A re-investigation of Late Iron Age and Roman iron production, and Saxon activity, at Rathlin Road, Crawley

By Jo Pine

with contributions by
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A small excavation was carried out in advance of redevelopment, to relocate precisely a previous excavation and to record any additional deposits. The original fieldwork carried out in the 1970s, known as Broadfield Site 2, revealed Iron Age and primarily Roman shaft smelting furnaces and ditches. The current project was able to relocate the remains of the previously excavated features. Although most of these had already been excavated in whole or in part, it was possible to obtain additional dating information, and to revise some of the earlier findings. A series of published radiocarbon dates is also reassessed and two new dates added. One unexpected result was the presence of a late Saxon ditch on the site.

THE SITE

Planning permission (CR/2005/0773/FUL) had been gained from Crawley Borough Council to redevelop 0.38ha of land off Rathlin Road, Crawley, West Sussex (TQ 26053520) (Fig. 1). It was believed that this area was the location of excavations in the 1970s but details of those excavations remained unclear (Cleere and Crossley 1985; Gibson-Hill and Cartwright 1992). An evaluation (Oram and Pine 2005) established that this was indeed the area of the previous excavation, which had recorded evidence of Iron Age and Roman iron working in the form of slag dumps, smelting furnaces, enclosure ditches and possible remains of timber buildings. The consent was therefore subject to a condition requiring the further excavation of the remains previously identified.

The site was in an area known as Broadfield, immediately north of the Broadfield Brook, ultimately a tributary of the River Mole (Fig. 1), at an elevation of 77m above Ordnance Datum and had been occupied by a sports pavilion, a car park and an access road. The underlying geology is Weald Clay (BGS 1972). The excavation took place during September and October 2006.

ARCHAEOLOGICAL BACKGROUND

The Weald of Kent and Sussex has a concentration of Late Iron Age/Roman and medieval bloomery smelting and iron-working sites and later medieval and post-medieval blast furnace production. This concentration was due to the favourable underlying geologies of the Weald which contained seams of ironstone from the Wealden beds, a concretion ironstone formed by weathering at the surface known as shrave or crowstone, and ore from ferruginous sandstone occurring in the Lower Greensand of this region (Cleere and Crossley 1985). Broadfield is one of the most north-westerly of the known Wealden iron-producing sites.

Rescue excavations by Gibson-Hill at Broadfield in 1970–5 indicated that iron making began here in the Late Iron Age and went on until the 3rd century AD. It will have been located here because of the presence of a silty siderite mudstone (boxstones ore) and the ironstone in the lower lying shaley clay bed. The siderite could be found at *c.* 1.5m below the ground, and the ironstone deeper. The remains recorded during survey and rescue work included iron 'mine pits' distributed over an area of 40ha (so called as the local name for iron ore was mine), together with some 36 furnaces, both domed and shaft types, and settlement evidence (Cleere and Crossley 1985). The settlement and iron-working areas were supposed to have been founded after the abandonment of the settlement at Goffs Park, where the inhabitants were also extracting iron in cylindrical shaft furnaces (Gibson-Hill 1976). The occupation and smelting sites extended both north and south of the Broadfield Brook, and Gibson-Hill investigated several sites at Broadfield, which were sub-divided into smaller excavation areas.

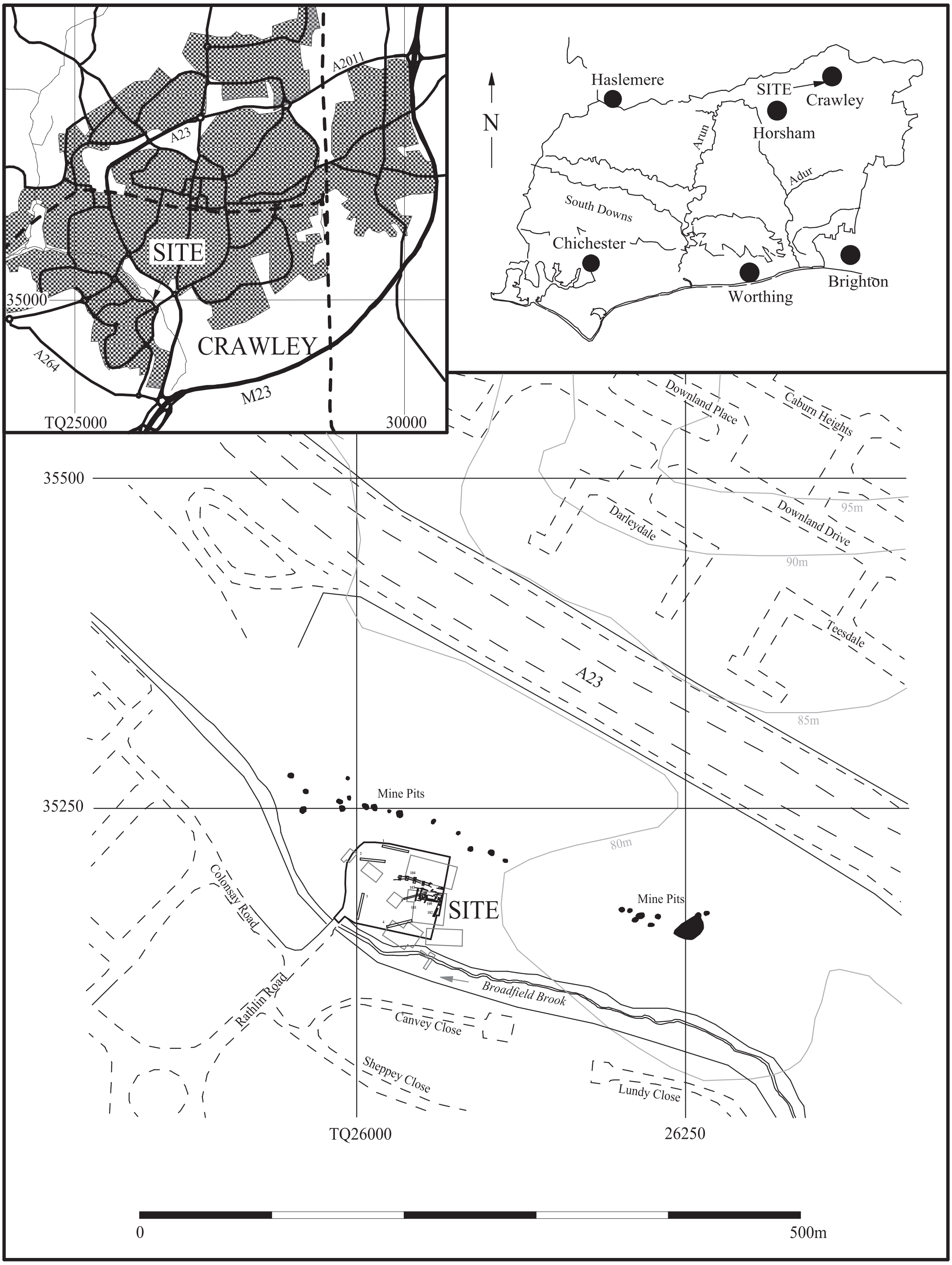

Fig. 1. Site location within Crawley and Sussex.

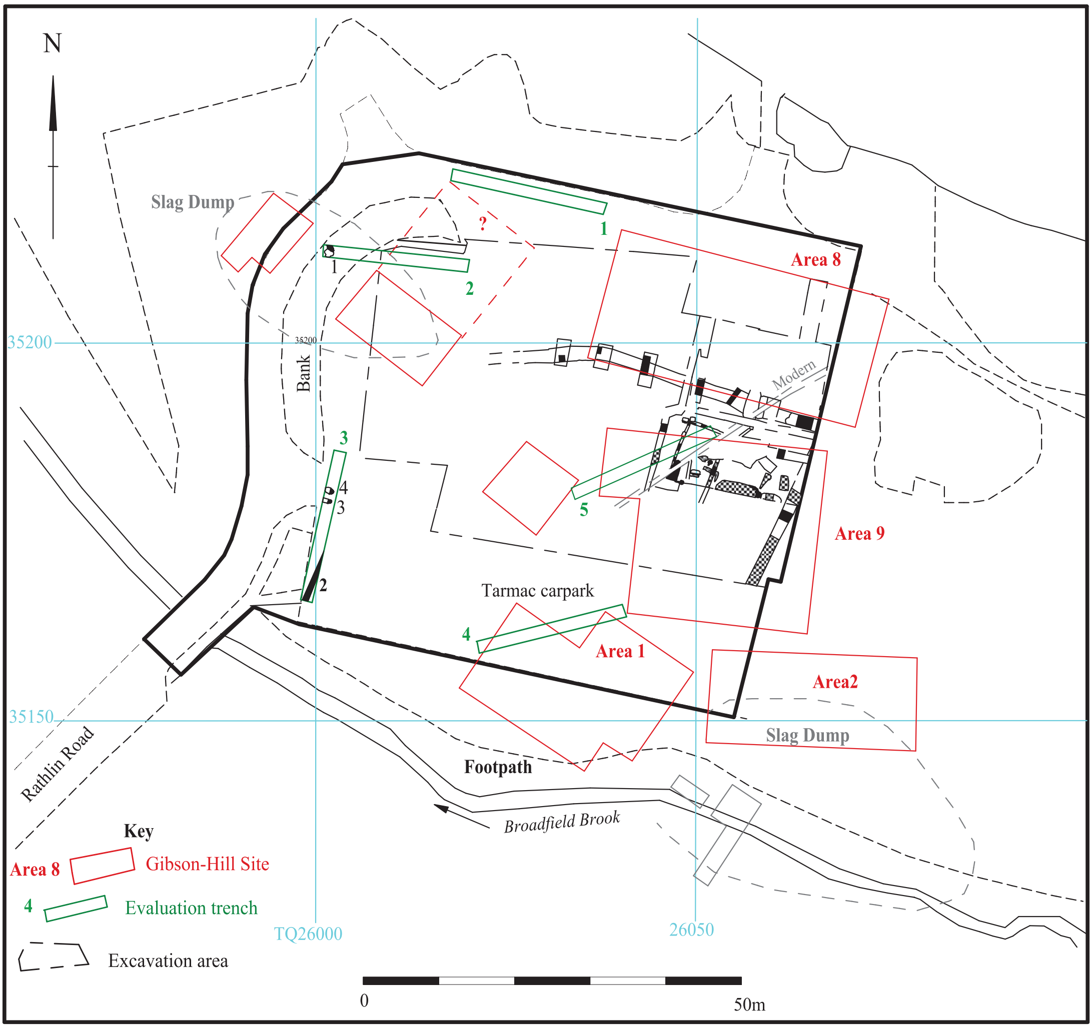

Fig. 2. Detail of area investigated in relation to previous excavations (red) and evaluation trenches.

The fieldwork and initial analysis were completed and a report was in preparation when Gibson-Hill passed away. Parts of the archive, including the majority of the finds, were subsequently misplaced. Prodigious efforts by Cartwright resulted in a publication of the results of these excavations (Gibson-Hill and Cartwright 1992) from the surviving material. Problems remained, however, including, not least, the exact location of excavation areas.

From the surviving documentation Cartwright was able to recreate an outline of the sites. Broadfield sites 1, 3 and 4 were located on the south side of the brook and excavations there revealed the remains of structures, together with the remains of cylindrical shaft furnaces and ore roasting areas.

Site 2 was located to the north of the Broadfield Brook, and it was likely that some of the excavated areas (1, 2, 8 and 9 and some unlabelled slag dumps) would be in the area covered by the current project. Seven radiocarbon dates from the furnaces on Site 2 had shown that occupation began in the Late Iron Age, possibly earlier, and continued to the 2nd century AD (Gibson-Hill 1976; Gibson-Hill and Cartwright 1992). A slag dump covered an area of 31m by 32m and beneath it was recorded

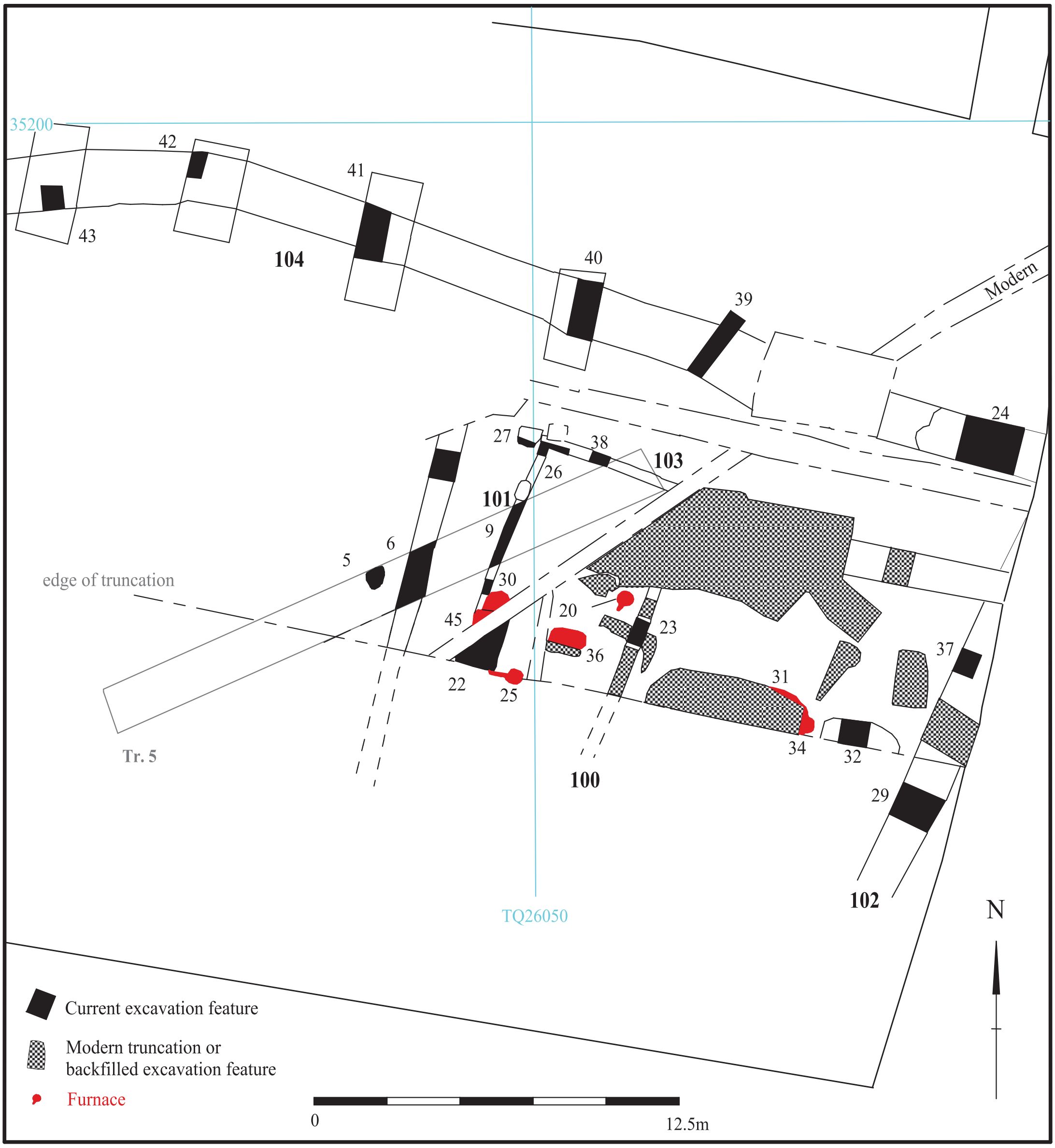

Fig. 3. Plan of all excavated features.

an ore-roasting area, 12m across in a slight hollow, together with six shaft-type smelting furnaces. No detailed locations for these can now be established other than 'below the slag dump'. Areas 1, 2, 8 and 9 were also excavated (probably) to the east of the slag dump (Fig. 2) and showed phases of occupation from the Iron Age through to the mid Roman period. Area 1 first comprised smelting furnaces, later a post-built building of 15.25m x 7.92m. It was then reoccupied with more furnaces. Area 9 contained a V-shaped ditch, aligned north–south, considered to be the edge of an enclosure, and a rectangular building of 15m x 7m. Smelting furnaces were constructed once the building had been abandoned, together with puddling pits and clay extraction pits. Area 8 exposed a large rectangular area 27m x 21m comprising slag and fragments of furnace considered to be hard standing for vehicles (Gibson-Hill 1976; Gibson-Hill and Cartwright 1992).

EVALUATION

A field evaluation was undertaken on the site to try to determine the location of the previous excavations at Broadfield Site 2 (Oram and Pine 2005), and to establish whether further deposits lay outside the areas previously investigated, in particular the linear features believed to extend beyond the excavated areas.

Five 20m trenches were excavated, all 1.6m wide (Fig. 2). They did indeed pinpoint the location of some of the excavation areas within Site 2. Trench 2 contained a modern tree bole (1). In Trench 3 was a gully (2) which contained three Late Iron Age/Roman pottery sherds but no modern debris, which suggests that it had not been excavated during the earlier fieldwork. Trench 5 was positioned to examine the area between, where, it was thought, excavated areas 8 and 9 were located. It contained a ditch, possible gullies and a pit (Fig. 3). This latter feature (5) contained over 5kg of slag including fragments of probable hearth lining and no modern debris, which suggested that it had not been previously examined. However, ditch 6 and gully 9 contained modern debris in their fills so they may have been excavated previously.

EXCAVATION RESULTS

Based on the evaluation results, an excavation area measuring *c*. 0.38ha was opened. Tarmac, topsoil and overburden were removed by machine under constant archaeological supervision (Fig. 2). The excavations revealed that the north-eastern part of the site had not been badly truncated by the construction of the former pavilion and archaeological deposits survived, whilst to the south and west the clay had been quite deeply truncated for construction of the car park. From the analysis of these excavations in relation to the plans of the previous fieldwork, it has been possible to pinpoint the location of one of Gibson-Hill's excavation areas within Site 2. Features recorded in his Area 9 (including furnaces) correspond with those recorded in the present excavation (Figs 2 and 3).

The majority of features had been previously excavated by Gibson-Hill. However, a ditch (104) had not been examined before, possibly because it lay just beyond the edge of Area 8, or perhaps the position of Area 8 relative to Area 9 had been plotted incorrectly, with Area 8 in fact slightly to the north. Stretches of the linear features (100, 101, 102 and 103) examined by Gibson-Hill had not been disturbed, so they were further explored. Seven smelting furnaces (20, 25, 30, 31, 34, 36 and 45) were located in Area 9, all of which had been previously recorded. Unfortunately, in the far south and west of the site (which corresponds to Site 2, Area 1), the truncation for the car park had completely removed any deposits that might once have been present (Fig. 2).

FURNACES (Fig. 4)
Slag tapping furnaces of two types were in use in England during the prehistoric and Roman periods. The earlier type, advanced bowl-shaped or domed, was in use from the 1st century BC and probably continued after the Roman conquest of AD43. Shaft furnaces were a later introduction of the full Roman period. Because previous excavation left only limited remains uncovered, it is impossible to discern the type of furnace in use on this site, but analysis of the smelting residue indicates that both types were in use.

Furnace 25 (excavated as Gibson–Hill's *furnace no.15*), had been further truncated to the south by the cut for the creation of the car park. The remains comprised a fire-reddened shallow scoop, 0.90 by 0.60m and 0.08m deep. It had a possible tapping groove to the east.

Furnaces 30 and 45 also appear to have been excavated by Gibson-Hill as *furnace no. 13*. Furnace 30 had been badly truncated by a modern service and a posthole. It comprised a scorched semi-circular bowl, 0.40m in projected diameter, lined with deposit 99, compact black fired clay. This was overlain by a light blue grey compact sand (98), all three colours indicative of a thermal gradient and high temperatures within the furnace. Slag debris 92 filled the remaining chamber. This furnace had been truncated by another (45), which had also been disturbed by the service and the previous archaeological excavations which had removed the southern portion. It comprised a fire-reddened semi-circle with thermal gradient deposits similar to those of 30 (172, 97). Metal-working debris was recovered from deposit 93, a disuse fill.

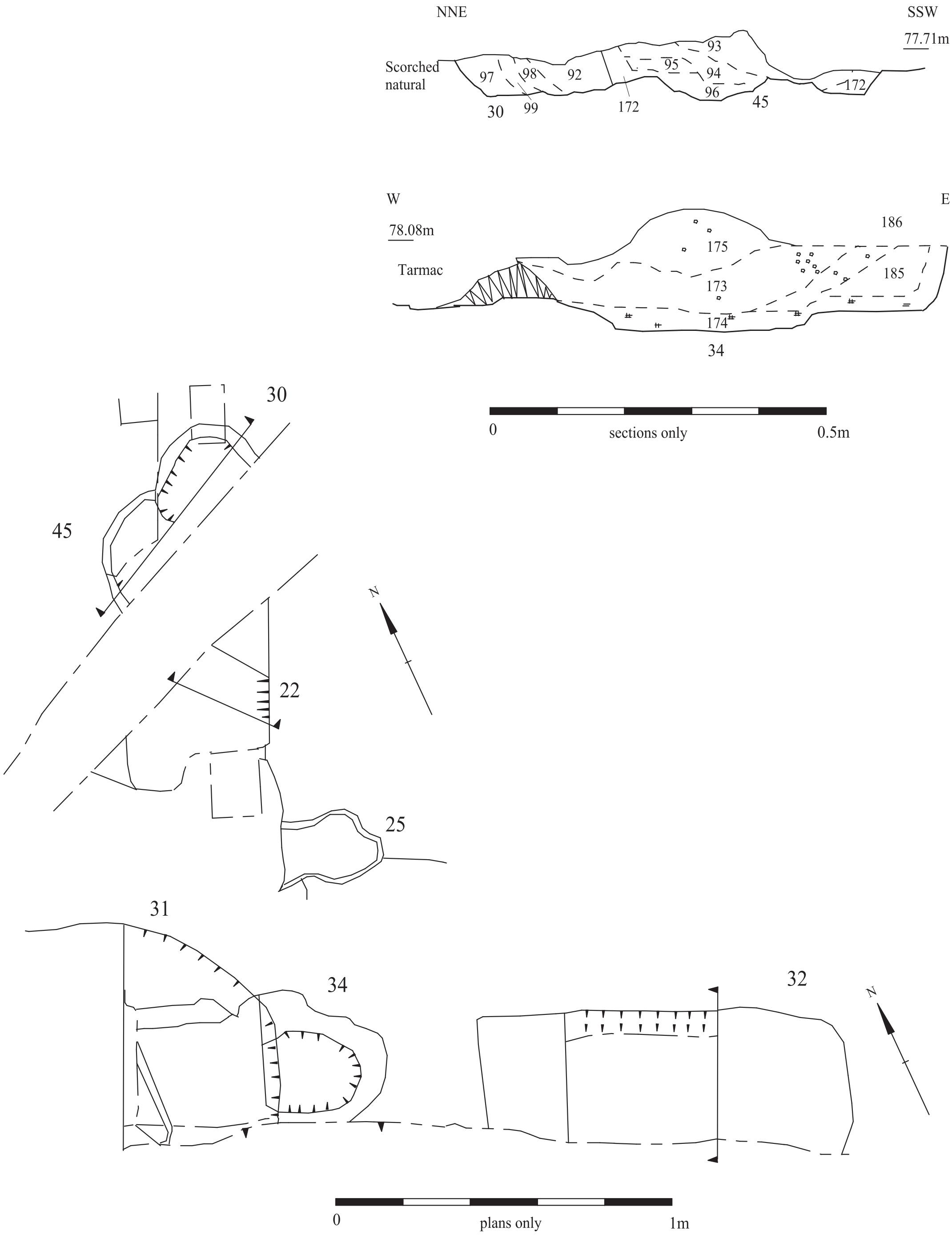

Fig. 4. Plans and sections of re-excavated furnaces.

The remains of a smelting furnace (34), previously partly excavated as *furnace no.14,* had been badly truncated to the west by furnace 31 (*furnace no. 7*). From the remaining elements it was possible to record its construction and composition. An initial scorched construction cut (34) was sealed by a yellow brown clay (174). A sandy clay deposit (185) was then laid down, the upper surface of which had been scorched. A burnt clay deposit (186) overlay this. A blue grey clay deposit (173) was then laid down; it is difficult to discern whether this is a modern deposit or upcast from earlier excavations. A fire-reddened clay (175) then sealed it.

Furnace 34 had been truncated to the west by feature 31, a large fire-reddened pit, also previously examined. Parts of the modern backfill were excavated to show a feature heavily burnt at its sides and base with a ridge-like shape within it. Gibson-Hill recorded this as the remains of an ore-roasting pit, which later had a large shaft smelting *furnace no. 7* built within it, constructed in part with sandstone blocks. A radiocarbon date from *furnace no. 7* gave a date of AD70 (as originally published, M.A.S.C.A corrected) (Gibson-Hill and Cartwright 1992); this date has been recalibrated (*see* Table 3 below) to 39BC–AD242.

A shallow depression, 36, could also be the remains of a previously excavated furnace. It comprised a fire-reddened oval scoop filled with a light grey clay with charcoal fragments (184), but does not appear to have been recorded as such by Gibson-Hill. Furnace 20 had also been previously excavated, corresponding to a hearth planned in area 9 but not numbered in the published report. The surviving elements comprised a shallow fire-reddened ovoid scoop, 0.78m by 0.50m and only 0.14m deep. A shallow tapping groove extended from its southern side for 0.2m, also fire-reddened.

DITCHES

Ditch 104 appeared to be the only feature that had not been investigated before. It was aligned NW–SE for *c.* 28m then curved gently round to the south-west where, because of truncation, it was not observed but probably once continued. At its eastern end it was emphasised by the concentration of metalwork debris within it, especially in slot 24. However, this concentration of material extended for only *c.* 3m. The rest of the ditch was filled with a series of clay fills which, because of the scalpins laid down for the pavilion, were difficult to distinguish. The site was restripped in test strips across the projected line of the ditch to show its progress, and within these strips, slots (40–43) were excavated. The ditch showed a consistent U-shaped profile (Fig. 5). Charcoal from slot 24 has been radiocarbon dated to 191–51 cal. BC (KIA32152) (*see* Table 3). It is possible that the curve of this ditch to the west continued sufficiently to join up with Late Iron Age gully 2 seen in the evaluation, to the south (Fig. 2), but this can only be speculation.

Ditch 102 was aligned NNE–SSW for *c.* 10m and was previously recorded in area 9 by Gibson-Hill. He suggested it was the eastern perimeter to a settlement enclosure, supposedly 82m by 98m, which he assigned to a date 20 to 30 years after the Roman invasion. Although any possible junction lay outside the excavated area, this ditch seems likely to join with ditch 104 and may be contemporary with the latter. Two fresh sections through this ditch (29 and 37) showed it to be 1.40m wide with a steep U-shaped profile, and a series of clay fills (Fig. 5). Slot 29 (73) contained charcoal which was radiocarbon dated to cal. AD 984–1043 (KIA32153). Thus the suggestion that this ditch is Roman in date cannot be sustained, unless part(s) of the ditch were re-excavated in the late Saxon period, possibly to gain access to the slag which at one time ought to have been deposited within it. The section certainly does not rule out the possibility of a recut at this point. There is earlier evidence on Site 2 and from other iron production sites of recycling and reworking of earlier slag dumps in the medieval and post-medieval periods (Gibson-Hill 1976; Cleere and Crossley 1985).

Three other linear features, 100, 101 and 103, could represent a small enclosure, although the southern elements of the north–south gullies had been removed by truncation so the true form of this feature could not be discerned. They could be part of the smelting system, such as channels for tap run-off, or simply an enclosure to work within. It is also possible that they were beam slots for a building at least 8m by 5m, probably 10m long with a little lost southwards. If so, the likelihood is that it would not have been related to the iron production site at all, but indoor furnaces have been recovered at Woolaston (Fulford and Allen 1992) and Westhawk Farm (Paynter 2007), for example. Nothing was recovered to help date this feature and no stratigraphic relationships survived.

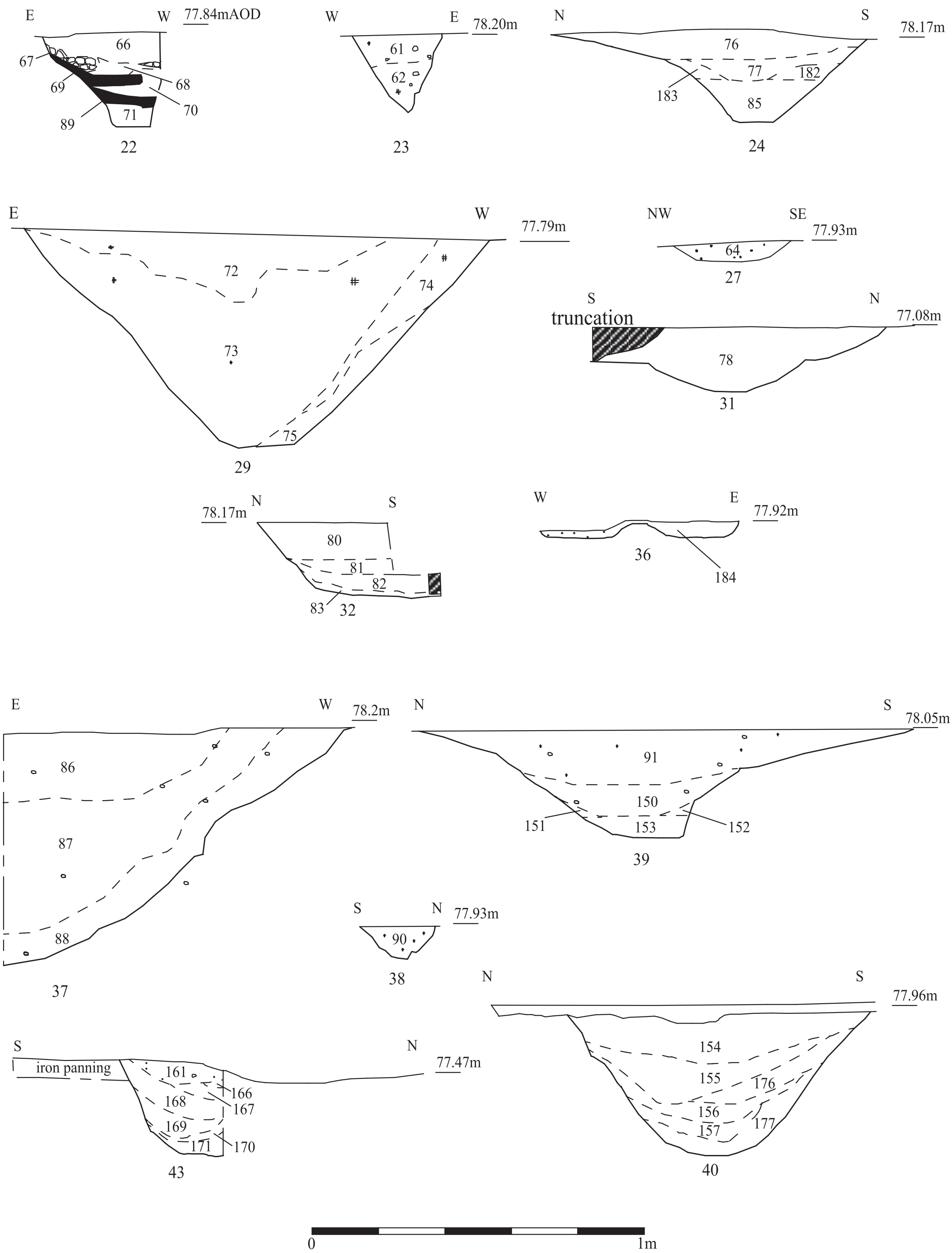

Fig. 5. Selected sections.

PITS

Two large pits (22 and 32) had both been excavated before. Pit 32 was completely lost to the south, but the elements that did survive showed a steep-sided, flat-based feature 0.43m deep, which contained alternate layers of fills of clay with occasional charcoal and slag debris, although the lowest fill contained a concentration of slag debris in a clay matrix. This pit could have been excavated originally to obtain clay for furnace construction and then backfilled with smelting by-products.

Feature 22 was unfortunately truncated by a modern service so its full dimensions and relationship to furnaces 30 and 45 could not be understood. It was steep-sided (near vertical) with a flat base and was 0.52m deep. It contained concentrations of slag debris, and sterile sand. A large feature filled with modern backfill in the eastern part of the site corresponds closely with an area of hard standing removed during the previous excavations. Several holes containing modern debris could be fully excavated postholes, which were thought to represent an early timber building on the site.

FINDS

POTTERY by Malcolm Lyne

The site yielded three sherds of pottery of probable Late Iron Age date from gully 2 (fill 53), with a very abraded post-medieval glazed red earthenware fragment and two Roman sherds from a modern tree bole (1).

Assemblage 1: From Gully 2 (53). A small non-diagnostic sherd of East Sussex Ware and two fragments in fabric IA.1. The fabric IA.1 sherds come from a simple lid and are in a handmade vesicular black fabric with profuse <0.50mm black ferrous inclusions and at least one leached-out fragment of thick fossil shell. This fabric appears to be a variant of Goffs Park Late Iron Age Fabric 2 (Hamilton 1992, 51) and suggests that the poorly dated non-diagnostic East Sussex Ware sherd from the same feature may also be Late Iron Age rather than Roman.

Assemblage 2: From tree bole 1 (52). The two Roman sherds comprise a closed form fragment in East Sussex Ware variant R2 and a piece from either a Dr 18 or Dr 15/17 platter in South Gaulish La Graufesenque samian. They suggest a mid- to late- 1st century AD date but were recovered from a late post-medieval feature.

METAL SMELTING RESIDUES by J. R. L. Allen

Approximately 122kg of material were examined using a hand-lens, knife, unglazed porcelain streak-plate and acid bottle. The following components were recognized in the assemblage, as summarized in Table 1.

Table 1. Summary by context of types of metal smelting residue. + = present.

Cut	Deposit	O	RO	T	B	RC	N	FL	C	CH	Total wt (g)
1	52	+	+	+		+	+	+			10,339
2	53	+		+			+				230
5	56		+	+				+			10,685
6	57			+				+			1097
23	61		+	+	+		+	+	+	+	1806
23	62							+	+		581
26	63			+			+				252
27	64		+	+							1091
28	65			+					+		1177
22	66			+			+				169
22	67		+	+	+	+	+		+		9971
22	69		+	+		+					471
22	71			+				+			743
29	73			+			+	+			2224
24	76			+		+	+	+	+		*c.*55,000
24	85			+	+		+	+			15,585
38	90			+		+	+				713
39	91	+		+			+				555
30	92					+	+		+		524
45	93						+				584
39	150							+			339
40	157		+	+			+	+			724
41	158	+		+							438
41	160			+	+		+		+		667
43	161							+			331
42	180			+	+		+				5000

Iron ore (O)

A very little raw iron ore in the form of discrete fragments was recovered, almost exclusively a few flakes of hard, grey clay-ironstone with evidence of oxidation along natural fracture surfaces. There were very occasional fragments of boxstone ore.

Calcined to incompletely smelted ore (RO)

A common component takes the form of small, moderately dense, potato-like lumps with smooth to slightly irregular surfaces and a rusty brown to almost black interior with irregular cavities which in shape tend to follow the exterior form. These are not a slag produced by smelting, and are best interpreted as lumps of ore either after calcining or partial reaction within a furnace.

Tap slag (T)

This is an abundant and distinctive component unquestionably indicative of iron-smelting in advanced types of primitive furnace. Tap slag from Crawley is black, hard, very dense to dense and slightly to moderately vesicular. Typically, and in addition to broken surfaces, the lumps display under surfaces moulded on earlier deposits of tap slag or the ground (sometimes trapping charcoal, slag fragments or soil), and upper surfaces with lava-like flow marks. Some of the fragments are of slag allowed to chill in thin (<80mm) sheets in wide pools. A few lumps mould narrow, shallow channels cut into the ground surface, possibly leading from a furnace to a slag pool. Many of the smaller pieces of tap slag have a finger-like form and probably represent threads of slag that broke away from the head of the main viscously flowing mass.

Slag basins (B)

This rare component takes the form of oval to irregular basin-shaped masses of dense slag of plano-convex to concavo-convex cross-section and weighing up to 3.64kg. The lower surfaces are smooth and without marks suggestive of the tools used to shape the hollow in which the slag chilled. The upper surfaces are irregular and in some cases trap fragments of charcoal, clay and ore.

Residual charge (RC)

This component makes up a significant proportion of the finds. The identification is applied to the larger lumps found to consist of a mixture of some or all of lumps of clay, partly smelted ore and fragments of charcoal, bonded together by vesicular slag. Patches of fuel-ash slag and drips of furnace lining are identifiable in some cases. Residual charge is incompletely smelted material.

Nondescript slag (N)

Much of the collection consists of fragments of slaggy material too small to be reliably assigned to other categories, but they are likely to have derived from some or all of tap slag, basins and residual charge.

Furnace lining (FL)

Furnace lining is uncommon and present in two main forms. On the one hand are purplish-black, clinker-like blebs of non-magnetic, vesicular, vitrified clay that dripped from the melting inner walls of a furnace on to the charge below. The larger pieces preserve the furnace wall. They reveal a gradation from grey to red unvitrified clay, sometimes with flow lines indicative of moulding during furnace construction, to variably thick, black, vesicular vitrified clay with a smooth to flow-marked surface that was in direct contact with the hot furnace gases.

Clay (C)

Not uncommon are small pieces of grey, orange or red clay, probably from the local geological deposits. They could either have been a deliberate part of the charge into a furnace or have fallen from the inner walls as they heated up and became cracked.

Charcoal (CH)

Occasional discrete fragments of charcoal are recorded (charcoal trapped in slag not included).

Discussion

Geologically, the site at Rathlin Road lies on the outcrop of the early Cretaceous Wealden Beds, a thick series of grey, fresh to brackish-water clays with thin sandstones and clay-ironstones in the form of continuous thin bands or horizons of nodules. Archaeologically, the site falls within the Wealden Iron-ore Field, where iron has been smelted from the Late Iron Age through to early modern times (Cleere and Crossley 1985).

The material examined was recovered largely from gullies, ditches and pits, where it had been dumped as rubbish. The only clearly undisturbed contexts are the Roman furnace 30 and ditch 104. Possibly partly undisturbed are pits 27 (64) and 22 (67 and 69), in which calcined to incompletely smelted ore (RO) was found amongst other debris, and which may have served as hollows in which to calcine ore.

The character of the material is fully consistent with the smelting of iron by the primitive or bloomery two-stage process (Tylecote 1962; 1976). The first stage is the production of a solid bloom of metallic iron contaminated with slag, obtained by smelting a suitable ore with charcoal in a furnace. By the Late Iron Age, advanced bowl furnaces were in use, from which liquid slag could be tapped, in addition to the older, simple bowl furnace ordinarily used only once. The Romans introduced the more efficient, tappable shaft furnace, the presence of which at Crawley is attested by the form of the furnace lining. The nature of the tap slag in most of the groups testifies to the use of both kinds of tappable furnace. The occurrence at Crawley of slag basins in some Late Iron Age and Roman contexts, and especially in pits 23 (61), 22 (67) and ditch 104, slots 24 (85) and 41 (160), suggests that simple bowl furnaces were occasionally employed. Slag in this form is conventionally interpreted as evidence of some kind of smithing, but there are substantial arguments against this (Allen 2006). No residues indicative of forging were present, suggesting that the blooms resulting from the first stage of the production process were traded on for purification at other sites.

An interesting feature of the assemblage is the frequent occurrence of lumps of clay, especially in what is described above as residual charge (RC). The chemical reaction involved in the primitive iron-making process is inefficient in the extent to which the iron present in the ore is brought to the metallic state. In effect, the ore is self-fluxing, a substantial proportion of the iron combining with sources of silica to form a dense silicate slag, worked as an ore when the early-modern blast furnace was introduced. The silica contributing to the slag can come from one or more of (1) the iron ore itself if of the lean kind, (2) the clay of the furnace lining or (3) lumps of clay deliberately added to the charge (Fulford and Allen 1992). Although the clay-ironstone used at Crawley is a lean ore, requiring calcining before it could be smelted, it would not have been inappropriate to have added some raw clay to the charge. Alternatively, the clay fell into the charge from the furnace walls.

ENVIRONMENTAL REMAINS by Lucy Cramp

Twenty bulk soil samples, of between 2.5 and 60 litres, were floated over a 0.2mm mesh and assessed using a binocular microscope at x10 magnification. No seeds or other plant remains were preserved, but a relative abundance of identifiable wood charcoal was present in 12 samples. This charcoal was identified at x45 to x200 magnification with reference to a modern reference collection at the University Museum of Natural History in Oxford and Vernet (2001). Where samples contained a high frequency of identifiable charcoal, 20 fragments were randomly selected from the smaller and larger fractions for identification. Results from these analyses are presented in Table 2.

Table 2. Charcoal. + present ++ some +++ much.

	Cut	**23**	**23**	**26**	**27**	**29**	**24**	**38**	**39**	**43**	**1**	**5**	**1**
	Deposit	**61**	**62**	**63**	**64**	**73**	**76**	**90**	**91**	**161**	**52**	**56**	**52**
	Sample	**1**	**2**	**3**	**4**	**8**	**10**	**11**	**12**	**17**	**18**	**20**	
	Sample vol. (l)	**60**	**30**	**10**	**20**	**15**	**40**	**25**	**20**	**10**	**30**	**5**	
Quercus sp.	oak	+++	++	+	+++	+++	+		+	+++	+++	+	++
Cf. *Quercus* sp.								++					
Alnus sp. or *Corylus* sp.	alder or hazel						+						
Pomoideae	hawthorn, apple etc.				+					++		+	

Table 3. Radiocarbon dating. All dates at 2-sigma (95.4%) calibrated using Bronk Ramsey 2010 with data from Reimer *et al.* 2009

Recalibration of original Broadfield dates

Furnace	**Lab no.**	**Uncorrected date bp**	**Published date**	**Calibrated date (OxCal 4.1)**
5	HAR971	2140±60	370–210 BC	372–42 BC
2	HAR970	2010±60	60–10 BC	174 BC–AD 90 (92.9%); AD 100–124 (2.5%)
16	HAR973	1920±60	AD 60	AD 43–232
8	HAR974	1920±60	AD 60	AD 43–232
Hearth	HAR075	1920±60	AD 60	AD 43–232
7	HAR559	1900±60	AD 70	39 BC–AD242
3	HAR972	1840±60	AD 130–140	AD 30–37 (0.5%) AD 52–336 (94.9%)

New dates

KIA32152, oak charcoal	Ditch 104 (slot 24, fill 76)		
Radiocarbon age	2101±25 BP	δ^{13}C(‰) –25.79±0.09	
Calibrated ages	147, 135, 114 cal BC		Probability
	2-sigma Range	191–50 cal BC	95.4%
KIA32153, oak charcoal	Ditch 102 (slot 29, fill 73)		
Radiocarbon age	1010±22 BP	δ^{13}C(‰) –27.76±0.13	
Calibrated age	cal AD 1020		
	2-sigma Range	cal AD 984–1043	94.4%
		cal AD 1107–1118	1.0%

Charcoal was identifiable from 11 flots and 1 of the hand-picked assemblages. The dominant species was oak (*Quercus* sp.) although some of the material identified as oak charcoal was missing its characteristic wide rays and so can only be tentatively identified as such. Oak heartwood was present in most samples. In addition to the use of oak for fuel, scrub species such as hawthorn/apple type (Pomoideae) and alder or hazel (*Alnus* or *Corylus* sp.) were present in smaller amounts. These were probably growing amongst oak woodland.

Radiocarbon dating

Two samples from the modern excavation were submitted to the University of Kiel for radiocarbon dating (Table 3): a sample of charcoal from ditch 104, slot 24 (fill 76) and charcoal from ditch 102, slot 29 (fill 73). Details of the methodology are in the archive. In short, both results are considered reliable. The opportunity has also been taken here to calibrate the original radiocarbon dates, which had been corrected for publication using MASCA correction factors. All the calibrations used OxCal 4.1.7 (Bronk Ramsey 2009; 2010) based on data in Reimer *et al*. 2009. All ranges given are at 2-sigma (95.4%) confidence. All the charcoal used is believed to have been oak, which may give rise to problems due to the long life of the trees, but was the only material available.

DISCUSSION

The current fieldwork at Rathlin Road has been successful in its aim of locating and re-examining parts of the earlier excavations by Gibson-Hill. The precise locations of these parts were unclear, due to the death of the principal archaeologist before he had the chance to archive the results and publish the details himself. By careful analysis and comparison of the results of this current fieldwork with that of Gibson-Hill, it is possible to state with some certainty that Area 9 of his Site 2 corresponds to the features identified in the current excavations. If Area 9 has thus been located, it is reasonable to expect that the other areas in Site 2 are correctly located in this part of Crawley because of their known relationship with Area 9.

The excavated features included iron smelting furnaces together with large quantities of smelting debris. A detailed analysis of this debris, not possible previously due to problems with the archive, indicates that the material is consistent with smelting of iron by the 'primitive' or bloomery two-stage process on the site. Analysis of the slags suggests use of three types of furnace: two kinds of tappable furnace (advanced bowl and shaft) and a non-tappable simple bowl form. The significance of this is that Gibson-Hill had suggested that all the furnaces in Area 9 were the shaft type (Gibson-Hill and Cartwright 1992), so this re-analysis supports Cleere's suggestion that both bowl and shaft furnaces were in use at Broadfield (Cleere and Crossley 1985).

Also of interest is the debate about the founding date of these smelting sites in the Weald. Some scholars have considered that a number would have pre-Roman foundation dates, and the site at Broadfield is clearly established as one of those. Radiocarbon dates from the 1975 excavations gave an Iron Age date for *furnace 5* of 370–210 BC (recalibrated here to 372 BC to 42 BC) and for *furnace 2* of 60–10 BC (recalibrated to 174 BC to AD 90). The new date of 191–51 cal. BC for charcoal in ditch 104 confirms the pre-Roman date for the smelting site, seeming to begin in the middle rather than the later Iron Age. The range of dates recovered may account for the range of slag types and the use of both simple and advanced furnaces. The re-use of the same location over a period spanning several centuries, and perhaps with gaps of centuries between episodes, which may at first glance appear somewhat surprising, can be paralleled in many other locations (Lewis *et al*. forthcoming). Indeed, it begins to appear that almost every site which has produced more than a couple of radiocarbon dates evinces similar longevity. The importance of extensive radiocarbon dating programmes is once again emphasised; iron production sites do not seem to generate enough waste of other materials for dating to depend on the usual artefactual evidence of pottery and coins.

The survival of a concentration of features in the north half of the site, even after construction and demolition of a modern building, bodes well for survival of other archaeological features in the areas around the current site. These areas appear to be topographically on the same level, or higher than the northern part of the site. Not only is there a good chance of being able to re-examine Gibson-Hill's other excavation areas on Site 2, with the discovery of ditch 104 which was not previously examined, but also there is demonstrated potential for further archaeological deposits and other furnaces which can be explored with the scientific techniques now available.

Finally, an unexpected result of the radiocarbon dating of ditch 102 was the demonstration of late Saxon activity on the site. It is not known whether this merely represents the coincidental presence of a boundary feature, but there is evidence from elsewhere on Site 2 and from other iron-producing sites of recycling and reworking of the slag dumps in the medieval and post-medieval periods (Gibson-Hill 1976; Cleere and Crossley 1985). Slag could also have been re-used as hardcore or for, say, post pads (Sarah Paynter, pers. comm.). This sort of scavenging may have led to the recutting of a slag-filled Roman ditch here in late Saxon times. The possibility of Saxon re-use of the area for further smelting (using techniques probably very similar to those of the Iron Age) also is not ruled out (Pine *et al*. 2010).

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