspects of Saxo-Norman London: II, Finds and Environmental Evidence* London and Middlesex Archaeological Society Special Paper 12, London, 120–278

RCHME, Royal Commission for Historical Monuments, 1928 *An Inventory of the Historical Monuments in London, Volume 3: Roman London*, London

Riley, H T, (ed) 1860 [Translation of *A Description of London* by William Fitz Stephen c.1174/1183: 22 Games on the Ice] *Munimenta Gildhallae Londoniensis: Liber Albus Liber Custumarum et Liber Horn* vol II, London, 2–15, http://users.trytel.com/~tristan/towns/florilegium/introduction/intro01.html#p04 (accessed 6 June 2013)

Robinson, M, & Hubbard, R, 1977 'The transport of pollen in bracts of hulled cereals' *J Archaeol Sci* 4, 197–9

Rowsome, P, 2014 'Roman and medieval defences north of Ludgate: excavations at 42–46 Ludgate Hill and 1–6 Old Bailey' *London Archaeol* 14, 3–10

Sankey, D, & Connell, B, 2007 'Late Roman burials and extra-mural and later development at Premier Place, Devonshire Square, Houndsditch, London EC2' *Trans London Middlesex Archaeol Soc* 58, 53–77

Sankey, D, & Stephenson, A, 1991 'Recent work on London's defences' in V A Maxfield & M J Dobson (eds) *Roman Frontier Studies 1989: Proceedings of the 15th International Congress of Roman Frontier Studies*, Exeter, 117–24

Scaife, R G, 1982a 'Pollen analysis of urban medieval sediments' in P Mills 'Excavations at Broad Sanctuary, Westminster' *Trans London Middlesex Archaeol Soc* 33, 360–5

Scaife, R G, 1982b *Pollen Analysis of Roman Peats Underlying the Temple of Mithras*, London Ancient Monuments Laboratory Report: 3502

Scaife, R G, 1998 *Falcon House: Pollen Analysis of the Medieval City Ditch* Pre-Construct Archaeology unpub report

Scaife, R G, 2000 *Pollen Assessment of the Fills of the City Ditch and Dark Earth soils* (*KEW98*) MOL unpub report

Scaife, R G, 2001 'Pollen (analysis of the town ditch)' in J Magilton & S Thomas *Midhurst* Chichester District Archaeology 1, Chichester, 60–3

Scaife, R G, 2003 *Canon Street, Winchester: Palynological Evidence from Winchester Medieval Town Ditch* Context 1 Archaeology, unpub report

Scaife, R G, 2004 'Pollen' in G Keevill *The Tower of London Moat: Archaeological Excavations 1995–99*, Oxford, 137–43

Scaife, R G, 2006 *Spitalfields: Pollen Assessment Analysis of Romano-British to Medieval Contexts (SRP98)* MOL unpub report

Schofield, J, with Maloney, C, (eds) 1998 *Guide to Records of Excavations by the Museum of London and its Predecessors* Archaeological Gazetteer Series 1, London

Sloane, B, & Watson, B, 2004 'Crossed wires: the redating of a group of funerary lead crosses from Newgate, London' *Trans London Middlesex Archaeol Soc* 55, 183–209

Stow, J, 1908 (1603) *A Survey of London* C L Kingsford (ed), Oxford, http://www.british-history.ac.uk/no-series/survey-of-london-stow/1603/ (accessed 21 October 2015)

Sudds, B, 2006 'Post-medieval redware production' in Butler 2006, 83–99

Swanton, M, (ed & trans) 2000 *The Anglo Saxon Chronicle*, London

Swift, D, 2003 *Roman Burials, Medieval Tenement and Suburban Growth* MoLAS Archaeological Study Series 10, London

Thomas, C, 2004 *Life and Death in London's East End: 2000 Years of Spitalfields*, London

Thomas, C, Sloane, B, & Phillpotts, C, 1997 *Excavations at the Priory of St Mary Spital, London* MoLAS Monograph Series 1, London

Watson, B, 2000 *An Interim Report on the 1998–99 Archaeological Investigations at the New Merrill Lynch Regional Headquarters, King Edward Street and Newgate Street, London EC1* unpub MoLAS report [part of KEB98 archive]

Wroe-Brown, R, with Spenbrooke, T, 2017 'A possible early Roman settlement boundary and the medieval city ditch: excavations at St Bartholomew's Hospital, London EC3' *Trans London Middlesex Archaeol Soc* 67, 37-98