

Saxon iron smelting in Bermondsey? Archaeological investigations at 150–156 Abbey Street

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An archaeological excavation at 150–156 Abbey Street, Bermondsey revealed an east–west aligned ditch cut into natural deposits and a parallel line of possible stakeholes to the south. The ditch contained Roman ceramic building material and a quantity of iron slag representing smithing and smelting, together with a coin dated to AD 730–50 and a single sherd of chaff-tempered pottery dated to AD 400–750. The unusual chemical composition of the slag suggests that it may have derived from bog iron ore rather than more commonly utilised raw materials in south-east England. The nature of the slag and its possible Middle Saxon date are of interest for they suggest that the smelting process involving slag tapping may have been reintroduced to England before the Late Saxon period. A small quantity of residual Late Bronze Age pottery was also recovered from both the ditch and the overlying plough soil. Post-medieval activity was represented by dumped deposits and a single late 18th/19th century pit containing a large assemblage of cattle horncores representing the waste from a tannery.

Introduction

An archaeological evaluation and excavation were carried out during November 2009 at 150–156 Abbey Street, Southwark under Museum of London site code ASR09 prior to redevelopment of the site (fig 1; TQ 3376 7940). An initial evaluation consisted of a single trench excavated at the southern side of the site. At the base of the trench, an east–west linear feature cut into natural deposits was revealed. This and a layer of grey silty sand above produced finds of Roman date and consequently the trench was extended to cover the footprint of the proposed structure (fig 2), allowing further excavation of the linear feature and revealing a parallel line of possible stakeholes to the south. The fill of the feature contained further Roman material, residual Bronze Age pottery and a quantity of iron slag. Post-excavation analysis revealed that a Middle Saxon coin had been present within the fill, together with a sherd of chaff-tempered pottery. It was thus realised that the nature and dating of the slag could be of some significance.

The site archive will be deposited at the London Archaeological Archive and Research Centre (LAARC) at Eagle Wharf Road.

Background

Geological and archaeological investigations have established that the palaeo-topography of north Southwark comprised a number of sand and gravel islands eroded and dissected by braided channels and tributaries of the Thames. These watercourses produced a landscape of low-lying islands, or eyots, themselves separated by mudflats and marshes. Archaeological evidence has shown that these islands were exploited to some extent from the Mesolithic period onwards (Ridgeway 2003, 106).

The study site overlay the northern side of Bermondsey Eyot, the largest of the former islands, which occupied approximately 2km² during the Roman period (Heard 1996, 76). The eyot was irregular in shape, aligned west-north-west to east-south-east and widened out from a blunt point at its western end to a bulbous eastern end, where a capping of brickearth has been recorded in several locations (*ibid*).

Although there is a growing body of evidence for prehistoric activity on the former islands (Drummond-Murray *et al* 1994; Ridgeway 2003, 106–7; Sidell *et al* 2002), much of the data concerning the earlier (Mesolithic to Neolithic) periods have been in the form

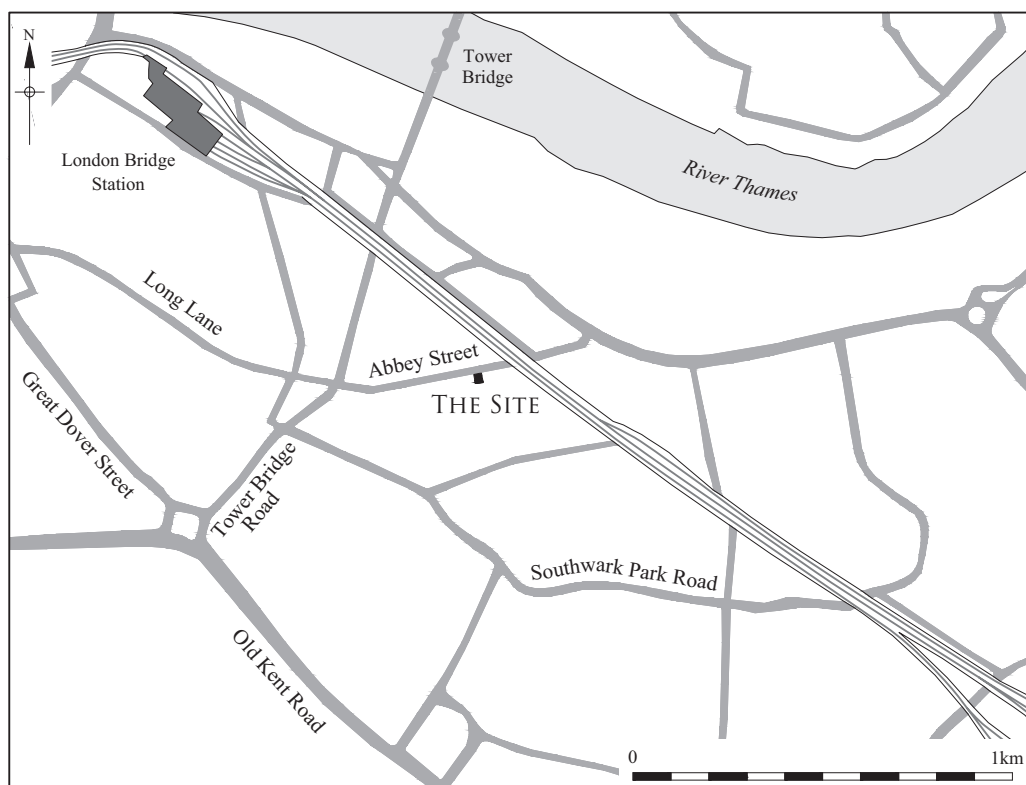


Fig 1 Abbey Street, Bermondsey. Site location.

of lithic artefacts recovered from broadly defined or residual contexts rather than specific archaeological features. No material definitely dated to these periods has been recorded within the vicinity of the study site, although an undated flint assemblage was recovered during excavations undertaken in 1991–2 in advance of redevelopment immediately to the south (Mason 1992).

Evidence from a number of sites across the islands suggests that while much of the land had been cultivated during the Neolithic and Bronze Age, rising sea levels caused flooding, and the lower reaches were abandoned, probably by the Early Iron Age (Sidell *et al* 2002, 44). The excavations immediately south of the study site recorded a north–south aligned channel, most likely the former course of the Neckinger stream; several pieces of Iron Age pottery were recovered from its lower fill. A number of other features were also recorded, including pits, postholes and ditches that produced finds of Late Bronze Age/Early Iron Age to Middle Iron Age date (Mason 1992). Elsewhere on the Bermondsey Eyot, pottery from the Middle Iron Age through to the Roman period has been recovered from various interventions at Bermondsey Abbey and Late Iron Age pottery was recorded on nearby sites at Grange Road, Grange Walk and the Alaska Works, also on Grange Road (Cowan *et al* 2009, 14). Further evidence for Iron Age occupation is provided by pottery fragments present in the fills of pits and deposits lying above the gravels at a site at Cherry Garden Pier to the north-east of the study site (Girardon & Heathcote 1988, 414).

It is likely that by the Roman period Bermondsey Eyot had become a peninsula attached to the mainland, rather than an island (Cowie & Corcoran 2008, 161–2), although the evidence for activity here is far less extensive than in areas to the west, on the North and South Islands, where Roman occupation clustered around the two roads leading from the bridgehead. However, a minor Roman road may have linked the peninsula with the main foci of Roman

activity, possibly following a similar line to the present day Long Lane (Heard 1996, 81 and fig 2). A number of sites on the former Bermondsey Eyot have produced evidence of Roman activity, including interventions within the vicinity of Bermondsey Abbey, although the excavations to the south of the study site produced only a single sherd of samian ware from the fill of the former Neckinger channel (Mason 1992).

The evidence for Saxon occupation of north Southwark is less well documented than that for the Saxon settlements of *Lundenwic* and *Lundenburgh* north of the Thames. Southwark is referred to in the Burgal Hidage of AD 914 as *Suthringa geweorch*, ‘the defensive work of the men of Surrey’, a fortified place. Possible evidence of these defences has been found during archaeological investigations at Hibernia Wharf, Montague Close, and recently during the Thameslink project at Bedale Street (Watson 2009; Wylie 2011, 28). A bridge is known to have existed by the early 11th century, as documentary sources refer to the bridge forming an obstacle to Cnut’s attack on London in 1016 (Watson *et al* 2001, 54). There are a number of archaeological records of Saxon river revetment on the Bermondsey Eyot, including that at Cherry Garden Pier to the north of the study site, where a large timber of Saxon date was found resting against a wattle structure (Girardon & Heathcote 1988, 414). Evidence of Saxon activity has also been identified in the area of Bermondsey Abbey, the site of which may have been occupied by a minster church in the Middle Saxon period. Significant quantities of Middle Saxon pottery, three *sceattas* (coins), copper-alloy strap ends, ceramic loom weights, a bone pin and an antler comb were all recovered during excavations in the 1980s (Beard 1986; Dyson *et al* 2011, 12–13). Late Saxon pottery was also found in deposits pre-dating the foundation of 11th century abbey buildings during investigations at the former Trocette Cinema site at the intersection of Bermondsey Street and Tower Bridge Road (Steele 1998; Dyson *et al* 2011, 14–17). In the late Saxon period, Bermondsey was a



Fig 2 Abbey Street, Bermondsey. Trench location.

royal manor held by Earl Harold. At Bermondsey Square, Saxon ditches, gullies and pits were excavated and pottery from throughout the Saxon period was present in the ceramic assemblage (Gaimster & O'Connor 2006, 316; Douglas 2011).

The Cluniac Priory of St Saviour (later a Benedictine abbey) was established in *c*AD 1089 approximately 350m to the west of the site (fig 3). This became a focus of activity in the Bermondsey area, particularly in terms of economic growth and land use (Dyson *et al* 2011, Gaimster & O'Connor 2006, 315–7). Throughout the medieval period much of the land, particularly to the north of the study site, was still low-lying and subject to occasional flooding (Ridgeway 2003, 109). By the late 14th century large-scale reclamation had provided cheap land on the periphery of the city that subsequently became a focus for industrial activity – in particular, industries associated with the processing of animal hides.

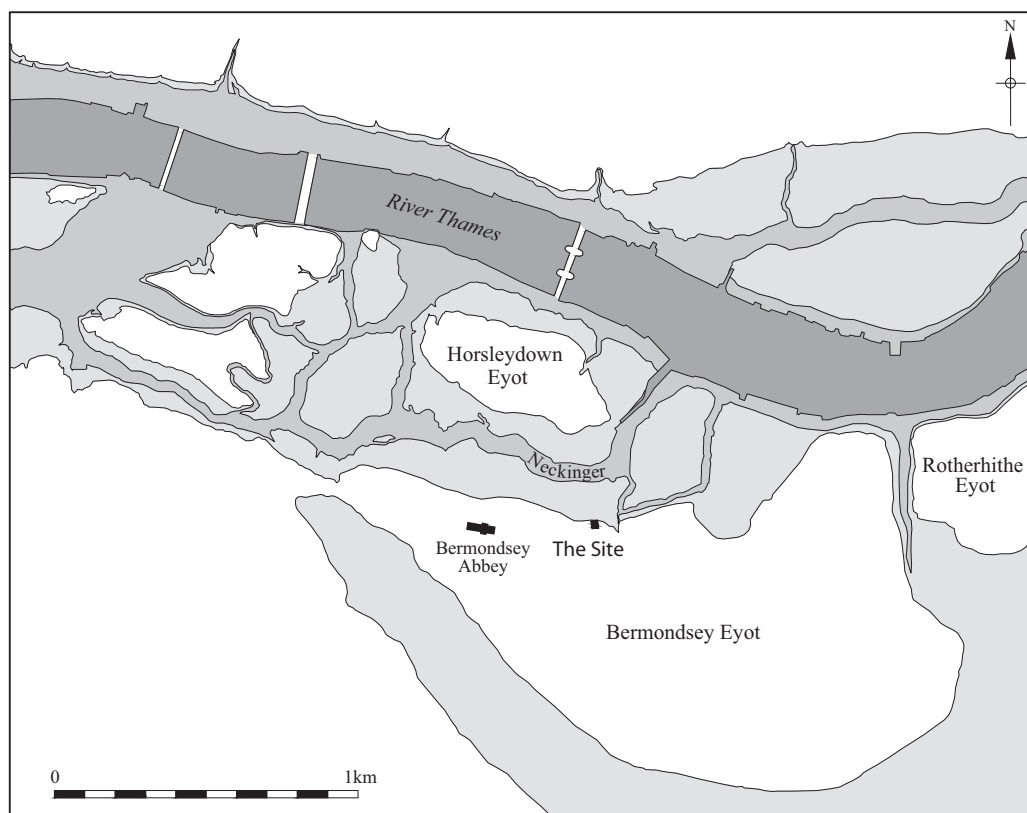


Fig 3 Abbey Street, Bermondsey. Location of site on Bermondsey Eyot and in relation to Bermondsey Abbey.

The archaeological sequence

The earliest deposit recorded was a mid-yellowish/brown, slightly clayey silty sand, probably an alluvial deposit that was present across the trench at elevations varying between +1.55m and +1.62m OD. Natural sands and gravels of the eyot surface were not exposed during the course of the investigations.

The alluvium was cut by a narrow linear feature, probably a shallow ditch (28) that ran east–west across the trench, extending beyond the western and eastern limits of excavation (figs 4 and 5). This was up to 0.73m wide with a maximum depth of 0.11m and cut from a highest elevation of +1.61m OD. The dark brown/grey sandy silt fill (27) contained a high



Fig 4 Abbey Street, Bermondsey. Archaeological features.



Fig 5 Abbey Street, Bermondsey. Ditch 28, looking west (2m scale).

percentage of iron slag. This provided evidence for both smelting and smithing operations in the vicinity. The fill also produced a small assemblage of Late Bronze Age pottery dated to the late 2nd millennium/early 1st millennium BC and eight tiny fragments of probable East Gaulish samian Roman pottery dated to the 2nd or 3rd centuries AD (see Seager Thomas, below), together with three fragments of Roman ceramic building material (CBM), including a fragment of straight combed box-flue hypocaust tile (Hayward 2011). Significantly, a sherd of chaff-tempered pottery with sparse chaff in a silty matrix with a fine sandy groundmass (CHSF) broadly dated to AD 400–750 (C Jarrett, pers comm) and a Saxon coin dated to *c*AD 730–50 (see Gaimster, below) were also recovered.

Running parallel with and to the south of the ditch was a series of seven stakeholes. These were regularly spaced at *c*1.35m intervals. The westernmost of these (within the excavation area) was paired with a second, slightly farther west and set closer to the ditch, an arrangement mirrored on the north side of the ditch. No artefacts were recovered from any of these features.

The ditch and the stakeholes were sealed by a layer of dark brown/grey sandy silt (26), 0.32–0.50m thick. This produced 59 further sherds of Late Bronze Age pottery, a single sherd of late Roman pottery of Oxford white slipped ware (OXWS) mortaria dated to AD 300+ (J Gerrard, pers comm), fragments of Roman CBM including brick and *tegulae*, and more iron slag. A single sherd of post-medieval redware pottery and a fragment of post-medieval peg tile were also recovered, suggesting that this deposit had at least been partly reworked by post-medieval agricultural activity.

A distinct interface was observed between context 26 and the dark grey and dark brown/grey silty sand (35) that lay above it. Context 35 was up to 0.15m thick and produced finds that dated the deposit to *c*1760–1830 (Jarrett 2010). In the south-eastern corner of the excavation area, a shallow pit (34) cut into this deposit. The pit was probably sub-rectangular in plan, although it extended beyond the eastern and southern limits of excavation and was truncated by a later pit to the north. The fill consisted principally of cattle horncores, which made up *c*80% of the deposit, within a light blue/grey silty clay matrix. Sherds of pottery and fragments of CBM were recovered that also dated the pit to *c*1760–1830 (Jarrett 2010). The pit was sealed by 19th century dumped deposits, into which a shallow pit was cut. This was in turn covered by a series of modern dumps, cut by three pits containing large quantities of clinker.

The finds

PREHISTORIC AND ROMAN POTTERY, by Mike Seager Thomas

The pottery assemblage from contexts 26 and 27 comprises 67 very abraded sherds weighing 184g. No chronologically diagnostic feature sherds were present but the bulk of the fabrics, which incorporate both flint and shell-tempering, belong to the late 2nd millennium/early 1st millennium BC (Late Bronze Age) post-Deverel-Rimbury pottery tradition. The range of fabrics present most probably belongs to several consecutive phases of this tradition, and thus indicates an extended Bronze Age occupation in the vicinity. However, the poor condition

Table 1 Prehistoric and Roman pottery

Context	No of sherds	Weight (g)	Fabrics/other diagnostic features	Likely pottery date
26	8	67	Post-Deverel-Rimbury (LBA): fine flint, fine to medium flint, medium flint, flint and (decalcified) shell & decalcified shell-tempered ware	LBA
27	59	162	Fine, fine-medium and medium flint-tempered	LBA
	8	4	Roman: East Gaulish (?) samian	2nd–3rd centuries AD

of the assemblage and its associations on site shows that it was residual. In addition, context 27 yielded eight tiny sherds of probable East Gaulish samian, datable to the 2nd or 3rd centuries AD.

THE ANGLO-SAXON COIN, by Märit Gaimster

A heavily worn Anglo-Saxon coin (sf 4) was retrieved from the fill of ditch 28. The coin is an irregular issue, or contemporary imitation, of a *sceat*; it is of silvered copper alloy rather than debased silver. The obverse features two standing figures flanking a cross, possibly ultimately derived from the *Gloria Exercitus* motif, showing two legionaries flanking a standard, on late Roman coins. This motif is characteristic of *sceattas* of Series N; however, the reverse shows a motif of a Celtic cross with a rosette of pellets, borrowed from coins of Series H. At least one identical hybrid is previously known (Stewart 1984, 13, no 58). The coin was kindly identified by Dr Gareth Williams of the British Museum.

Catalogue

Context 27: fill of ditch 28

Sf 4: silvered base-metal (?) contemporary imitation of a silver penny (*sceat*), secondary series, eclectic type, showing two standing figures with cross between on one side, 'Celtic' cross with rosette of pellets in each quadrant on the other; probably mid-late secondary, cAD 730–50; wt 0.75g

IRON OBJECTS, by Märit Gaimster

Context 26, sf <1>

Two pieces of heavily corroded iron:

- a) Irregular, flat rectangular piece, c20 x 50mm, encased in heavy corrosion; wt 122g
- b) Flat-section rectangular fragment of ?strap mount; irregular hole, 7 x 10mm, visible on X-ray; W 25mm; L 40mm; wt 30g

Context 27, sf <3>

Iron ?wire; fragment only; gauge 2.5mm; L 14mm; wt <1g

Context 27, bulk

Four small pieces of iron:

- a) Rectangular ?strap; fragment only; W 5mm; L 23mm; wt 4g
- b) Small lump showing cracked surface; diam. 10mm; wt 4g
- c) ?offcut of strap; W 12mm; L 5mm; wt 1g
- d) ?offcut of strap; W 12mm; L 3mm; wt 1g

THE IRON SLAG, by Lynne Keys

An assemblage of iron slag and related high-temperature debris weighing more than 14.4kg was recovered from the site (figs 6–9). Almost 11.7kg came from ditch 28 and 2.7kg from deposit 26, which overlay it. Although much of the assemblage (2.13kg) was undiagnostic owing to its fragmentary state, the diagnostic slags were those of smelting and smithing. Smelting was represented by almost 1.3kg of tap slag, 1.32kg of dense slag (similar to tap slag but without the flowed surface) and 434g of miscellaneous smelting slag. The smelting slags are similar to those seen at sites where slag tapping took place in the Roman period and from late Saxon times onward. The slag assemblage lacks some types commonly encountered in Iron Age smelting assemblages in England and in Ireland (for example, slag fragments with large voids from burnt-out fuel, non-tapping slag runs and large dribbles). In Ireland, the

great increase in archaeological excavation across the country over the last decade has shown Iron Age slag pit, non-tapping technology, continued and was ubiquitous until modern times. These mostly unpublished sites have provided archaeometallurgists with assemblages of all sizes for examination, enhancing our knowledge of Iron Age smelting slags. The Abbey Street smithing evidence consists of three smithing hearth bottoms (a convex/concave shaped slag formed under the blowing hole where air from the bellows entered the smithing hearth) and possible fragments of three others, small quantities of smithing micro-slugs (hammerscale flake and tiny spheres) and at least seven fragments of iron (smith's stock or smithing off-cuts) (see Gaimster above). Small quantities of vitrified hearth lining and a piece of reduce-fired furnace lining were also present.

Bloomery smelting is the manufacture of iron from ore and fuel in a furnace. The products are a spongy mass called an unconsolidated bloom (iron with a considerable amount of slag still trapped inside), and slag (waste); the latter can sometimes be so distinctive as to suggest a date for the activity. Smithing, until the development of iron casting in the post-medieval period, was of two types: primary smithing (hot working, by a smith using a hammer, of the newly produced iron bloom to remove excess slag), or secondary smithing (hot working, using a hammer, of one or more pieces of iron to create or to repair an object). Smithing was common in London south of the Thames, particularly in Southwark, in the Roman and medieval periods. Evidence for smelting, however, has not hitherto been found in London. The Abbey Street assemblage is of considerable interest and raises questions concerning its date (particularly because of the presence of tap slag in an assemblage containing residual Roman material, a sherd of Saxon pottery and an 8th century AD imitation *sceat*), the likely ore source, and why smelting should take place at this location. None of these questions is definitely answered in this report, but they are put forward as future research priorities.

Tap slag is a distinctive, dense, low porosity, iron silicate slag with a ropy flowed structure. It is formed as the liquid slag is allowed to flow out, continuously or intermittently, through

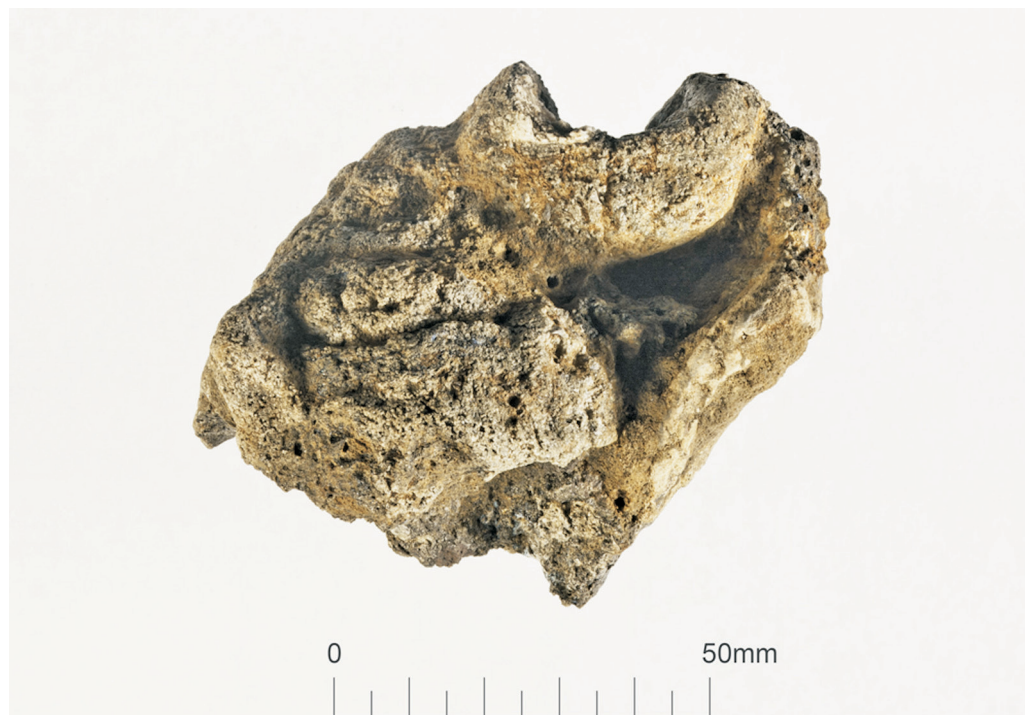


Fig 6 Abbey Street, Bermondsey. Fragment of vitrified furnace or hearth lining with part of tuyère hole (context 27).



Fig 7 Abbey Street, Bermondsey. Furnace slag with abraded slag on surface (context 26).



Fig 8 Abbey Street, Bermondsey. Fragments of tap slag and slag dribble (context 27).

a hole in the furnace side into a specially made channel leading to a hollow in the ground. This tapping removed slag as the process progressed, potentially allowing re-use of the furnace and facilitating retrieval of the bloom after the smelting operation. It is believed that furnaces with tapping holes replaced slag pit furnaces when their efficiency was recognised very early in the Roman occupation. After the Roman period, the technology used to smelt iron reverted to that employed in the pre-Roman Iron Age, at least for the Early Anglo-Saxon period. The type-site for dating the re-introduction of slag tapping into Anglo-Saxon England has been Ramsbury, Wiltshire, radiocarbon-dated to the 9th century AD (Haslam *et*



Fig 9 Abbey Street, Bermondsey. Two smithing hearth bottoms (context 27).

al 1980, 54). On the basis of Furnace 4 (where slag was tapped out during successive smelts) it has continued to be argued by archaeometallurgists that slag tapping was re-introduced into England in the 9th century (eg Cleere & Crossley 1995, 42).

There is, however, reason to believe that Ramsbury's Furnace 4, dated to the 9th century AD at publication (Haslam *et al* 1980, 30 and 54), could be later in date than originally proposed. A recent re-analysis for this report of the sequence of radiocarbon dates from Ramsbury (A Bayliss, pers comm) suggests the dated sample from Furnace 4 (HAR-1607; 1320 ± 70 BP) is too early because it contained a high proportion of mature oak with an appreciable age-at-death offset (Bowman 1990, 51). This is because the carbon in tree-rings is fixed from the atmosphere during the year in which the tree-ring formed. Consequently, the rings at the centre of a long-lived tree can contain carbon that is several centuries older than the burning event. If this age-at-death offset is unknown, the radiocarbon date may be much older than the archaeological activity with which the sample is associated. Based on a Bayesian analysis of the other radiocarbon dates (including those from the earlier furnaces on the site) (Jordan *et al* 1994, 141–2) and on the location of Furnace 4 within the stratigraphic sequence, a 10th century date for this furnace can be tentatively proposed (cal AD 830–1020 at 95% probability; model not shown; cal AD 890–990 at 68% probability). This would move slag tapping at Ramsbury from the Middle Saxon to the Late Saxon period.

Most primary iron production (smelting), before the development of the blast furnace, took place near an ore source. Until recently there was no evidence (either geologically or archaeologically) that inner London had ore sources that could be or were exploited. It has hitherto been believed that iron smelting in the south-east of England occurred in the Weald of Sussex, Kent or Surrey – and this was probably true for the Roman period. Several years ago, however, a large (> 80kg) assemblage of smelting slag was found in an Iron Age ditch at Eaglesfield Park (site code SHL07; NGR 543800 176600) during the *Time Team* excavation of four sites at Shooters Hill, near Greenwich in south-east London (Wessex Archaeology 2008). Recent evidence from a number of sites across the south-east and east of England has shown, however, that Iron Age and Anglo-Saxon smelting was mostly small-scale (Fell *et al* 2006; Keys & Shaffrey 2006), and possibly seasonal (D Dungworth, pers comm). Iron smelting in these periods could take place wherever a viable ore source, even if small, was available (Keys 2009; D Dungworth, pers comm; T Young, pers comm). The ore might require preparation (crushing and/or roasting) but this was certainly no bar to its exploitation.

The Abbey Street site is within a few metres of the Neckinger stream. The site immediately adjacent and closest to the stream (ABY01) (Mason 1992), had only one lump of slag (Keys 2010). The slag was very magnetic, with some vitrified clay from the furnace or hearth adhering. Between the slag and vitrified lining were voids from burnt-out charcoal. The piece is either a fragment of furnace slag (smelting) or it is from a smithing hearth bottom; analysis would be necessary to determine which. It is worth noting here that the contexts bulk finds sheet records the presence, with a question mark, of Saxon pot and medieval building material; without specialist study neither of these identifications can be confirmed.

Fortunately, the other London site with diagnostic tap slag lies only c350m away at Bermondsey Square (BYQ 98) (Douglas 2011). Here a total of 2.21kg of this slag type (one fragment weighing 1510g) was recovered from four pits dated by pottery to between the Late Saxon or early medieval period (Keys 2011). Coincidentally, fragments of Bronze Age pottery – unrelated to the later iron smelting – were also found in some of the same pits. The Bermondsey Square slag was intriguing at the time because of its type but, owing to the small amount scattered over different features, it did not merit more than a comment noting its presence. In the light of the larger Abbey Street assemblage it can be re-evaluated. Its dispersal in pits with dating later than the Abbey Street coin possibly indicates that it is residual material, especially as there were a great many residual finds within the pit fills (A Douglas, pers comm). There is, indeed, the very slight possibility that all the slag is residual Roman. However, the dating evidence for both sites tends to suggest a smelting operation on the Bermondsey eyot some time between the Middle Saxon and early medieval periods.

The question of the ore source must be raised. It is possible there may be ore sources at Greenwich and in the Lea Valley where horizons of iron nodules have been identified within alluvium in the Thanet Beds (J Corcoran, pers comm). Their suitability for smelting is not known, but when they are encountered in the future they should be sampled in order that the nodules may be analysed to determine their ferrous component. Analysis of the ore used at Eaglesfield Park, Greenwich reveals that it was 94% iron oxide, had a high manganese content and is possibly a nodular ore (Dungworth & Mephram 2012), which corresponds well with the possible ore at Greenwich. It also suggests iron ore could have arrived at Bermondsey, not by road from the Weald, but via the Thames from Greenwich (or the Lea Valley) and thence into the Neckinger. Localised ore sources at Greenwich and the Lea Valley open up the possibility that a Bermondsey ore source may have existed and was exploited by a secular or religious authority based on the eyot. Detailed analysis of a sample of slag from Abbey Street (Young 2011) revealed a high percentage of manganese (7wt%) – more than twice that normally recorded in Wealden iron ores (Paynter 2006; 2007). As such, the material was comparable to bog iron ores found at locations further to the west in England and also in Ireland (Young 2011). As Pleiner (2000, 88) points out, sources of bog ores are river flood plains, water meadows, blanket bogs, river banks and regions of lakes and marshes (ie poorly drained grounds). Many of these environments would have existed in the vicinity of Bermondsey in the past.

If local sources were unavailable then there are others in the south of England from which ore could conceivably have been traded if suitable transport was available. Young (2011) has pointed out that there were a number of sites in Berkshire where bog iron ore, presumably from local sources, appears to have been utilised during the Iron Age. In addition to a site at Fleet Hill Farm, Eversley (between Camberley and Reading), which he observed himself, Young highlights a cluster of others nearby where the smelting of bog ore was likely; these include sites at Heckfield (Dungworth 2007), Risely (McDonnell 1984), Baird Road, Arborfield (Hammond, forthcoming) and the former Whitehall brickworks (Pine 2003), while further to the west and close to the river Kennet near Thatcham, sites such as Hartshill Copse (Collard *et al* 2006; Young 2004) and Dunston's Park (Fitzpatrick *et al* 1995) all possibly exploited bog ores although they were previously thought to have used raw material from Tertiary sands (Young 2011). Young has also pointed to sites in Surrey where bog ore rather than iron ore from Tertiary bedrock may have been exploited. These include Brooklands

(Hanworth & Tomalin 1977), Thorpe Lea (Starley 1998) and Littleton Manor, Reigate. The latter site, which yielded significant volumes of poor quality bog iron ore (Young 2010), is significant, however, as it has provided evidence of bog iron ores formed on or close to the Lower Greensand geological strata considered as a potential source of raw iron ore. Other smelting sites such as those at Ashford in Kent also lie on the Greensand belt that stretches across southern England, and although Paynter (2006) suggests sources in the Tertiary sands overlying the chalk, bog ores may have been exploited in that area too, alongside or instead of the Tertiary material (Young 2011). The potential sources of bog iron ore in south-east England are therefore quite numerous, although the origin of the material found at Abbey Street has still to be identified.

The Bermondsey slag represents, at the very least, a small, one-off smelting operation, possibly during one of the early phases of Bermondsey Abbey. At this stage, it is not possible to rule out a Middle Saxon date. The mixed nature of the assemblage suggests smithing of the bloom or blooms took place very close to the smelting site, while the iron off-cuts or smith's stock indicate the process was carried out from start to finish, from smelting to end product.

In the light of the Bermondsey evidence two new research questions for London and, particularly, Bermondsey, are proposed: Is there more smelting evidence to be found in Bermondsey? And were there viable iron ore sources in that locality (or in areas immediately south or north of the Thames) that were exploited by the Bermondsey smelters?

Discussion

The investigations at 150–156 Abbey Street have added to the list of locations in north Southwark with known later prehistoric and Roman activity, but they have produced significant evidence for iron smelting in the post-Roman period, which is important in terms of the source material, techniques involved and dating of the activity.

The earliest evidence of activity on the site dated to the Late Bronze Age, and while no features of this date were identified, a small quantity of pottery attested to a presence in the area. The pottery all derived from ditch 28 and overlying deposit 26. Broadly contemporary material has been identified on other sites in the vicinity, including the investigations immediately south of the study site, where a small number of features was tentatively dated to the Late Bronze Age/Early Iron Age and Middle Iron Age on the basis of the pottery recovered (Mason 1992). It was suggested that the evidence pointed to field-related activity rather than the existence of a settlement nearby, and it is likely that a similar conclusion could be drawn from the limited, albeit residual, assemblage from the study site.

Palaeoecological evidence from 211 Long Lane, more than 600m west of the study site but in a similar location at the northern margin of Bermondsey Eyot, as well as from other sites, has suggested that field systems were established on the higher ground of the eyot during the Late Bronze Age, following earlier woodland clearance allowing the establishment of pasture land on the Neckinger flood plain as well as on the eyot (Allen *et al* 2005). This adds support to the suggestion that the area of the study site lay within agricultural land towards the eyot margin. Elsewhere, agricultural activity at this time has been further indicated by ard marks, for example at 169 Tower Bridge Road (Boyer & Langthorne, in prep) and Lafone Street (Bates & Minkin 1999), both on Horsleydown Eyot, while at Three Oak Lane (also on the margins of the Horsleydown Eyot) a wooden ard tip was recovered (Proctor & Bishop 2002).

The evidence for activity during the Roman period again appears to have been represented only by an artefactual assemblage recovered from the fill of ditch 28 and the overlying deposit. Analysis of the pottery and CBM from these deposits has shown a wide date range from the 1st to 4th centuries, suggesting that the material was probably all residual and derived from a number of sources. While the material suggests there was some activity in the vicinity during the Roman period, this is difficult to define and it is likely that the site lay in a marginal location at the edge of the Bermondsey Eyot (or peninsula) at this time. The excavations

immediately to the south in 1991–2 yielded only a single sherd of Roman pottery (Mason 1992), while at other marginal locations on the edge of the eyot, evidence of Roman activity has also come from mixed ceramic assemblages rather than clearly defined features.

While the bulk of finds recovered from ditch 28 were of Bronze Age and Roman date, these were all residual and the ditch appears to have been post-Roman in origin. A single sherd of chaff-tempered pottery and a Saxon *sceat* suggest that the ditch was backfilled in the Middle Saxon period at the earliest. Its actual date of excavation and its function, however, are unclear, although given its orientation and the apparent recognition of part of the Neckinger Channel to the east during the 1991–2 excavations, it is probable that the ditch acted as a drainage feature that discharged into the Neckinger. It is likely that the stakeholes alongside the ditch were contemporary and represented some type of ephemeral wooden or wattle structure, although the function is unclear.

Clearly, the most significant evidence from the ditch was the assemblage of iron slag, elements of which were also recovered from the overlying deposit. The significance of the material has been discussed above but the ore used and dating of the activity represented are of great importance not only for this site but also for post-Roman iron-smelting in the wider Southwark area and the South-East region as a whole.

Iron is most likely to be smelted close to its source, given that it is far more efficient to transport processed metal rather than bulky ore. There were numerous smelting sites across the Weald of Kent, Sussex and Surrey because this area had extensive reserves of the raw materials necessary for production: iron ore and charcoal. However, there is evidence that raw unprocessed iron ore was traded at least as early as the medieval period. Ore from the Forest of Dean, for example, was transported to sites along the Severn Estuary and Bristol Channel, possibly even passing through the port of Bristol itself (Allen 1996). There seems to be evidence for ore transportation (Forest of Dean to Worcester) in the Roman period too (Blakelock 2005). It is not certain, therefore, that the ore processed at Abbey Street derived from the immediate vicinity. Chemical analysis of the slag sample has also strongly suggested that bog iron ore was being processed, a raw material for which there is currently no known source in the vicinity of the study site, or indeed the wider London area, although suitable conditions for the formation of the ore – poorly-drained wet areas – do persist in the London region (Young 2011). Prior to intensive post-medieval development across Southwark, involving extensive ground-raising, such suitable environments may have been located very close to the Abbey Street site.

As has already been discussed, the earliest evidence for post-Roman slag tapping in England has been dated to the 9th or 10th centuries, whereas the latest finds from ditch 28 have been dated to the second half of the 8th century. The earliest deposit containing post-Roman iron smelting debris from the recent excavations at Bermondsey Square (BYQ 98) also contained pottery of Middle Saxon date (A Douglas, pers comm). If this were the date of the smelting technology suggested, then this clearly has implications for the dating of the re-introduction of this technology to England and consequently the chronology of iron smelting across the country. However, there is insufficient secure evidence to allow confidence about the exact dating of either site and it would be far too bold a statement to suggest that slag tapping had been re-introduced up to 200 years earlier than previously thought. It is conceivable though, that the sparse Middle Saxon finds were, together with those of Bronze Age and Roman date, also residual, and that the iron smelting actually dated to the Late Saxon period (A Douglas, pers comm). A date closer to that generally accepted for the re-introduction would therefore be possible, but who was carrying out the smelting and how did the technology come to be re-introduced to Southwark at what would still have been quite an early date?

Given the lack of specific evidence, it is at present very difficult to answer these related questions. However, one intriguing, and currently contentious, possibility is that there was a Viking influence in the Bermondsey area (A Douglas, pers comm). The Vikings are known to have employed the smelting technology witnessed in the residues from Abbey Street and Bermondsey Abbey, and they were familiar with the processing of bog iron ore on sites over a

wide area including northern Europe, Ireland, Iceland and even North America (eg Buchwald 2005, 134–50; Graham-Campbell *et al* 1994, 91–2; 292–336; Hall 1995; Smith 2005). It has also been suggested that Viking groups may have been responsible for the destruction of a number of religious houses in the south of England during the 9th century. In the London area, the Saxon abbeys at Barking and Bermondsey, for example, both appear to have been sacked at this time (Dyson *et al* 2011, 17; Redknap 1991, 353), and while the latter was re-established as a Cluniac Priory, the earlier sacking would be broadly contemporary with the date of the iron slag recovered from the excavations at Abbey Street and on the site of the abbey itself. Clearly though, further evidence of a Viking presence would be necessary in order to endorse such a possibility.

Later activity on the Abbey Street site was much less significant and the mixed deposits that overlay the Saxon ditch fill indicated mixing by possible ploughing activity, suggesting that the area was probably exploited for agricultural purposes throughout much of the medieval and early post-medieval periods. In common with much of the surrounding area, parts of the site were affected by industrialisation from the second half of the 18th century onwards.

ACKNOWLEDGEMENTS

Pre-Construct Archaeology Ltd would like to thank Acorn Property Group for funding the excavation, in particular Ken Voase for commissioning the work. Thanks also to Chris Constable, Senior Archaeological Officer for Southwark Council, for his help and advice during the evaluation and excavation. Thanks are due to the project manager, Peter Moore and post-excavation manager, Jon Butler for their support.

The authors would like to thank Stuart Holden for supervising the archaeological fieldwork, and all members of the post-excavation team who have contributed to the programme; Tim Young who analysed the iron slag, Mike Seager Thomas for the prehistoric pottery, James Gerrard for the Roman pottery, Chris Jarrett for the post-Roman pottery, Kevin Hayward for the building materials and Kevin Rielly for the animal bone. Also many thanks to Jennifer Simonson and Josephine Brown for their work on the illustrations, Nathalie Barrett for surveying and Rob Nicholson and his team for finds processing. Thanks also to all those who worked on the site, whose contribution is greatly appreciated; Rik Archer, Pat Cavanagh and Stuart Watson; and Lisa Lonsdale for logistical and technical support.

Lynne Keys would like to thank Jane Corcoran (MoLA), David Dungworth (English Heritage) and Nathalie Cohen (Thames Discovery Programme) for discussions that encouraged the formulation of ideas expressed in this article; Cath Maloney and staff at LAARC for making the ABY 91 slag and site records available at short notice; and Alex Bayliss (English Heritage) for reassessing the radiocarbon dating evidence from Ramsbury.

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