

# Excavations on a late medieval ironworking site at London Road, Crawley, West Sussex, 1997

by Nicholas Cooke

*with contributions by*

Phil Andrews

Rowena Gale

Pat Hinton

Emma Loader

Lorraine Mephram

*Illustrations by*

S. E. James

## INTRODUCTION

Cartographic evidence indicates the presence of a rectangular building on the site of The Sun Inn during the first half of the 19th century. The Sun appears to have opened on the site in c. 1864 and either replaced or reused the earlier structure along the street frontage. The sequence of 19th- and 20th-century buildings represented in cartographic sources is discussed further below.

## POST-MEDIEVAL AND MODERN ARCHAEOLOGICAL FEATURES

Evidence for post-medieval activity included a north–south ditch, possibly a recut of an earlier ditch, containing substantial amounts of 18th- and 19th-century pottery (trench 3).

Part of what was formerly The Sun Inn (trenches 4a and 5) was shown to have been built on sandstone footings, which suggested a possible post-medieval date for the initial structure. Evidence for fireplaces was recovered in the northern and southern walls.

Further traces of 19th- and 20th-century brick buildings, several drains associated with The Sun Inn, and a series of land drains beneath the former Crawley Town FC football pitch were recorded, as well as undated features, which included an expanse of alluvial deposits (trenches 14 and 16), some 30 m

wide and at least 40 m long, likely to have been deposited in a body of standing water such as a pond.

## PHASE III. POST-MEDIEVAL: 17TH–18TH CENTURY (Fig. 8)

The post-medieval period saw the construction of a substantial rectangular brick building (6004) on sandstone foundations within the area defined to the north and south by the then in-filled late medieval ditches 7137 and 7303 (Fig. 4).

Initially, building 6004 was constructed as a simple rectangular structure, some 10 m by 7.5 m, with no obvious contemporary internal divisions. The bricks survived to two or three courses in places, and their form and dimensions suggest that the building dated to the 16th or 17th century. Pottery recovered from the foundation trenches dates from the 17th century.

Internal walls were added later in Phase III, with a north–south dividing wall built of brick on sandstone footings butting the external walls of 6004. This was cut by an east–west wall of similar construction. Well 7207, built of large un-mortared blocks of sandstone and limestone was also probably of this period. It was later capped with brick, during the 19th or 20th centuries.

## PHASE IV. MODERN: 19TH–20TH CENTURY (Fig. 8) Archaeological remains

There is evidence for the rebuilding of 6004 during

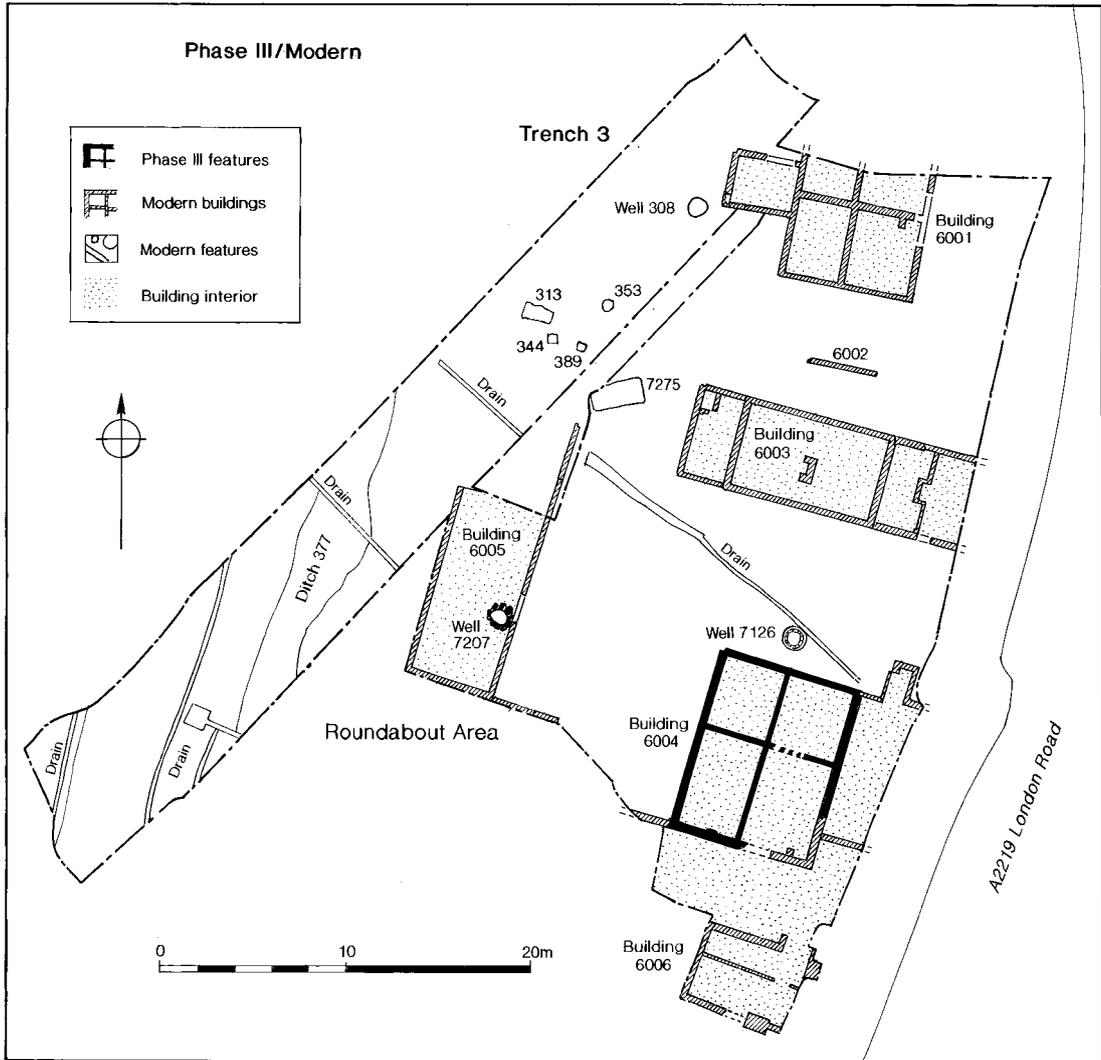


Fig. 8. Plan, roundabout area and trench 3: Phase III and Phase IV features.

the 18th or 19th centuries. All surviving upper courses of brickwork contained bricks of this date, and this period is also likely to have seen the insertion of fireplaces against the northern and southern gable walls respectively. Survey of the visible parts of the standing buildings recorded nothing that could be dated earlier than the 19th century. The building was later incorporated within a much larger, cellared building, which continued in use as a public house (The Sun Inn) until shortly before its demolition in 1995.

Three other buildings of 19th-century date were

also recorded. These comprised a long building on an east-west axis (6003), the remains of Nos 1-3 London Road (6001), and a further, probably ancillary, building to the west of The Sun Inn (6005). A brick-lined well (7126) immediately to the north of building 6004 is also likely to date to the late 19th century, as is a similar well (308) to the west of building 6001. A large ditch (377) running roughly north-south in trench 3 contained substantial amounts of 18th- and 19th-century pottery. It was some 3 m wide and 0.8 m deep, and may have formed a property boundary.

**The building survey**

Detailed examination of the buildings comprising The Sun Inn (6004) revealed a clear sequence of construction. The earliest building was a rectangular brick-built structure set back from the road, with a roughly north–south axis and gable ends. These gables were covered in tiles and each contained a chimney. Although much of this building was enveloped in later additions, there was nothing in the standing remains to suggest that the existing structure could be dated to any century earlier than the 19th.

This building was extended to the east later in the 19th century by the construction of a long brick-built extension, which fronted directly onto the pavement. This extension had a flat roof and chimneys at either end, and may have been associated with the first use of the building as a public house. The 20th-century structural additions included a small extension to the north and a more substantial addition to the south. The former was a single-storey, brick-built structure with a flat roof, whilst the latter was built of brick with a sloping roof.

The study of Nos 1–3 London Road (6001) concluded that the building originally consisted of two 19th-century semi-detached cottages, which were later modified to form a single unit. Both were thought to have been contemporary, brick-built structures. A modern wooden lean-to was built onto the back of this building during its recent use as a furniture shop.

**Cartographic study**

A map regression exercise was undertaken in order to determine the recent history of development and occupation of the site. The maps consulted included the Tithe Map of 1839 and Ordnance Survey Maps of 1874, 1910, 1932, and 1991. This exercise revealed that most of the site had been subject to little

development, and that the majority of the area had been under farmland. The only significant development took place along the street frontage.

The Tithe Map of 1839 shows two buildings fronting onto London Road. The rectangular building shown on the site of The Sun Inn is certainly that identified in excavation as building 6004. The plot was described in the award as ‘House, Garden Premises’ and was owned by William Fuller. From this it is clear that the original building was not an inn — indeed, a ‘Sun Inn’ is shown further to the south on the opposite side of London Road. Nos 1–3 London Road (6001) also appear on this map, in the form of two semi-detached cottages, both owned by a Richard Boston and occupied by a Lucy Godsmach and a Thomas Steadman, who paid 26s. 6d. in rent. A small pond is shown to the north of these buildings.

By 1874, the building on the site of The Sun had been extended to the south, and was recorded as The Sun Inn. Two new buildings are also shown on this map. The first was a large, L-shaped building to the rear of the Sun Inn, and the second, between The Sun Inn and Nos 1–3 London Road, a relatively long narrow building on an east–west axis. These were recorded during the excavations as buildings 6005 and 6003 respectively. There is no significant change in the form of Nos 1–3 London Road on this map.

The Ordnance Survey Map of 1932 shows a number of changes. The Sun Inn had been extended to the south and west, and the L-shaped building (6005) to the west had also been enlarged. The long east–west building (6003) had been demolished, and the southern half of Nos 1–3 London Road had been extended to the south. Subsequent to this, there was very little change in the structures fronting London Road, although the building to the west of The Sun must have been demolished between 1946 and 1991.

## FINDS

**METAL OBJECTS** By Emma Loader

The ironwork recovered comprises 64 objects. All objects have been X-radiographed. The total includes 41 individual nails, as well as two corroded masses of nails from post-holes 4072 and 4074. All objects are of post-medieval date.

A small fork (pit 342) is post-medieval and consists of three tines and a short-scale tang. Small rivets *in situ* would have attached a bone, antler or wooden handle. A comparable fork was found at Oyster Street, Portsmouth and dated to the early- to mid-19th century (Fox & Barton 1986, fig. 153).

An incomplete candle-snuffer (or wick trimmer) of 17th- to 18th-century date (*see* Ruempol & van Dongen 1991, 213),

and several tools (a triangular-sectioned file, a small file, and a heavy hammer/pick with a flat, square head on one side and a pointed, slightly curved pick end opposite this) were recorded as unstratified. The tools are all of probable post-medieval date and, therefore, unrelated to the earlier ironworking activity on the site.

Five copper-alloy coins ranging in date from 1773 to 1949, a piece of sheet and a flat ring were recovered. One coin is of particular interest. It is an 1854 issue of Napoleon III, which was recovered from the cellar wall of the 19th-century Sun Inn (7281),

**POTTERY** By Lorraine Mephram**Methods**

The pottery has been analyzed following the standard Wessex

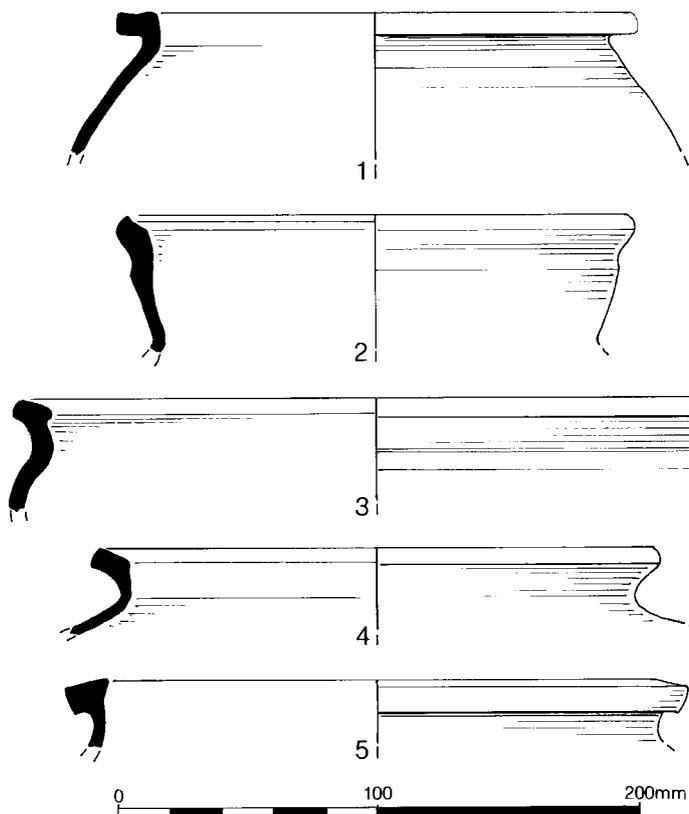


Fig. 14. Pottery.

Archaeology pottery recording system (Morris 1994), based on full fabric and form analysis. A total of 14 fabrics has been identified here, comprising 11 sandy wares, one shelly, and two 'established' wares. These have been correlated with the fabric type series (SEAS fabrics) already established for Crawley (Barber 1997b; Timby 1998).

#### Fabrics and forms

The fabrics fall into six groups, four of which reflect known or potential source areas. The other two groups comprise shelly ware (represented by a single sherd), and miscellaneous sandy wares of unknown source. Fabric totals are given in Table 1.

#### Earlswood-type wares (SEAS Fabric 1)

The assemblage is dominated by the Earlswood-type wares (56.4% of the total medieval assemblage by weight), for which rim sherds suggest a roughly equal occurrence of jar and jug forms (Fig. 14:1, 2), with one possible bowl. Rims are generally everted and squared, and the jar forms are necked; jugs have similar rim types on plain, upright necks; handles include both rod and strap forms. Jugs are frequently white-slipped on exterior surfaces under a clear or mottled green glaze; at least one vessel carries slip decoration in bands. Otherwise, decoration is limited to a single example of an applied strip. All these forms are paralleled within the range published from the excavated kiln at Earlswood (Turner 1974). The kiln is dated by the excavator on ceramic grounds to the

14th century, although the range of wares here and from other sites in Crawley suggest a wider 13th- to 14th-century range (Barber 1997b; Timby 1998).

#### Miscellaneous sandy wares (SEAS Fabrics 2 and 8)

SEAS Fabric 2 is essentially a 'catch-all' group for fine sandy wares, and probably includes wares deriving from different sources. Only plain, unglazed body sherds are present here, but associated fabrics indicate a 13th- to 14th-century date range. Fabric 8 is represented by a single jar rim, of a squared form similar to the Earlswood and Limpsfield examples, which may in fact be product of either of those two sources.

#### Limpsfield-type wares (SEAS Fabric 3)

Jars are the only vessel form recognized, and rim forms are similar to those in Earlswood-type wares, i.e. squared rims on necked jars (Fig. 14:3-5). There are two examples of applied strips. A similarity has been noted between these wares and those described for the Limpsfield production centre (Prendergast 1974; Ketteringham 1989), although a more local source (or sources) may exist. Documentary evidence indicates that potters were working in the Limpsfield area from the mid-13th century at least until the mid-14th century, and one kiln has an archaeomagnetic date in the early-14th century (Ketteringham 1989, 130).

#### West Sussex-type wares (SEAS Fabric 4)

West Sussex-type wares make up 12.9% of the medieval assemblage. Sherds derive almost exclusively from glazed jugs with strap handles. Decoration is rare, restricted to occasional horizontal incision or grooving, one example of a horizontal slipped band below the rim, and one example of an applied thumb pad.

#### Surrey whitewares (SEAS Fabric 5)

This group includes Kingston-type ware and Coarse Border ware (Pearce & Vince 1988). Surrey whitewares occur in small quantities but only as plain body sherds, some glazed. Kingston-type ware appears in London from the early 13th century and Coarse Border ware, manufactured at centres such as Farnham and Farnborough, from the mid-13th century.

#### Shelly ware (SEAS Fabric 9)

This fabric is represented by a single body sherd (from clay floor layer 7245). The vessel form is unknown, as is the source; this sherd is nevertheless significant in indicating an earlier date range than that suggested by the other wares in the assemblage. The tradition of early medieval shelly wares in Surrey and the surrounding region has been recently discussed by Jones (1986), who concludes that in Surrey most of these wares may be dated to the 11th and 12th centuries. The date of their final demise is uncertain, but they appear to have been

superseded by sandy wares by the mid-13th century.

**Post-medieval pottery**

The post-medieval assemblage comprises a limited range of wares (see Table 1). Totals are skewed by the presence of sherds of a single large stoneware jar (context 7142: wall trench 7141). Most of these wares would fit within a date range of 18th to 20th century, although the Border wares and coarse redwares could be of earlier date, possibly as early as 16th century. These potentially earlier wares are concentrated in trench 3 and the roundabout excavation area.

**List of illustrated sherds** (Fig. 14)

1. Jar rim (Earlswood fabric), roundabout area. PRN (Pottery Record Number) 82, layer 7091.
2. Jar/jug rim, patchy internal glaze (Earlswood fabric). PRN 110, roundabout area, layer 7098.
3. Jar rim (Limpsfield fabric). PRN 36, trench 4, context 412, pit 423.
4. Jar rim (Limpsfield fabric). PRN 81, roundabout area, layer 7091.
5. Jar rim (Limpsfield fabric). PRN 122, roundabout area, layer 7098.

**CERAMIC BUILDING MATERIAL** By

Emma Loader

The assemblage of ceramic building material comprises 202 pieces (24,663 g), of which 72 (4952 g) are miscellaneous fragments and 130 (19,711 g) are complete bricks retained from structural elements. All the ceramic building material is post-medieval.

The first group includes fragments of brick, flat roof tile (including peg tiles), field drain and possible ridge tile, and miscellaneous undiagnostic fragments. Samples of brick, generally comprising three complete bricks, were taken from a number of walls within structures 6002–5. The dimensions (length, breadth and thickness) of one example from each element were recorded, as well as other features such as the presence of frogs (details in archive).

The uniformity of shape, fabric and size of most of the bricks recovered suggests that they date from the late 18th to 19th century. Many of the samples of this date were recovered from walls associated with structure 6003. Several examples of earlier, handmade, un-frogged bricks of 16th- to 17th-century date were also noted, mainly associated with the earliest of the post-medieval structures (6004). These bricks are noticeably thinner than the later bricks (dimensions typically 235 × 110 × 50 mm). The fabric also differs, being lighter in colour, softer and generally not as well wedged as the later bricks.

ENVIRONMENTAL EVIDENCE

**CHARRED PLANT REMAINS** By Pat Hinton

All of the samples examined included a few pieces of slag (or

Table 1. Pottery fabric totals.

Fabric (by weight)	No. sherds	Weight	% of period
<b>MEDIEVAL</b>			
<i>Earlswood-type wares</i>			
SEAS fabric 1b	145	1012	35.1
SEAS fabric 1a/1c	68	614	21.3
<i>?Limpsfield-type wares</i>			
SEAS fabric 3a	20	141	4.9
SEAS fabric 3b	48	541	18.8
<i>West Sussex-type wares</i>			
SEAS fabric 4	36	371	12.9
<i>Surrey whitewares (SEAS fabric 5)</i>			
Kingston-type	3	19	0.7
Coarse Border	7	75	2.6
Miscellaneous sandy			
SEAS fabric 2	7	63	2.1
SEAS fabric 8	1	37	1.3
<i>Shelly ware</i>			
SEAS fabric 9	1	8	0.3
<b>Sub-total</b>	<b>336</b>	<b>2881</b>	
<b>POST-MED</b>			
Redwares	84	2497	26.1
Borderwares	3	43	0.5
Slipware	1	87	0.9
Tinglaze	1	2	–
Fine whiteware	127	1216	12.7
Fine buff ware	8	225	2.4
Creamware	1	4	–
Pearlware	5	69	0.7
Stoneware	55	5421	56.6
Bone china	5	10	0.1
<b>Sub-total</b>	<b>290</b>	<b>9574</b>	
<b>OVERALL TOTAL</b>	<b>626</b>	<b>12,455</b>	

slag-like material) and numerous more or less spherical items from c. 0.5 mm to c. 3.5 mm. in diameter — spheroidal hammerscale. The majority are shiny and metallic in appearance, others dull. Most are hollow and easily crushed, but some are solid and unbreakable.

It is possible that also included in this background are occasional small fungal sclerotia, but charred plant remains, apart from charcoal, are very sparse indeed (Table 2). A few badly degraded cereal grains, which include *Triticum* and *Avena* species (wheats and oats), and amorphous charred fragments which probably include cereal, are present in all samples. Context 7084 (pit 7113, Phase II) is more informative as it also contains a number of wild plant species which provide some general illustration of probable surroundings.

Grassland is indicated by *Trifolium campestre* (hop trefoil), a common plant of both grassy and rather bare places, *Danthonia decumbens* (heath grass) found in damp, often peaty soils, and the unidentified grasses. *Carex nigra* (common sedge) which occurs in both acid and basic soils, usually damp or wetter places, with the other unidentified sedge and a possible moss stem fragment are all suggestive of damp grassy places. The only suggestion of woodland is a probable fragment of *Corylus avellana* (hazel) nut shell in context 7189 (pit 7193, Phase II). Fungal sclerotia are common in upper soil layers.

More surprising is a glume base of either *Triticum dicoccum* or *Triticum spelta* (emmer or spelt) in 7189. These glume wheats,

Table 2. Charred plant remains.

Feature		7113		7161	7193
Context		7084	7154	7060	7189
Sample		1020	1027	1029	1036
Sample volume (litres)		10	10	10	10
<i>Triticum aestivum</i> s.l.	Bread wheat	1			
<i>Triticum dicoccum/spelta</i> – glume base	Emmer or spelt				1
cf <i>Triticum</i> sp.	Probable wheat	1		1	(1)
<i>Avena</i> sp.	Oats			1(1)	
Cerealia indet. – grain fragments	Cereals	1	1(2)	4	4
<i>Trifolium campestre</i> Schreber	Hop trefoil	1			
<i>Danthonia decumbens</i> (L.) DC.	Heath grass	1			
Poaceae indet.	Grasses	2		(1)	
<i>Carex nigra</i> (L.) Reichard	Common sedge	1			
<i>Carex</i> sp.	Sedge	1			
cf. <i>Corylus avellana</i> L. – shell fragment	Hazel				1
cf. <i>Musci</i> indet. – stem fragment	a moss	1			

Table 3. Charcoal.

**Key:** r: roundwood (diameter <20 mm); s: sapwood; h: heartwood  
The number of fragments identified is indicated.

Feature/No.	Context	Sample	<i>Betula</i>	<i>Corylus</i>	<i>Fagus</i>	<i>Ilex</i>	<i>Pomoideae</i>	<i>Quercus</i>
<i>Roundabout area/trench 3</i>								
Hearth	7074	1016	11	–	4	1	–	4
Pit 7113	7084	1020	20	–	38s	–	1r	44s,h
Pit 7125	7124	1024	17	1r	33r,s	–	–	8s,h
Layer	7154	1027	6	–	54	–	–	14s,h
Pit 7161	7160	1029	6	–	45	–	–	16s,h
Pit 7193	7189	1036	15r	–	23	–	–	13s,h
Pit 7315	7292	1051	6	–	18r	–	–	12r,h
Hearth	7176	1052	31r	–	2	–	–	3r,h
Pit 7218	7219	1033	6	1	–	–	26	1h
<i>Football pitch area</i>								
Ditch 5023	4063	17	4	–	8	–	(1)	8h
Hollow 5169	4068	18	–	–	–	–	–	141s,h

predominant during the prehistoric and Roman periods, are found very occasionally in later contexts and although possibly contemporary are more likely to be residual. This is probable in this case as the only wheat grain specifically identified is *Tr. aestivum* (bread wheat), appropriate for the medieval period.

The plant remains in these samples appear to represent no more than a background of disturbed charred waste material, perhaps not surprising given the ‘industrial’ nature of the part of the site from which they came.

#### CHARCOAL By Rowena Gale

Most, if not all, of the charcoal described in this study represents fuel residues associated with furnaces, hearths and other ironworking activities dating to the 14th and 15th centuries. Nine samples were examined from the roundabout area/trench 3 to identify the type and character of the fuel, and the source of the fuel used by the industry. Two further samples were examined from the football pitch area, one from a 13th- to 14th-century ditch (5023), and the other from an undated hollow (5169).

The charcoal examined was well-preserved and frequently abundant. Samples were prepared for examination using standard methods. Where possible the maturity (i.e. heartwood/ sapwood) of the wood was assessed and number

of growth rings recorded. It should be noted that measurements of stem diameters are from charred material; when living these stems may have been up to 40%, or more, wider.

The results are summarized in Table 3. The anatomical structure of the charcoal was consistent with the taxa, or groups of taxa, given below. Classification follows that of Flora Europaea (Tutin: Heywood *et al.* 1964–80).

#### Roundabout area/trench 3 Hearth 7074 (sample 1016)

The charcoal from this small hearth consisted of large fragments of beech (*Fagus*), birch (*Betula*), and smaller pieces of oak (*Quercus*) and holly (*Ilex*). Pieces of beech measured up to 21 mm radially and included up to 24+ growth rings. Inner and outer areas of the wood were absent and it was apparent that they had derived from wide billets of wood of moderate growth rates. The birch was probably roundwood, although none of the pieces included the outermost rings. The widest radial section measured 12 mm and included four wide growth rings. In general the birch indicated very fast or moderate growth rates. Oak consisted of heartwood. A single piece of holly stem

measured 9 mm in diameter.

#### Pit 7113, layer 7084 (sample 1020)

The charcoal, probably representing rake-out material from a hearth, was mainly beech (*Fagus*), birch (*Betula*) and oak (*Quercus*). A single piece of stem (diameter estimated at 8 mm) from a member of the *Pomoideae* group (hawthorn, service tree, rowan, apple etc.) was also identified. Beech from billets of wood of similar dimensions to those in sample 1016 had been used. The oak was predominantly heartwood, some of which appeared to have derived from trees undergoing rapid growth in their early stages, possibly indicative of an origin from managed woodland. Large fragments of unidentified carbonized bark, up to 6mm thick, were consistent with the use of wide billets of wood 100 mm or more in diameter.

#### Pit 7125, layer 7124 (sample 1024)

The pit fill, in which hammerscale was abundant, also included large pieces of charcoal measuring up to 35 mm in length and 15 mm thick. The larger pieces were mainly birch (*Betula*); these included 17+ growth rings and it was evident that they were from stems exceeding 50 mm in diameter. Additional taxa included beech (*Fagus*), which was more fragmented but included narrow roundwood with some measuring 8 mm in

diameter; oak (*Quercus*), both sap- and heartwood; and a single piece of hazel (*Corylus*) roundwood, diameter <10 mm.

*Layer 7154 (sample 1027)*

This sample came from an area rich in hammerscale. The charcoal was more fragmented than in previous samples, but was very similar in species content. Beech (*Fagus*) was most frequent, although oak (*Quercus*) sapwood and heartwood, and birch (*Betula*) were also present, along with some pieces of unidentified bark.

*Pit 7161, layer 7160 (sample 1029)*

This sample was from a pit filled with redeposited slag. Taxa identified included beech (*Fagus*), oak (*Quercus*) sapwood and heartwood, and birch (*Betula*).

*Pit 7193, layer 7189 (sample 1036)*

Large pieces of charcoal measuring up to 35 mm in length were present in the fill which also contained hammerscale, slag and burnt clay. The larger bits of charcoal were identified as fast-grown birch (*Betula*) roundwood ranging from 7–18 mm in diameter (the latter including 5 growth rings). Some pieces retained bark and the structure at the outer edge of the xylem suggested that the wood had been felled in the spring or early summer, just after the start of the spring growth. Other taxa identified included beech (*Fagus*) and oak (*Quercus*) sapwood and heartwood.

*Pit 7315, layer 7292 (sample 1051)*

The charcoal, from the upper fill of a small pit, was more comminuted than that from other contexts. The sample included birch (*Betula*), oak (*Quercus*), and beech (*Fagus*). In addition to oak heartwood, oak roundwood (e.g. diameter 10 mm, 11 growth rings) and beech roundwood (from diameter 4 mm) were present. The oak was probably felled when dormant.

*Hearth 7176 (sample 1052)*

Charcoal from this hearth was predominantly birch (*Betula*) roundwood with some fragments measuring 6 mm in diameter (4 growth rings). Although some stems retained bark it was impossible to assess the exact season of felling, apart from noting that it could have occurred between mid-summer and the end of the dormant period. In addition, Oak (*Quercus*) roundwood and heartwood, and beech (*Fagus*) were recorded.

*Pit 7218, layer 7219 (sample 1033)*

The charcoal was mainly from the hawthorn group (*Pomoideae*), but also included birch (*Betula*), oak (*Quercus*) heartwood, and hazel (*Corylus*).

**Football pitch area**

*Ditch 5023, layer 4063 (sample 17)*

The small amount of poorly preserved charcoal was identified as oak (*Quercus*) heartwood, beech (*Fagus*), birch (*Betula*) and possibly a member of the *Pomoideae* (hawthorn etc.).

*Pit 5169, layer 4068 (sample 18)*

Charcoal, fired clay and a small amount of hammerscale was found in this shallow, undated hollow. The charcoal was very abundant and consisted of large chunks of oak (*Quercus*) up to 35mm in length and 25 mm thick. Heartwood was more

frequent than sapwood. Although poorly preserved, it was evident that the charcoal was from poles or branches exceeding 60 mm in diameter (when charred) and at least 30 years old. Growth rates varied from piece to piece with some including moderate to fast growth (rings widths of 3 mm), although later growth was generally slower. There was no evidence to suggest coppice growth. The identification of a single taxon in this context contrasts with the multiple taxa present in other contexts with associated metalworking debris, and a structural origin is considered more likely.

**Discussion**

The Crawley area has long associations with ironworking, as the Iron Age and Romano-British evidence from Goffs Park and Broadfield testifies (Cartwright 1992). Radiocarbon-dated material ranging from the 1st century BC to the 4th century AD from over 40 iron-smelting furnaces at Broadfield indicated the use of oak (*Quercus*), mostly heartwood, in the three earliest samples, and probably maple (*Acer*) in the 4th century AD (Gale n.p.; Jordan *et al.* 1995, 41).

The 13th to 15th centuries saw a considerable expansion of ironworking activity in Britain (Havins 1976). The principal areas — including the Weald — centred on favourable environments supplying the requisite combination of clay, iron ore and dense woodland. The demand for charcoal was enormous, and by the 13th-century charcoal-burners were licensed and penalties imposed on those ignoring the restrictions (Armstrong 1978).

The conversion of wood to charcoal consumes approximately 6–7 units of wood to produce 1 unit of charcoal (Percy 1864); charcoal emits about twice the heat of wood (depending on the quality of the charcoal). Charcoal production on an industrial scale required huge quantities of wood, and the effect of continuous felling over a period of some decades or even centuries often depleted local supplies, even with the use of managed woodlands. Protection of woodland resources is reflected by the prohibition of the export of charcoal from the Weald of Sussex and Kent in the late 13th century (Armstrong 1978). Such was the devastation to the Wealden woodlands, and also to the highways from the perpetual transport of fuel, that in the late 16th century regulations stated that charcoal could only be made from coppice wood. This was, in part, a measure to allow wood to grow to larger dimensions for structural work and ship-building. However, the implication is that prior to this charcoal was probably produced from both managed rods and poles, and from unmanaged woodland. The varied growth rates and dimensions of the charcoal identified from the site at London Road, Crawley fits well with this suggestion.

The Iron Age and Romano-British iron industries at Goffs Park and Broadfield would most likely have been fuelled from local woodlands, but ironworking operating on a single site for any extended period during the 13th to 15th centuries may well have bought charcoal from further afield. Documentary evidence from manors and estates supplying fuel to London in the 13th and 14th centuries indicate that fuel demand dictated the character of managed woodlands. For example, industries such as brewing, baking, brick- and tile-making, potteries, and glass-making used faggots, therefore many of the woodlands in the London region produced short cycle (7 years) coppiced wood (Galloway *et al.* 1996). By extrapolation, managed woodlands in some parts of the Weald may have been

grown specifically for the local iron industry, and if the charcoal from London Road was supplied from such woodlands, the evidence suggests that these were grown on long cycles, sometimes of some decades.

Charcoal identifications have not been published for other medieval ironworking sites in Crawley, but analysis of material from London Road indicated a remarkable consistency in the fuel, comprising principally of birch (*Betula*), beech (*Fagus*) and oak (*Quercus*). The only exceptions were the charcoal from pit 7193 which was mostly hawthorn type (*Pomoideae*) with only small quantities of oak (*Quercus*) heartwood, hazel (*Corylus*) and birch (*Betula*), and the oak charcoal from undated hollow 5020 which may have had a structural origin.

A high proportion of the oak and beech charcoal originated from poles or branches from trees exceeding 20 years of age, and varied growth rates were frequent. Although the latter may be attributed to climatic or edaphic fluctuations (i.e. increasing and decreasing competition from the growth and felling of adjacent trees), there were few examples of wide growth rings in the juvenile growth that characterize the early stages of the regenerating growth in trees from managed woodland (i.e. coppiced/ pollarded). Birch, however, tended to be from narrower stems or roundwood, some of which were fast-grown. It seems likely that at least some of the fuel was obtained from managed woodlands. A few sections of oak and birch which retained bark indicated felling in the dormant period. Well-seasoned wood, with a low moisture content, is quicker and safer to render into charcoal (Percy 1864; Armstrong 1978) and it is probable that charcoal-burners in the Weald followed this practice.

In 1662, John Evelyn, then living on the northern edge of the Weald, recorded that oak (*Quercus*) cordwood (e.g. branches) made the best charcoal for iron-working (Armstrong 1978). The popularity of oak charcoal for metallurgy is borne out by numerous studies of fuel residues from sites dating from the Iron Age and Roman periods, e.g. Parnell Road, London and Lefevre Walk, London (Rockham *et al.* 1998), Creeton (Cowgill & Trimble in prep.), and Scole, Norfolk (Cowgill *et al.* in prep.). Although oak heartwood was common in the samples from London Road, beech and birch were equally frequent and it was clear that this combination of fuel was specifically chosen for the job. Oak was a major component of the Wealden woods in the medieval period and, by implication, a greater ratio of oak could have been used if required.

Experimental attempts to reproduce ironworking methods used in prehistoric times have been conducted by Peter Crew (1991). Techniques in later periods were probably very similar. He concluded that crushed charcoal ranging from 10–50 mm was used, while the finer pieces were discarded. The same size of charcoal was probably used for both smelting and smithing, but in smithing, the finer charcoal was sometimes used to cover the fire to contain the heat for a welding process. The largest chunks of charcoal from London Road comply with these measurements, although subsequent fragmentation of most pieces would have been inevitable. Interestingly, Crew failed to achieve comparable success in smithing; a possible reason for this, he decided, was his use of the wrong species of charcoal (oak). Historical and ethnographic evidence indicates the use of different charcoal for smelting and smithing, and that hot-

burning charcoal such as alder (*Alnus*) and birch (*Betula*) are particularly suited to smithing. This observation may be particularly relevant in the charcoal identified from the forging/smithing area at London Road, with the common occurrence of birch in all but one of the samples from this part of the site.

## REFERENCES

- Armstrong, L.** 1978. *Woodcolliers and Charcoal Burning*. Singleton: Coach Publishing House Ltd and The Weald and Downland Open Air Museum.
- Barber, L.** 1997b. Pottery, in Stevens 1997, 200–204.
- Cartwright, C.** 1992. The excavation of a Romano-British iron working site at Broadfield, Crawley, West Sussex, *Sussex Archaeological Collections* (hereafter SAC) **130**, 22–59.
- Cowgill, J. & Trimble, R.** In prep. An Iron Age and Romano-British iron-smelting site at Creeton Quarry.
- Cowgill, J., McDonnell, G. & Mills, J. M.** In prep. Iron working report for the Scole and Oakley Road Improvement Project.
- Crew, P.** 1991. The experimental production of prehistoric bar iron, *Historical Metallurgy* **25**, 21–31.
- Fox, R. & Barton, K. J.** 1986. Excavations at Oyster Street, Portsmouth, Hampshire 1968–71, *Post-medieval Archaeology* **20**, 31–255.
- Galloway, J. A., Keene, D. & Murphy, M.** 1996. Fuelling the city: production and distribution of firewood and fuel in London's region, 1200–1400, *Economic History Review* **49.3**, 447–72.
- Havins, P. J. N.** 1976. *The Forests of England*. Devon: Readers Union Ltd.
- Jones, P.** 1986. The pottery, in R. Poulton, Excavations on the site of the Old Vicarage, Church Street, Reigate, 1977–82, part I: Saxo-Norman and earlier discoveries, *Surrey Archaeological Collections* (hereafter SyAC) **77**, 36–85.
- Jordan, D., Haddon-Reece, D. & Bayliss, A.** 1995. *Radiocarbon Dates from Samples Funded by English Heritage and Dated before 1981*. London: English Heritage.
- Ketteringham, L. L.** 1989. Two medieval pottery kilns at Limpsfield Chart, SyAC **79**, 125–45.
- Morris, E. L.** 1994. *The Analysis of Pottery*. Wessex Archaeology Guideline **4**. Salisbury.
- Pearce, J. & Vince, A.** 1988. *Surrey Whitewares*. London Mdx. Archaeol. Soc. Specials Paper **10**.
- Percy, J.** 1864. *Metallurgy*. London: John Murray.
- Prendergast, M. D.** 1974. Limpsfield medieval coarseware, SyAC **70**, 57–77.
- Rockham, D. J., Gale, R., Holden, T., Izard, K. & Locker, A.** 1998. *Parnell Road and Lefevre Walk, Bow, London, PRB 95 and LEK 95*. Environmental Archaeology Report. London: Report for Pre-Construct Archaeology.
- Ruempol, A. E. P. & van Dongen, A. G. A.** 1991. *Pre-Industrial Utensils 1150–1800*. Rotterdam: Museum Boymans-van Beuningen.
- Timby, J.** 1998. The pottery, in Saunders 1998, 89–92.
- Turner, D. J.** 1974. Medieval pottery kiln at Bushfield Shaw, Earlswood, SyAC **70**, 47–55.