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FIELD NOTES

compiled by J. S. HODGKINSON

Two Romano-British bloomeries at Waldron, East Sussex

A bloomery has been discovered by members of the Field Group in Ralph Wood, Waldron (TQ 5468 1757). The site extends for about 30m, on both sides of the stream which runs down the west side of the wood. Slag can be found in the stream and in the ground for about 70m. About 30m to the north, beside the stream, an open-cast working may be a source of ore.

Two trenches, each 1m by 2m, were dug into the slag heap of the site. In one, dense black slag was encountered about 300mm below the surface, and appeared to extend to a depth of more than a metre. From this trench four sherds of Romano-British pottery were recovered. The other trench was filled with furnace debris, with burnt clay and slag-impregnated clay. This material lay about 100mm below the surface and also appeared to extend to a depth in excess of a metre.

Tap slag was found at the site, and it was noticed that a small amount of the slag recovered from the first trench showed evidence of having been melted at a higher temperature than that normally associated with the direct iron-making process, for it was highly vitrified and, in other circumstances, could have been mistaken for blast furnace slag.

Two other sherds of pottery, also dating from the Romano-British period, were recovered from the stream adjacent to the site.

A further concentration of bloomery slag has been discovered on the north slope of the valley of a small stream, also in Ralph Wood, at TQ 5475 1736. The site extended for about 20m along the valley and was about 10m wide. In the stream adjacent to the site two sherds, one of which was from a bellied cooking pot, probably dating from the 13th century, were recovered from the stream bed. The larger sherd included a section of rim and body, and included a decoration of pointed indentations in two parallel lines around the rim as well as a small raised rectangular stub on the upper curve of the body.

Two small trenches were dug into the slag heap of the second site. Each trench yielded a single sherd of sandy ware, probably of the 13th century, in the topsoil. However, in the more westerly trench six sherds of East Sussex ware, probably dating from the Romano-British period, were recovered from within the slag layer.

A bloomery at Nutfield, Surrey

A concentration of bloomery slag has been discovered at the edge of a field (TQ 3148 4774) on Burstow Park Farm. The site, which includes tap slag and furnace cinder, lies at a depth of about 200mm below the surface and extends for about 25m north-south, and about 10m east-west, although it may have originally extended further to the west before straightening of the road caused it to encroach on the field. Just to the north of the site a scatter of medieval pottery, of date no later than the mid-14th century, suggests a possible former habitation site.

We are grateful to Robin Tanner for discovering and drawing attention to this site.

A Romano-British bloomery at High Hurstwood, Buxted, East Sussex

Topsoil stripping in the north-east corner of a field (TQ 4912 2604) adjacent to 'Tilgate', High Hurstwood, has revealed a concentration of tap slag, furnace debris and roasted ore. A brief opportunity to investigate, assisted by further machine-stripping of the slag area, enabled several sherds of a bowl to be recovered from within the slag layer. These have been dated to the Romano-British period. The site covered an area about 10 metres square, with the slag and other debris, on average, about 150mm deep. Several large blocks of slag were recovered, some of which were evidently tap slag, although as much as 120mm thick, and a small number showed signs of having formed by slag dribbling down within a furnace. Also present were a small number of pieces of vitrified clay furnace lining which showed evidence of

having been formed by rolling into sausage-shaped pieces and coiled around a former; a similar example was found at Cow Park, Hartfield.[1]

We are particularly grateful to Graham Weller who discovered the site and very carefully stripped the surface to facilitate investigation.

A bloomery at Egerton, Kent

An extensive bloomery site has been found in an old orchard off Crump's Lane, near Egerton (TQ 855477). Slag, to a depth of 1m in places, is visible for about 60m along the east bank of a stream which forms the parish boundary, and probing has indicated that it extends as much as 30m from the stream, giving an overall area for the site of about 1400m^2. We are grateful to Mr R. de Ste. Croix, who found the site, for notification of it.

A bloomery at Pluckley, Kent

An extensive bloomery site has been found in Frith Wood, near Pluckley (TQ 900450). The site lies about 20m south of the main track through the wood, and extends over an area estimated by probing to be about 25m by 30m. Areas of charcoal and roasted ore staining have been revealed in the roots of two fallen trees. This site lies very close to the suggested route of the Roman road said to link the fort at Lympne (*Portus Lemanis*) with the road postulated between Hastings and Rochester.[2] Again we are grateful to the finder, Mr R. de Ste. Croix, for informing us of his discovery.

Two bloomeries in Forest Row, East Sussex

Two areas of bloomery slag have been found by members of the Field Group in a field on the edge of Sharpthorne. At the first, centred on TQ 3763 3264, east of Mare Pit Wood, pieces of fine-grained, black tap slag and plano-convex hearth bottom fragments were brought to the surface

by ploughing. Slag was detected over an area of about 80m^2. At the second site, centred on TQ 3780 3260, above the bank of a northward-flowing stream on the east side of the same field, lumps of slag were detected in a semi-circular area of about 40m^2.

A bloomery in West Hoathly, West Sussex

A small, but dense, concentration of bloomery slag has been found by members of the Field Group on recently-cleared ground immediately north of Mare Pit Wood, Sharpthorne. Some of the pieces of slag found showed evidence of high-temperature firing, with a black, vitreous appearance. The site lies approximately beside the route of a green lane, which recent clearance in advance of brick-clay extraction has obliterated. The site, which occupies an area of about 100m^2 lies about 20m east of the edge of the Sharpthorne brick pit and is threatened by continuing clay working. Mine pits sectioned in these brickworks have previously been studied, and radio-carbon dates obtained from wood found in the fill of two pits have been of the 12th and 13th centuries.[3] Mare Pit Wood (formerly Cinder Wood) and Cookhams Wood, which are contiguous, are extensively pitted with ore workings as well as each containing larger, open-cast workings which were probably for the extraction of marl. The pits sectioned during brick-earth digging were a continuation of these workings.

Medieval iron working at Mersham, Kent

Excavations by the Canterbury Archaeological Trust, in advance of the Channel Tunnel Rail Link, have revealed evidence of iron smelting with associated pottery from the 11th-13th centuries on land to the south of Mersham parish church and Court Lodge Farm (TR 052393). No furnaces have been found to date but the abundance of tap slag on the site suggests their proximity. The site lies on the Lower Greensand, so the source of ore is not immediately obvious. Lying considerably to the

east of the main iron-working area of the Weald in the early-medieval period, the site's position near to the church and to Court Lodge, a medieval holding of the Archbishop of Canterbury, suggests manorial organisation.

We are most grateful to Miss J. Mills, Clerk of Mersham and Sevington Parish Council, for information about the site.

Roman Road at Shortbridge, East Sussex

Brian Herbert

The exposure of a short length of the London-Lewes Roman road, by the draining of the former mill pond at Lower Morgan's Farm, Shortbridge (TQ 4514 2139), has enabled a section to be excavated. The pond was dug about 150 years ago, and the only portion of the road to survive in the pond was a length of about 3 metres on the north side of the pond, in line with a hollow leading across the field to the north, and coinciding with the line described by Margary.[4]

The section (Figure 1) lay some 2.4m below the ground surface on the north side of the pond, although it is likely that much of this depth can be accounted for by the deposition of spoil during the digging of the pond. The upper surface of the road showed considerable signs of wear, especially on its western side, and there appeared to have been two distinct slag layers in its construction. The thinner, lower layer, predominantly on the west side of the section, appeared to have predated the upper layer, a lens of silt having formed between the layers where they overlapped. Whether the two layers represent separate stages of construction, or a substantial repair at a later date, is not clear. On the east side of the section it was apparent that the slag had been laid in layers about 40mm thick, and rammed. Each layer was separated from the one below by a thin lens of silt, and the slag had disintegrated through being rammed. On either side of the road orange staining was probably due to iron oxides from the slag. Sandstone and significant quantities of angular flints were present, the latter possibly derived from

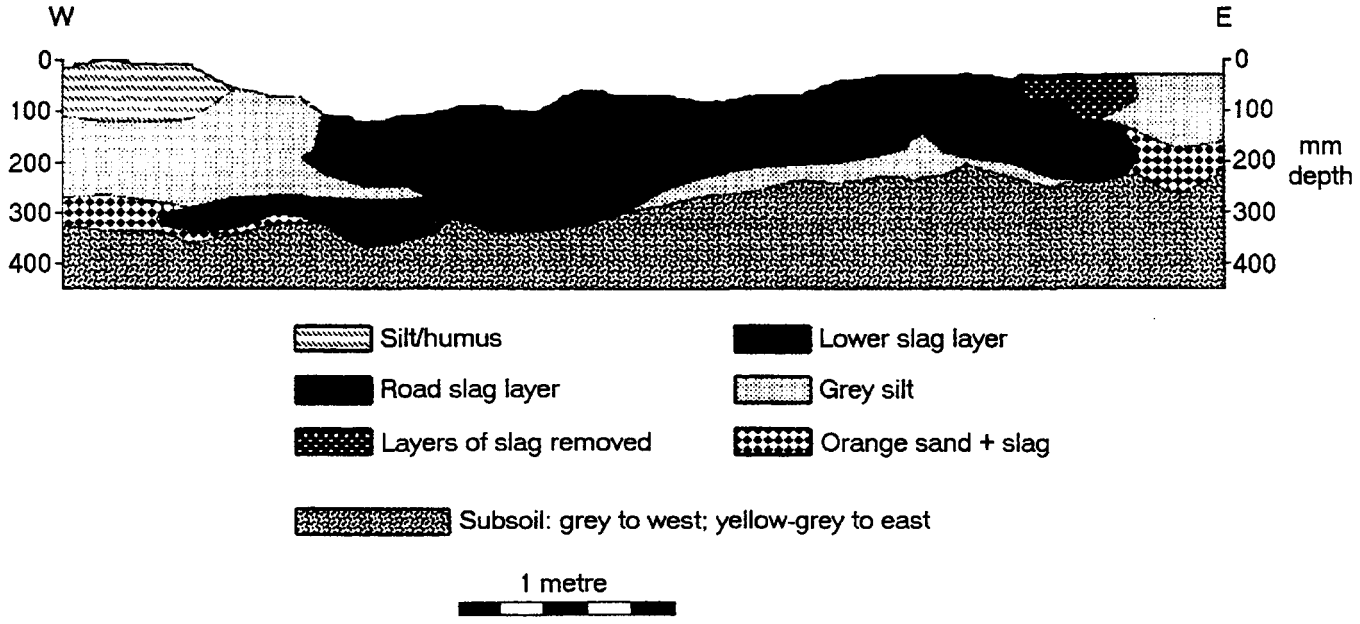

Figure 1 Section of the Roman road at Shortbridge, Sussex

beds at Piltdown nearby, mixed with the slag in the centre of the section. The slag was laid directly on the subsoil of Tunbridge Wells Sand.

It is worth noting that the area of slag represented by the excavated section was approximately $0.7m^{2,}$ which amounts to about $700m^3$ of slag over 1 kilometre; equivalent to the volume of slag from a modest bloomery site.

The excavators, Brian and Valerie Herbert, acknowledge the assistance of Mr D. Chivers, of Shortbridge Mill, and of Mr and Mrs Dennis Beeney and Mr Reg Houghton.

A bloomery furnace at Forest Row, East Sussex

Brian Herbert

No further forays have been made to Forest Row in search of the Domesday *ferraria*. However, during the summer of 1999, a much-damaged bloomery furnace was discovered by Mr Billings, of Forest Row, while a new farm reservoir was being excavated in a valley already searched by the Field Group. The furnace was discovered at a depth of about 1m at TQ 4298 3559, well below the detection level of our existing metal detector, when the scraping machine was deepening the valley for the pond. Very little remained apart from some broken furnace structure, charcoal and charcoal fines at the base; all in an area of less than 1m diameter. Very little slag was found in the area; this may be due to the downwash, which had caused the furnace to be buried. A sample of charcoal has been submitted for radiocarbon dating.

Three bloomeries at Blackham, Withyham, East Sussex

Brian Herbert

Two visits have taken place in Blackham, Sussex; one foray and one dig. This was in response to a request for information concerning the history of this village for a book that is being written.

A total of three new bloomery furnace sites were found along with some suitably situated pits from which ore may have been dug. Slag had

already been found by the owner, Mr Skinner, at TQ 4880 4015, this was measured to be a semi-circle with an area of about 225m^2. Associated pits were found at TQ 4913 4012, TQ 4871 4006, TQ 4871 4000 and TQ 4887 4001, and a dip in the field at TQ 4872 4014 where one had been filled in. Another bloomery site was found at TQ 4845 3957, beside a small stream, a semi-circle with an area of about 40m^2 with associated mine pits in the surrounding woodland. A further magnetic anomaly was also discovered 50m upstream of the west bank. A low-lying area in the field to the east was rather too high in the Wadhurst Clay to be a mine pit and might be the remains of a hollow way. The final site, beside the same stream at TQ 4853 3983, covered a semi-circular area of about 100m^2.

This latter site was excavated on the next foray where one piece of medieval pottery was discovered. Unfortunately the pottery was not found in a sealed layer, but in the plough soil. No solid layer of slag was found nor any furnace structures, making the site undatable.

Cinderfield, Ightham, Kent

Nicola R. Bannister

Cinderfield (TQ 5795 5305) lies south-west of Ightham Mote, at the junction of the Lower Greensand with the Weald Clay, on farmland belonging to the National Trust. A detailed archaeological and historic landscape survey was undertaken of the Ightham Mote Estate on behalf of the Kent and East Sussex Region of the National Trust, and the site was identified during the archive researches. Ernest Straker recorded the site as a bloomery of very early type. He described it as being very restricted and confined to a radius of a few yards above a spring with sparse cinder but quite typical.[5] The 1839 Tithe Map of Ightham records Cinderfield Shaw (wood, 1a. 3r. 27p.) on the north side of Cinderfield (hops, 3a. 1r. 10p.) with a Shaw (wood, 1a. 0r. 17p.) to the south and Great Cinderfield (arable, 5a.) to the west.[6] However, the name can be traced back to the 16th century. A deed dated 1552 records Thomas Fenys of Cockfelde and his wife granting to Nicholas Fitzherbert of Wrotham land at Ightham including two parcels of land called Synderfeld (11a.) and Parness Mead and woodland in Shipbourne (2a.).[7]

By 1889, what had been Cinderfield Shaw was then called Cinderfield Wood, and the Shaw renamed Cinderfield Shaw. The latter was grubbed out after 1972, whilst the narrow shaw between Cinderfield and Great Cinder Mead was removed after 1839 and before 1876. Today, the large field is under arable. The antiquity of the field name suggests that any iron working may be of Roman or medieval origin rather than later. Post-medieval field names relating to the iron industry tend to describe features or processes such as Furnace Field or Hammer Field.

During the archaeological survey the author recovered several small pieces of worn and rounded iron slag and one piece of vitrified stone from this field. The stone measured 84mm x 65mm x 29mm and was very flat on one surface with a green, glassy glaze all over it. This indicates that it had been through very intense heat, such as in a furnace. During a site visit by members of WIRG, further pieces of slag were recovered from a wide scatter across the field. However, nothing further was recovered from the locality of the vitrified stone.

Some small pieces of medieval roof tile were seen in the field as well as broken bricks. The latter came from demolished hoppers' huts.

A metal detector was used on several transects of the field but no readings were recorded that one might expect from the site of a bloomery furnace or concentration of slag. Cinderfield Wood, which was also walked through, marks the sharp change in slope between two fields, and at the eastern end is a large stone quarry. The site of the spring identified by Straker was probably in Greyberry Wood, on the eastern edge of Cinder Field. There is a wet ditch which runs due south from a boggy area within the wood.

Investigations were then concentrated in the fields on the east side of Mote Road, south-east of the lower pond. Traversing this field in a south-west to north-east direction, towards East Mote Oast, is the reputed line of a possible Roman or pre-Roman road, identified by Margary and also by Witney.[8] Part of its course, which was found by the previous farmer, Mr John Goodwin, when laying water pipes, is said to be between 0.3m and 0.9m below the ground surface and paved with stone. Use of a metal detector produced no evidence to support the use of slag along the line of this track, but did identify two largish pieces of iron

slag and a piece of iron ore at the edge of the field by Mote Road (TQ 5847 5325).

In conclusion, the evidence continues to suggest that iron was being produced in the vicinity of Ightham Mote, but the exact site has yet to be discovered. It is possible that the site lay within Cinderfield, towards the ditch, but that it has become buried beneath centuries of soil creep resulting from the cultivation of the fields. This is supported by the small, rounded nature of much of the slag, as if it had been subject to considerable movement either in water or in the top soil of a much-cultivated field.

Notes and References

1. C. F. Tebbutt, The excavation of three Roman bloomery furnaces at Hartfield, Sussex, *Sussex Archaeological Collections*, **117** (1979), plate 4, facing p. 55.
2. I. D. Margary, *Roman Ways in the Weald* (1965), 235.
3. B. Worssam & G. Swift, 'Minepits at West Hoathly brickworks, Sharpthorne, Sussex', *Wealden Iron*, 2nd ser., 7 (1987), 3-15.
4. Margary, 147-8.
5. E. Straker, *Archaeologia Cantiana*, **46** (1934), 207.
6. Centre for Kentish Studies, Maidstone (hereafter CKS), IR 30/17/196.
7. CKS, 947 T2/10.
8. Margary, 264-5; K. P. Witney, *The Jutish Forest* (1976), 190.

AN UNUSUAL TYPE OF SLAG AT HEATHFIELD

B. C. WORSSAM

At the Romano-British Tilsmore Wood, Heathfield, bloomery site (TQ 5763 2174),[1] visited in January 1999, some slag fragments attracted attention by reason of their brassy-yellow metallic lustre, rather like that of freshly-broken pyrite (iron sulphide), except that pyrite surfaces would be expected to tarnish rapidly once exposed to the air. A typical slab of this metallic-looking slag is 4cm thick, with one surface smooth and irregularly corrugated, as of the top of a congealed flow, and a vesicular presumed basal layer up to 1cm thick, while the body of the slab shows striations steeply inclined or at right angles to the presumed top surface, and is apparently composed of closely set very thin (0.1 to 0.2mm) crystalline laminae, some of them intergrowing. Some narrow (1mm diameter) tubular passages parallel to the striations suggest the escape of gas from the vesicular layer vertically upwards to the surface. A rough determination gave the specific gravity of a 20-gram fragment as 4.0.

A sample was sent to Mr J. E. T. (Trader) Horne, of Kemsing, a former colleague, who was at one time Head of the Mineralogy Department at the Geological Survey, requesting identification. He in turn sent it on to the British Geological Survey at Keyworth, Nottingham, and received a report dated 9th February 1999 from Dr V. L. Hards of the BGS Mineralogy and Petrology Group. Dr Hards had analysed the sample by X-ray diffraction (XRD) analysis and found it composed predominantly of fayalite (Fe_2SiO_4), with trace amounts of quartz and magnetite.

The slag has therefore the composition that would be expected of the bloomery process, in which the ore (say siderite, $FeCO_3$) sacrifices part of its iron by combination with impurities (eg silica, SiO_2) to form an iron silicate slag, fluid at temperatures obtainable by hand-operated bellows. Fayalite, which has a melting point of 1205°C, is a rare mineral in nature. Curiously enough in the present context it is named after Fayal Island in the Azores, where it was believed to occur in a local volcanic rock, but more probably was obtained from slag brought to the island as

ships' ballast.[2] In igneous rocks, fayalite is an end-member of an isomorphous series from iron silicate (Fe_2SiO_4) to magnesium silicate or forsterite (Mg_2SiO_4). The SG of fayalite is given as 4.4, of forsterite 3.2. Intermediate members of this series, with the composition $(Mg.Fe)_2SiO_4$, are common, under the name of olivine (or peridot if of gem quality, transparent and pale green to bottle green).

As to why this particular slag from Tilsmore Wood should be conspicuously crystalline, as opposed to being in a more common amorphous (or at least microcrystalline) state, vesicular throughout, one can only suppose that it happened to cool unusually slowly, allowing crystals to grow gradually.

Notes and References

1. *Wealden Iron*, **6** (1973), 22; ibid., 2nd ser., **19** (1999), 2.
2. C. E. Tilley, 'Olivines', in *The New Encyclopaedia Britannica, Macropaedia*, **13**, (1979), 560-4.

TWO BLOOMERIES NEAR BLETCHINGLEY, SURREY

B. C. WORSSAM & B. K. HERBERT

Introduction

Straker recorded that a bloomery on the Weald Clay outcrop at South Park, Bletchingley, Surrey, had been shown to him by the landowner, Mr Uvedale Lambert.[1] Mr Lambert had written a two-volume history of Bletchingley,[2] which includes reference to Sir Thomas Cawarden, a 16th-century owner of the estate, who in 1548-49 was head of a commission of enquiry into iron furnaces and fuel in the Weald.[3] Straker wrote of the bloomery: 'It is the most northerly bloomery yet found, being very near the rise of the greensand hills. There is a deposit of *Paludina* limestone within a short distance, which may have provided the flux. A considerable amount of ancient cinder is spread over the field, and large lumps have been thrown up on the hedges. There are some marlpits which probably yielded the ore'. He gave its location in terms of latitude and longitude, which work out as grid reference TQ 3306 4820. The area was visited by members of WIRG firstly on February 13th 1999, when a reconnaissance was made and two separate bloomery sites discovered, and secondly on February 12th 2000 in order to carry out trial excavation of Straker's site, these visits being made by kind permission of Mr and Mrs Wetter of South Park Farm and of Mr Michael Lambert of Cucksey's Farm.

Evidence for iron-working

The Geological Survey map (Reigate Sheet 286) shows that the South Park Farm buildings (at TQ 3418 4883) are on the outcrop of a Weald Clay sandstone bed, which gives rise to an east-west ridge of high ground. About 100m south of the farm, a track passes over the Bletchingley railway tunnel, built in 1844 on the Redhill to Tonbridge line. Mounds of spoil, apparently consisting of material brought up air shafts and then simply dumped around them and left to become tree-grown, mark the course of the tunnel. In the 1999 visit the farm track

was followed southwards downhill as far as a small west-flowing stream, tributary to the River Mole. The track crosses the stream (at TQ 3400 4795) by a small bridge of reinforced concrete beams; in the stream bed are blocks of glauconitic sandstone from the Hythe Formation (Lower Greensand), presumably debris from a former bridge. The stream banks here are about 1.5m high, mostly overgrown, in grey Weald Clay with some very thin (1 to 2cm) lenticular pieces of clay-ironstone, some showing a grey unweathered core with a granular texture, suggesting that the ironstone is sphaerosideritic. The occurrence is of interest in providing a glimpse of the Weald Clay facies at that point, though these thin layers of poor-quality ironstone would have had no potential as an iron ore.

Of much more interest from an iron industry point of view is the field lying north of the stream and to the east of the farm track. A map giving field names from an estate survey of 1761 as well as those recorded on the Tithe Map of 1841 shows that in 1761 this particular field was known as Yew Tree Field, in 1841 as Sixteen Acres (see Fig. 1).[4] A ridge extending into the field from the east has the characteristic profile of a Weald Clay minor escarpment, with a steep south-facing slope and a gentler north-facing reverse- or dip-slope. The field had recently been ploughed, and a traverse northwards up its eastern edge showed a clay soil, practically stoneless except at the ridge crest, where for a distance of 5m or so it included numerous 1cm-cube fragments of brown, limonitic weathered clay ironstone. The ridge is, therefore, presumed to be formed along the outcrop of a hard, erosion-resistant bed of ironstone, its thickness unknown but possibly about 20cm. The ridge could be seen to extend eastwards across the adjacent field for a distance of at least 500m. To the west, however, it dies out within Sixteen Acres. No slag fragments or indications of working for ironstone were noted north of the ridge, but a few small round hollows that may mark filled-in minepits occur in the southernmost part (TQ 3410 4840) of the wood on the rising ground to the north.

West of Sixteen Acres the ironstone outcrop, displaced about 100m northwards, forms a distinct shelf-like feature extending westwards to a

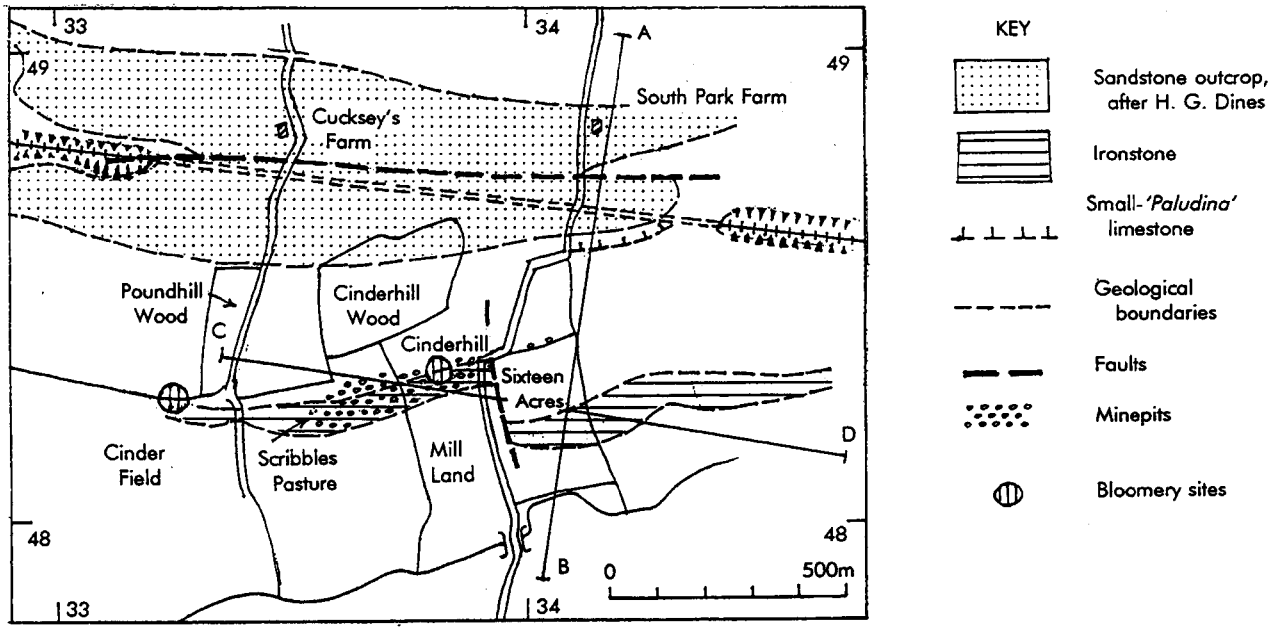

Figure 1 Sketch map of an area around South Park Farm and Cucksey's Farm, Bletchingley. The numbers indicate grid lines in 100km square TQ.

lane leading south from Cucksey's Farm, beyond which it dies out. The northward displacement is presumed to be caused by a dip-fault with downthrow to the east, as shown in Fig 1. Cross-section CD in Fig. 2 suggests that the amount of throw of the fault is about 15m. Just west of the fault line are indications of a hitherto unrecorded bloomery furnace site at TQ 3385 4830, centred on an east-west hedgerow forming the southern boundary of a field known as Cinderhill. Much slag, mostly vesicular, with only the occasional piece of tap slag, occurs both in this field and to the south of the hedgerow, in a field known as Mill Land. Probing showed slag to at least 0.3m depth. The site has an estimated diameter of 30m. The ploughed surface of Mill Land showed, along the crest of the ridge-feature, 1cm-cube fragments of brown-weathered clay-ironstone like those along the crest in Sixteen Acres.

The field surface just north of the hedgerow showed some unevenness, suggestive of filled-in minepits. The name of Cinderhill Wood, on rising ground north of the field, might sound promising, but no effort was made to search for bloomery sites there, since woods on the farm were being used for pheasant rearing. Minepits would not be expected in the wood, owing to depth of ore.

Evidence of mining was definitely seen in a grass field lying across the ridge to the west of the bloomery site. There, at the crest and on the gentle northerly dip-slope of the ridge, were a number of particularly wet, slight saucer-shaped hollows (the soil in February, after a wet winter, tending to be waterlogged) apparently connected by irregular channels running northwards. The channels, which are very shallow, seemed to have been dug in an effort to drain a slope where the compacting fill of minepits had created hollows at the surface, in which water tended to collect. The part of this field that lies along and to the north of the ridge was known as The Scrubbles in 1761 and as Scribbles Pasture in 1841. Both are names that give the impression of a rather rough pasture. Lambert said that the name, 'The Scrubs', was still used, but thought the meaning doubtful.[5] He suggested that it might derive from 'to scribble down', a Hampshire expression meaning to tread down as of a cow, or from a similar word meaning to card or tease wool, for

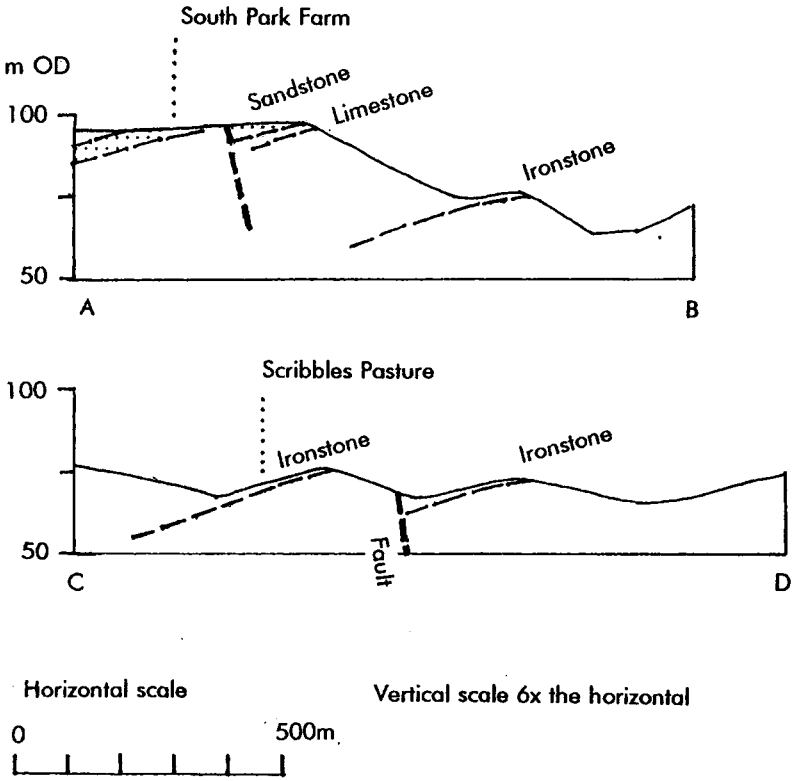

Figure 2 Geological cross-section along the lines AB and CD in Fig. 1.

teasels tended to grow in poorly drained soil. A pond dug into the dip-slope at TQ 3351 4823 may have been one of the marl-pits noted by Straker; its position is such that it is likely to have produced ironstone as well as 'marl'.

West of the north-south lane from Cucksey's Farm lies Cinder Field (in 1761 known as Cendles). As mentioned above, the ridge, and presumably the ironstone bed, here dies out, but at the highest point of the field, on its northern boundary, the slag detector worked well at map reference TQ 3325 4825. This site is assumed to be Straker's, and to be the place which Lambert had in mind in reporting that in Cinder Field pieces of slag were turned up plentifully by the plough.[6] In the visit of February 2000 two trial trenches were dug in search of pottery, unfortunately without success. One of them, close to the northern boundary of Cinder Field, contained very little slag apart from that scattered from a ditch, which had probably been filled with slag. The ditch sloped down in a roughly south-east direction, no doubt from the indistinct east-west ditch along the northern boundary of the field.

Cinder Field was formerly bounded to the north by Poundhill Wood, now mostly cleared except for a rectangular tract adjoining the lane from Cucksey's Farm, as shown in Fig. 1. The main area of slag was found to run along the southern boundary of the former wood, where there is a dense concentration of slag for 50m east-west by some 5 to 10m wide. The second trench was dug through a 99% bed of slag to a depth of 300mm at this location. The metal detector found other magnetic anomalies in the old Poundhill Wood; these may have been charcoal-making areas.

Estimate of production

The belt of minepitted ground (Fig. 1) extends for some 400m east-west, with a down-dip width of about 50m, giving a total mined area of 20,000sq. m. Assuming that only a single ironstone bed 10cm thick was worked, and that half of it was left underground by the method of minepitting, this would still give a volume of 1000m^3 of ore. With a

specific gravity of 3.0, $1m^3$ of ore would have a weight of 3000 kg, or 3 tonnes, so that something of the order of 3000 tonnes of ore may have been produced.[7]

Additional observations

The outcrop of clay ironstone here described does not appear on the Geological Survey map (the published 1:50 000 map is based six-inch sheet Surrey 35 NW, surveyed by H. G. Dines in 1928-9). Further, Dines's map of the sandstone outcrop through South Park Farm, showing a strike fault close to the line of the railway tunnel, is not particularly convincing. Sandstone is undoubtedly there, since a sandstone bed 3 to 4m thick, with 3m of clay above it and 6m or so of blue shaly clay below, could be made out in the mostly overgrown cutting west of the railway tunnel mouth.[8] The cutting and tunnel were under observation during their construction by Simms, who stated that numerous faults and displacements 'occasioned much difficulty in the construction of the tunnel'.[9] At the western end of the tunnel the beds were folded into an anticline apparently with a north-south axis, the strata dipping in various directions from west by north to east, and at almost every angle from 5° to 60°. It is difficult to know what to make of the structure described by Simms, as a north-south anticline would not normally be expected in the Weald, while it is too far west of the line of the dip-fault deduced to displace the ironstone outcrop, for any connection with that to be likely.

Straker mentioned, as already quoted, a deposit of '*Paludina*' limestone within a short distance of the bloomery site. No evidence was found to support his suggestion that it might have been used as a flux. He must have been referring to the Large-'*Paludina*' limestone (or Bethersden Marble) which Lambert had recorded as being dug in 1904 and subsequent years in Tye Coppice, just to the north of South Park Farm.[10] Dines and Edmunds recorded in addition that this stone, in beds about 0.3m thick, was to be seen in a small excavation north-west of Cucksey's Farm, and their map shows a short outcrop of it to the north of (i.e. above) the sandstone.[11] Large-'*Paludina*' limestone is composed of shells of the large (hazelnut-sized) freshwater snail, *Viviparus fluviorum.*

The 1999 foray however indicated the existence of another bed, of the quite different Small-'*Paludina*' limestone, or Charlwood stone, south of South Park Farm and hence below the sandstone. The limestone, a pale grey stone crowded with remains of the small (pea-sized) elongate water-snail, *Viviparus infracretacicus*, and with scattered shells of the bivalve, *Filosina*, was seen as thin (1 to 2cm) weathered slabs in the soil in a ploughed-over hollow (shown on large-scale Ordnance Survey maps as a pond) at TQ 3422 4860, about 70m east of the farm track and just south of the line of the railway tunnel.[12] It is inferred that the pond was another of Straker's marl-pits, excavated for clay (useful for spreading on fields on the sandstone outcrop) but yielding slabs of limestone as a by-product. A limestone outcrop can be inferred to run along an escarpment crest for at least 100m eastward and westward, as shown in Fig. 1. Too much should not, perhaps, be read into a single occurrence of stone not certainly seen 'in situ', but if the occurrence should be confirmed it would be geologically significant, for Small-'*Paludina*' limestone has rarely been recorded at so high a level in the Weald Clay succession.

Summary

The following conclusions can be reached:
1. Straker's report of a bloomery was confirmed, with two furnace sites located: one at TQ 3325 4825, assumed to be his site; the other, at TQ 3385 4830, hitherto unrecorded. No evidence for dating was obtained.
2. One site is on, the other close to a previously unknown faulted outcrop of clay ironstone, which has been mapped over a distance of about 1km.
3. The ironstone was worked by minepits, which from a very rough estimate may have produced some 3000 tonnes of ore.
4. A previously unrecorded apparent outcrop of Small-'*Paludina*' limestone, at an unexpectedly high horizon in the Weald Clay, is of geological interest.

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10. Lambert (1921), 555.
11. Dines and Edmunds (1933), 39-40.
12. For a description of this species and of 'V. fluviorum' see A. A. Morter, Appendix 2: 'Weald Clay Mollusca' in B. C. Worssam, 'The stratigraphy of the Weald Clay', *Rep. Inst. Geol. Sci.*, No. 78/11 (1978)

A GAZETTEER OF MEDIEVAL IRON-MAKING SITES IN THE WEALD

J. S. HODGKINSON

In *The Iron Industry of the Weald*, Cleere and Crossley provided gazetteers of Roman sites and water-powered sites. Medieval sites were identified only in the checklist of bloomeries, and no other details were given. The list below provides a gazetteer of such sites in the same format.

ALFOLD

Great Wildwood

TQ 050354
Wealden Iron, 2nd ser., **11** (1991), 6

A concentration of tap slag with associated late-twelfth or early-thirteenth century pottery may be linked to the nearby Vachery moated site.

BRAMSHOTT

Wassals Field, Ludshott

SU 842345
Wealden Iron, 2nd ser., **6** (1986), 6

Parts of two hearth bottoms, together with tap slag, with associated late-twelfth or early-thirteenth century pottery have been found about 100m south of Ludshott Common.

BURSTOW

Ten Acre Wood, Outwood

TQ 320447
Wealden Iron, 2nd ser., **18** (1998), 2

A sherd of Saxo-Norman pottery was found on a burnt surface about 300m below the surface on a linear bank. Two other sherds of the same period were found in the leaf litter, in which lumps of bloomery slag were also scattered over an area of about $9m^2$.

BUXTED

Culver Wood

TQ 494231
Wealden Iron, **11** (1973), 21

A number of sherds of sixteenth century pottery was found among the slag on a terrace about 30m above a stream, where there were two concentrations of slag. This may have been a very late bloomery.

Spaulines, Etchingwood

TQ 501226
Wealden Iron, **8** (1975), 8-9

A small sherd of probable thirteenth century pottery was found in an extensive scatter of bloomery slag in a shaw and an adjoining field. The existence of a small bay about 40m upstream suggests the possible use of water power. There is a number of ore pits in the vicinity of this and the Tankards Croft site (below).

Tankards Croft

TQ 498225
SNQ, **17** (1970), 168

A small amount of mid-thirteenth century pottery was recovered from the filling of a pit, which also included tap slag and furnace lining. The pit had been severed by a stream.

CRAWLEY

Driftway

TQ 268370
Wealden Iron, 2nd ser., **8** (1988), 8-9
Sussex Arch. Colls., **127** (1989), 247

Pieces of bloomery slag, including part of the contents of a small furnace, were found in association with sherds of a probable fourteenth century jug, in the roots of a fallen tree. Nineteenth century maps show a small pond at the location, which may have had its origin in ore working.

High Street

TQ 267364

TQ 268365
TQ 268367
TQ 268368
VCH Sussex, **2** (1907), 242
Wealden Iron, 6 (1973), 14; 2nd ser., **10** (1990), 2; 2nd ser., **15** (1995), 2; 2nd ser., **16** (1996), 3
Sussex Arch Colls, **135** (1997), 193-208

At 15, High Street, a pit containing iron slag, both forging, tap slag and furnace cinder, and associated pottery dated to between 1430 and 1550, was found about 7-8m to the rear of where this property formerly stood (now the south side of Haslett Avenue). An absence of evidence of burning suggested working took place elsewhere. At 42, High Street, a furnace bottom and pieces of tap slag and forging slag were found at the rear of a building fronting the east side of the street. Pottery from the fourteenth to sixteenth centuries was found in the same debris. At 101, High Street. a small amount of bloomery slag, together with pieces of late-medieval pottery, were found at the rear of the Old Punch Bowl, an early-fifteenth century building. The dismantling of a timber-framed moot hall at 103, High Street, revealed bloomery slag in the flooring and foundations, dated by associated pottery to the early-fourteenth century.

Poll tax returns for 1379 record two men assessed as 'factor ferri', as well two smiths.

Ifield Road

TQ 265365
Wealden Iron, 2nd ser., **16** (1996), 2-3; 2nd ser., **17** (1997), 6
Sussex Arch. Colls., **136** (1998), 81-94

Bloomery tap and forging slags, together with pieces of thirteenth or fourteenth century pottery, were excavated from pits, gullies and post/stake holes in the rear gardens of 18-28, Ifield Road, some 200m west of the High Street. Also present was hammer scale. No hearths were found, although clearly these must lie nearby.

Spencers Road

TQ 265365
TQ 266365

Wealden Iron, 2nd ser., **9** (1989), 2; 2nd ser., **16** (1996), 3

At 15-17, Spencers Road, small areas of bloomery slag, containing both furnace cinder and tap slag, associated with sherds of medieval pottery were found, some possibly dating from the fourteenth century. At 6-8, Spencers Road, a pit containing ironworking slag and medieval pottery was found in the front garden of the property. Both sites lie about 150m west of the High Street.

London Road

TQ 268371
TQ 269371
Wealden Iron, 2nd ser., **18** (1998), 5

Excavations on the site of The Sun public house on the west side of London Road, Crawley, revealed extensive iron-working debris, including slag-filled pits and areas of burning. Two concentrated areas of burning were sampled for archæo-magnetic dating. One was the base of a hearth, some 2.8m by 1.4m, largely defined by an area of orange/red oxidised clay, but with evidence of grey, reduced clay at the northern end. This gave a date range of AD 1390-1410. The other area of burning gave a date range of AD 1370-1390, and was part of a number of burnt areas and small pits, one of which contained a quantity of hammerscale. The dates from both features are consistent with the limited finds of pottery on the site. Evaluation trenches dug on Kiln Mead, on the east side of the London Road, opposite the Sun site, produced a number of pits with bloomery slag in them, but no dating material.

Pit Croft

TQ 249403
Bull. Inst. Archaeol., **13** (1976), 263

An area of bloomery slag in a field is described as medieval.

EWHURST

Coneyhurst Gill Forge

TQ 083404
Cleere & Crossley (1985), 323

A pond bay with evidence of a wooden wheelpit, trough and revetment to the bay, together with bloomery slag, has suggested this site as a possible water-powered bloomery.

FOREST ROW

Brambletye Manor Farm

TQ 415350
TQ 416351
Wealden Iron, **6** (1973), 18

Fragments of thirteenth or fourteenth century pottery were found with concentrations of bloomery slag.

FRANT

Brookland Forge

TQ 618349
Straker (1931), 278-80
Cleere & Crossley (1995), 319, 384

Bloomery tap slag in a meadow downstream of the bay suggests possible use as a water-powered bloomery prior to long, well-documented occupation during the post-medieval period.

GOUDHURST

Chingley Forge

TQ 682335
Crossley (1975), 2, 7-17

Excavations at the site of the post-medieval forge revealed the remains of a timber-framed wheel-pit dated, from associated pottery, to 1300-50. Other debris suggested a use probably connected with iron forging, rather than corn milling or cloth fulling.

Payments of iron were due to the Abbot of Boxley, from Chingley manor, *temp.* Edward I, and there is clear evidence, from Ministers' Accounts, of the existence of an ironworks on the demesne of the manor between 1340-54.

HADLOW DOWN

Warren Farm

TQ 519225

HARTFIELD

Chandlers Farm

TQ 471387
SNQ, **17** (1970), 167-8

Sherds of a twelfth or early-thirteenth century vessel were recovered from where a bloomery slag heap had been cut through by a stream.

Millbrook

TQ 441296
Sussex Arch. Colls., **120** (1982), 19-36

Discovered during pipe laying across Ashdown Forest, this small, non-slag tapping furnace, dated archaeo-magnetically, and by radio-carbon, to the ninth century, together with contemporary pottery, is the only Wealden example of a smelting site from the Saxon period. The furnace type suggests continuity with traditions seen in those from the north European homelands of the Saxons, and is fundamentally different from the slag-tapping furnaces of the Romano-British period.

Newbridge Furnace

TQ 456325
Cleere & Crossley (1985), 346

Finds of bloomery-type slag may suggest use of this site prior to the establishment of the blast furnace in 1496.

Parrock

TQ 452341
Sussex Arch. Colls., **113** (1975), 148

A dense concentration of bloomery slag around the perimeter of two slight hollow areas in a field on the edge of a shaw. The hollows may have been ore workings. Sherds of fourteenth to sixteenth century pottery (Raeren ware) were recovered from the scatter of slag, ore and roasted ore along the north and west boundaries of the field.

HORLEY

Thunderfield Castle

TQ 300426
Surrey Arch. Colls., **45** (1937), 146-50

Pottery of the thirteenth to fifteenth centuries was found in conjunction with an ironworking hearth excavated in a moated site.

HORSHAM RURAL

Roffey

TQ 206335
Sussex Arch. Colls., **17** (1865), 117
VCH Sussex, **2** (1907), 242
Straker 1931, 442
Wealden Iron, 2nd ser., **3** (1983), 2-3

A large-scale site with slag scattered over an area of 18 hectares. An unpublished excavation by Horsham Museum Society in 1985, in the south-east corner of the site, produced a quantity of Graffham and Surrey white wares dating from the late-fourteenth and fifteenth centuries, with smaller amounts of Cheam White and Tudor Green wares extending the range into the early-sixteenth century. Also noted were the foundations of a small building and evidence suggestive of a hearth perhaps mounted on a stone plinth. A small number of pieces of forging slag found adjacent to a pond bay to the rear of Brook House may indicate water-powered forging.

1000 horseshoes were purchased by the Crown, and carried from 'la Rogheye' in 1327, and tipped arrows were made at Horsham eleven years later. In 1344 Thomas Chyew demised to Matilda Bonewyk a smithy with bellows, anvils and hammers etc. belonging, at the same location (Catalogue of Ancient Deeds 3 (HMSO 1900), 286).

Southwater Street

TQ 160274
Wealden Iron, 2nd ser., **15** (1995), 2

Tap slag and forging slag has been found in association with the site of a probable

fourteenth-century smallholding.

MAYFIELD

Wet Wood, Mousehall

TQ 602294
Wealden Iron, 2nd ser., **10** (1990), 3

Three small sherds of late-medieval pottery were recovered from within the slag heap.

Woolbridge Forge

TQ 571266
Wealden Iron, **11** (1977), 5

Quantities of tap slag and bloomery cinder have been found behind the bay and in the stream, suggesting that this may be a water-powered bloomery site. No post-medieval slag has been noted.

PETT

Pannel Farm

TQ 888149

PETT/FAIRLIGHT

Cliff End

TQ 887128

ROTHERFIELD

Hodges Wood

TQ 527324
Wealden Iron, **8** (1975), 3

Three small sherds of coarse, unglazed, thirteenth/fourteenth century pottery were found in the slag heap, which covered some $27m^2$.

Maynards Gate

TQ 538297
Wealden Iron, **12** (1977), 4-7

Surface finds of medieval and post-medieval pottery may indicate a contemporary date for the remains of three smelting furnaces uncovered during the development of an industrial estate.

Minepit Wood/Orznash

TQ 523338
Straker (1931), 257
Money (1971), 86-111

Excavations revealed two smelting furnaces, one constructed on the remains of the other, enclosed within a timber-framed building. Also discovered were a well-preserved ore-roasting hearth, and the remains of a small, timber-framed hut found close by. The site was dated, by pottery and radio-carbon, to the fourteenth and fifteenth centuries, and indications were that it was operated over two almost consecutive periods.

Piping Wood

TQ 509278
Wealden Iron, **13** (1978), 7-9

Two sherds of late-medieval pottery were found in a slag heap on a steep stream bank. In an adjoining field there are possible house platforms, and the *-ingas* place name suggests an early origin.

WEST HOATHLY

Courtlands Farm

TQ 381314
Wealden Iron, 2nd ser., **10** (1990), 2

Four sherds of late-thirteenth or fourteenth century pottery were found in, or close to, a slag heap.

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ABBREVIATIONS

SNQ Sussex Notes & Queries
VCH Victoria County History

IRIDGE FURNACE, HURST GREEN

J. S. HODGKINSON & R. G. HOUGHTON

The Field Group first visited this site in May 1971, and revisited it in 1975 and 1997. The incentive for the present survey has been the acquisition, by East Sussex Record Office, of a fine map, by Ambrose Cogger, of the Iridge Estate, dated 1637.[1] In that year, the estate was inherited by Robert Wildgoose, from his grandfather, Sir John Wildgoose. The furnace, however, had been built in 1584 by Robert's great-grandfather, John.[2] Of particular interest with regard to the iron industry, the map illustrates an elaborate water management system for the furnace, which invites comparison with the water systems of other furnaces in the Weald. It also draws attention to the importance of recording the features of the landscape in which ironworks are located.

The Water Supply System

The map of 1637 (Fig. 1) shows a system of no less than 30 ponds, in two converging chains, supplying the furnace. Each pond is shown having a sluice connecting it to the next pond downstream, with some ponds constructed so that their bays form the sides of adjacent ponds.

Iridge manor was purchased by John Wildgoose from Martin Brabon in 1557, and in the ensuing twenty years Wildgoose set about increasing the size of the estate.[3] Of particular significance was his purchase, in 1575, of part of the neighbouring property of

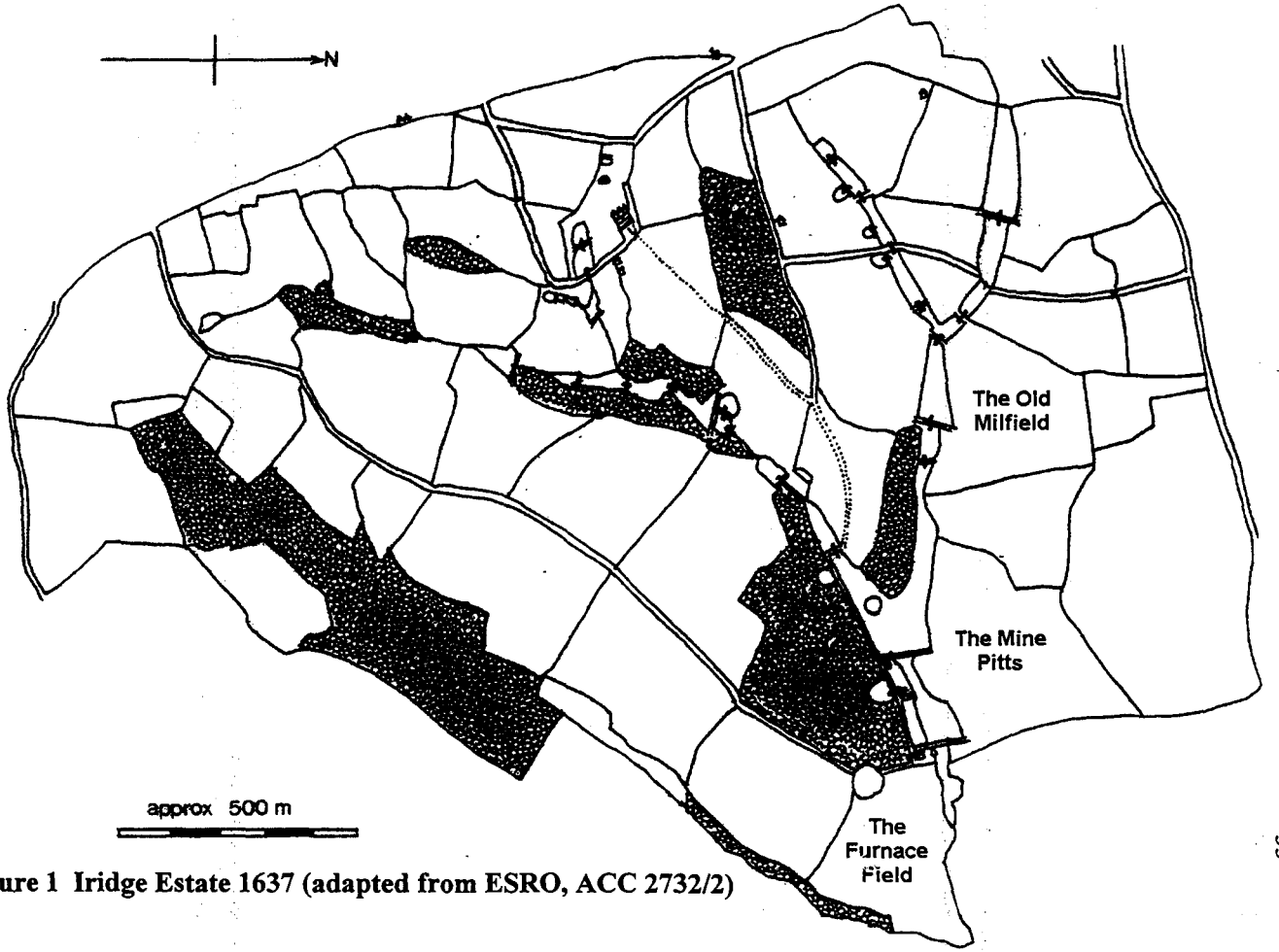

Figure 1 Iridge Estate 1637 (adapted from ESRO, ACC 2732/2)

Bexhurst, thus securing the stream and both sides of the northern arm of the system. This purchase gave him unencumbered rights over the two streams, ensuring that the system he would lay out for his furnace nine years later was entirely contained within the bounds of the estate. The existence of 'The Old Milfield', however, hints at the former existence of a mill, suggesting that at least part of the northern arm of the water system may have been laid out before the furnace. No mention of a mill was made in the terms of the settlement on the marriage of John Wildgoose's son, John, to Grace Annesley, of Lee, Kent, in 1588.[4]

Lying less than a mile from the source of the streams which fed it, it was essential that the furnace had a water supply which was reliable for a minimum of seven months of the year. Constructing the furnace within the estate but as far below the confluence of the streams as possible, it is evident from the map that the valley at the chosen point was relatively narrow, and did not allow for a pond with sufficient acreage alone to keep a furnace working. However, the gradient down which the streams fell (about 50m in 1800m for the southern stream) would have resulted in high pond bays were larger pen ponds to be contemplated. These would have been difficult to build and susceptible to failure, so the alternative was a large number of small ponds. The advantages of such a system were that a constant supply of water to the furnace could be maintained, and the danger of flash floods could be reduced. There were inherent disadvantages as well; the relative level of the water in the ponds would have needed regulating more often, and smaller, shallower ponds would have silted up or become overgrown with vegetation more quickly, necessitating more frequent maintenance. To this day, despite the small size of their former ponds, some of the pond bays survive to a height of between 2.4 and 3.6 metres, which is typical of the height of many ironworks bays elsewhere in the Weald. A further advantage of the system is hinted at in the 1588 marriage settlement, in which the reservation of the watercourses to John Wildgoose senior was also intended to protect the fish stocked in the ponds.

The system as shown on the 1637 map has survived to a considerable extent. The original pond bays are still visible in the

southern arm of the system with the exception of the next bay above the furnace pond, which was levelled in about 1971,[5] and the bays of the two ponds nearest Iridge Place which have been levelled and the sites filled in to form a tennis court. The northern arm of the system divides in two, and evidence survives of all but the top pond bay and the higher of the two side pond bays on the more southerly arm. On the northernmost arm the pond bays are intact, with some modification above the site of the top pond where a further pond has been added.

The Furnace Site (TQ 749277)

Compared to that of Frith furnace, also recently surveyed, the potential working area at Iridge was only about a quarter of the size (Figure 2).[6] Although the bay (**A**) extends for about 75m across the valley, only to the south of the stream is the floor of the valley sufficiently level to accommodate the site of the furnace and other ancillary structures which may have existed formerly.

Although the furnace is not marked on the map of 1637, suggesting that it may have ceased operation by that date, the watercourses shown on the map can still be traced on the ground. Two streams are shown issuing from the bay (Figure 3), one from the centre and the other at the southern end. On the estate map what appears to have been a pool is shown next to the bay, on the downstream side, where the southern watercourse passed through. A hollow (**B**) is still in evidence at the same place, with a linear depression (**C**) extending away from it to the east. On the 1637 map this is shown as a stream - presumably an overflow - which joined the other watercourse further down. What appears to have been the same channel peters out temporarily about 40m from the bay although heading in the direction of a confluence with the present stream (**D**). This channel appears to have been artificial, having been cut into the natural slope of the side of the valley, and a ditch survives along the boundary with the field, formerly The Furnace Field, south east of the furnace site, meeting the current stream at point approximately equivalent to its confluence shown on the estate map. The present stream, which follows the more

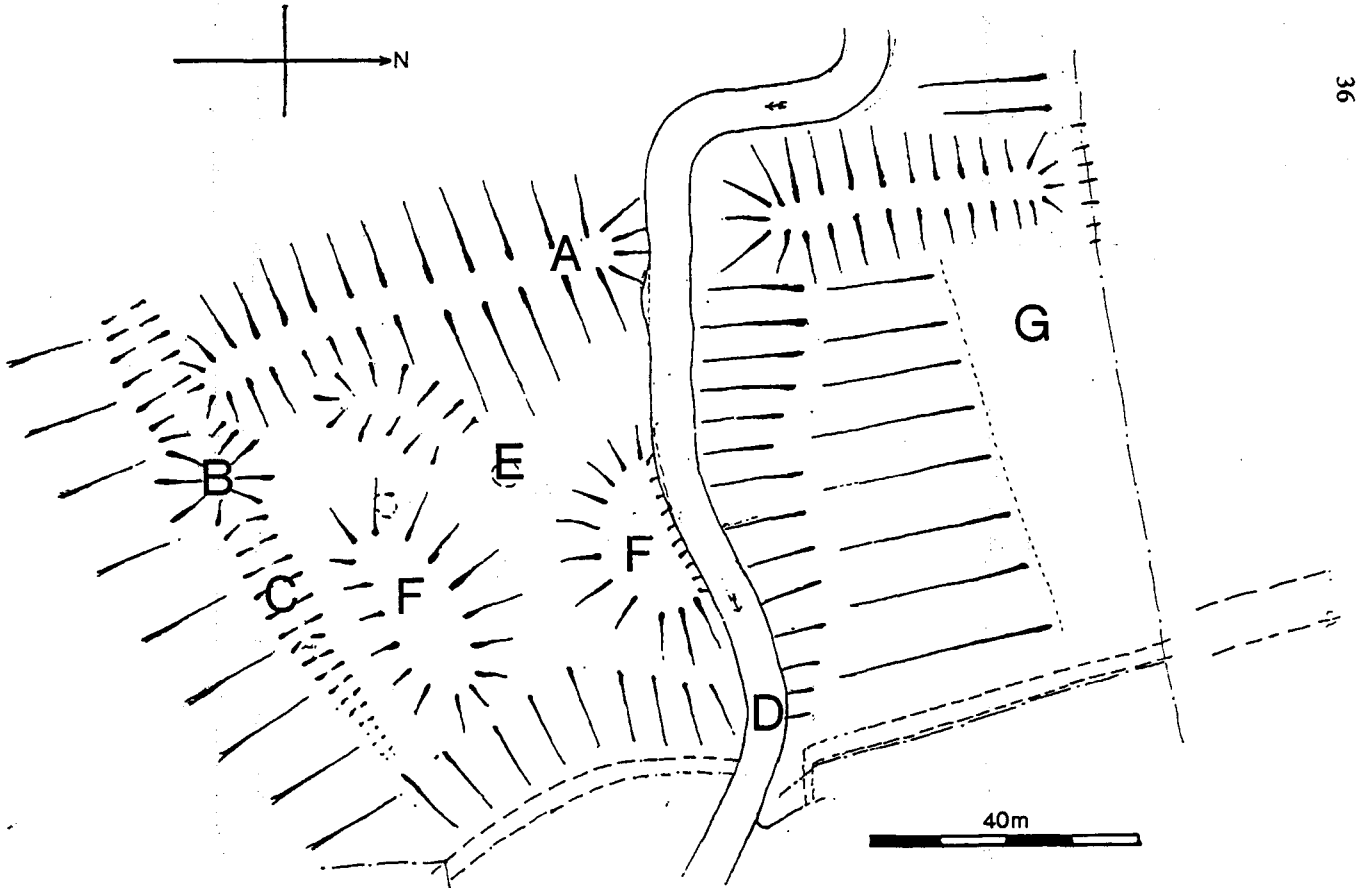

Figure 2 Plan of Iridge furnace site

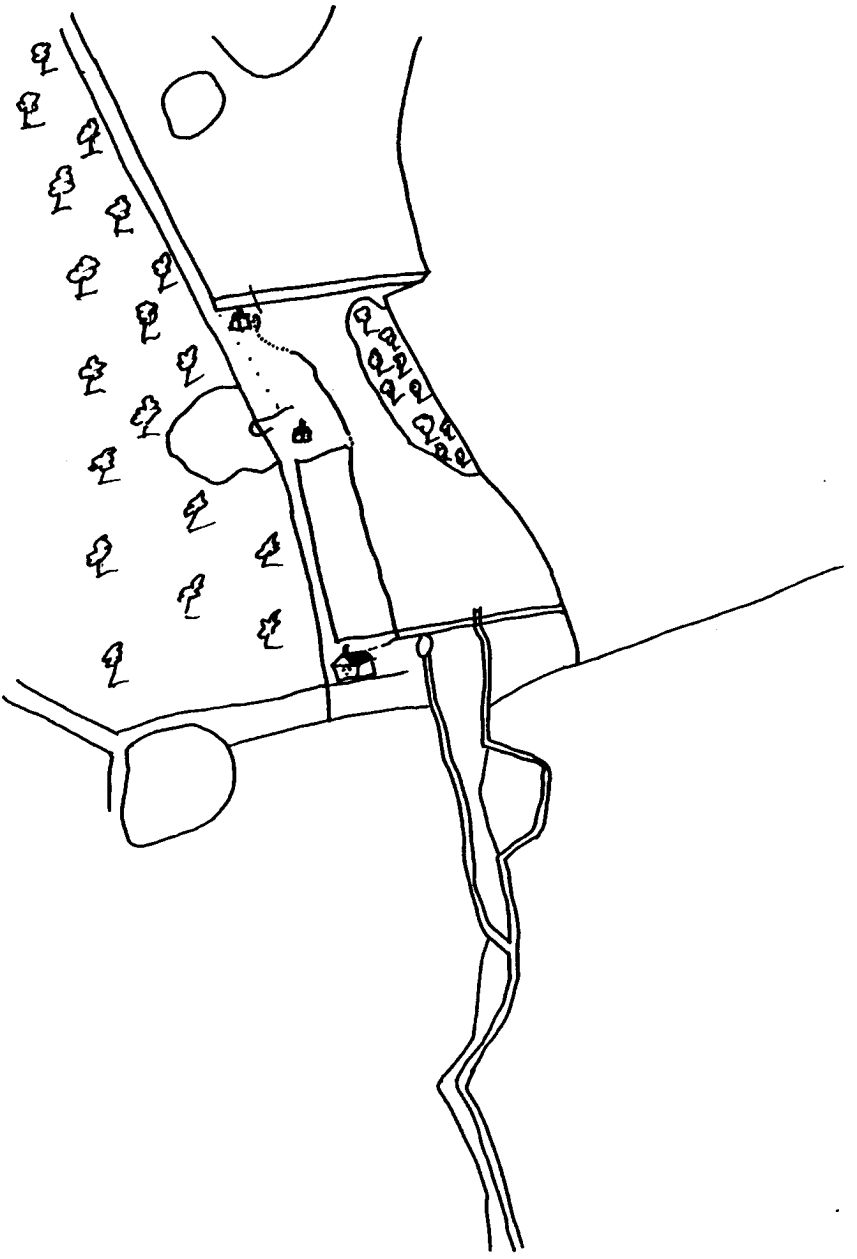

Figure 3 Detail of Fig. 1, showing furnace pond

natural course along the floor of the valley, would have powered the furnace bellows.

The original working area of the site appears to have been confined to the area between the overflow and the present stream, for on the north side of the latter is a steep bank. The 1637 map shows an access to the site on the south side, with a building adjacent, and the ground close to the former overflow is heavily impregnated with charcoal dust and calcined ore, suggesting that the raw materials were stored here and that they were loaded into the furnace from this side.

The probable site of the furnace (E) is marked by a mound of brick and stone debris, some obviously subjected to considerable heat. A complete brick was submitted for examination, the report on which concluded it was made from Wadhurst Clay and contained inclusions of iron, which had 'run' during firing.[7] Erosion on the brick indicated that it had probably been used as part of the lining of the furnace. It was suggested that the brick had been laid on edge, with the largest face of the brick facing the fire in the bosh area of the furnace, and that strong reducing conditions in this part of the furnace, where temperatures of 1000°C would be normal, had caused the concretion of ferrous dust and charcoal on other the side of the brick. Two substantial mounds of blast furnace slag (F) occupy part of the working area, and it is possible that one of them, close to the bay, is the remains of a charging bank.

It is clear from the absence of slag that the sloping ground on the north side of the stream was not part of the working area. However, at the top of the bank (G) there is a level area covered with slag which may have served as a hard standing for wagons. The 1637 map records that the adjacent field (now Broomfield Wood) was called The Mine Pitts, and field-walking has led to the discovery of pits up the hill to the north. Iron ore may have been brought down to the hard standing and carried across the bay; the 1637 map indicates that there was access across most of the pond bays of the water supply system.

The 1637 map shows areas of woodland on the Iridge estate, and the regular arrangement of the tree symbols on much of the woodland shown on the map (but not replicated in Figure 1)

suggests that coppicing was established in at least some of the estate woods. Crossley has demonstrated that the Robertsbridge ironworks, during the period before the construction of Iridge furnace, drew their charcoal supplies from woods south of the river Rother, suggesting that Iridge furnace may have had access to woodland on farms to the north of the river.[8]

Notes and References

1. East Sussex Record Office (hereafter ESRO), ACC 6732/2; the authors are grateful to Christopher Whittick for bringing this and other documents relating to this site to their attention, to ESRO for permission to photograph the map, and to David Martin and Andrew Woodcock for facilitating the reproduction of the map in this article.
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4. ESRO, ACC 3713/46.
5. *Wealden Iron*, **2** (1971), 6.
6. *Wealden Iron*, 2nd ser., **19** (1999), 30-3.
7. The authors are indebted to Molly and the late Wilfrid Beswick for examining and reporting on the brick.
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NOTES FROM THE OFFICE OF THE ORDNANCE: THE 1650S

RUTH RHYNAS BROWN

Although the Office of the Ordnance's records for the Civil War and the Protectorate are incomplete, two volumes in the Minute Book series covering the First Dutch War have survived. In many ways this was the first test of the Wealden iron industry. Although the number of ships in the Navy had been gradually growing in the first half of the 17th century, here was an emergency when guns

were needed fast, needed regularly and needed often, then not needed until the next emergency, a pattern repeated over the next hundred years. There was one major difference since the government had money from the estates of delinquent royalists; this large purse and prompt payment would be missing from the future pattern. The Navy was the true consumer of the Wealden iron industry; one ship could carry as many guns as a civil war army. The last time that England had fought at sea in strength was during the Spanish threats in the age of Elizabeth, more than 60 years before. This was also the time when the balance changed irrevocably from brass guns for ships to iron; the Navy would never again carry more brass than iron guns.

It was also a test for the new English republic. It is one of the ironies of history that attempts by King Charles to increase his Navy by imposing ship money had been one of the factors in provoking the Civil Wars; in truth, it was under the republic that Charles's plans came to fruition, a programme, with ships ordered in large numbers as opposed to one or two every year. There was little point in being able to build a large naval force if they could not be armed; Britain's superiority at sea would depend on her ability to match ships with guns and crews to man them.

How successful would it be in meeting this first real test? In many ways the Dutch were the superior force; they had better ships and sailors but they were hampered by rivalries both in the command and running of their forces. By contrast many of the English officers and bureaucrats had recently worked together on land and transferred these skills to sea war. More importantly the English ships were bigger, firing heavier broadsides. Here was the Weald's contribution; the Dutch could cast bronze guns at home or order cast-iron from Sweden. Although the Dutch early on gained control of the Baltic, the English captured several ships carrying munition supplies for the United Provinces. The English had to convoy only from the coasts of Sussex and Kent, although given the proximity of the Dutch they remained a constant threat.

I have expanded some of the contractions for the ease of readers unfamiliar with 17th century usage.

Part 1

In March 1652 relations between the two Protestant republics were deteriorating. However the Navy had ships building and the Office of Ordnance was letting contracts for guns; at this period it still ordered guns for individual ships.

> 26 March 1652 (WO 47/2, 4v)
> It is ordered that the officers of the ordinance doe forth with Contract & agree with such persons as they shall think fitt for providing the Gunnes ... for ye use of the frigot now building at Wollwich at as Cheepe rates as possible they cann, haveing report to the Gunnes offered to saill by Mr Powell Memceoned in ye Certificate annexed in case they or any of them shallbe found if full for ye service. And that they consult with the Commitee of the Navy concerning the tyme when the said frigott wilbe redey to lanch & accordingly to Contract for delivery of ye gunnes To bee paid for In forme following viz. one third part upon delivery & the remainder twoe months after delivery And to Certify their proceedings hereupon this Committe...
>
> To ye honourable Committe for ye Navy
>
> According to an order from the hon'ble Committe dat 18 ffeb: 1651
> Wee ye officers of ye ordinance doe humbly Certify that upon treatie with Mr Powell... of ye new friggott now In building at Wollwich wee humbly Conseue ye odinance hereafter mencioned ...to be provided for ye furnishing of ye said frigott.
> Viz
> Lower Deck Di:Cannon of 9 foote poiz each 36 cwt 20

	Culverin of 11 foote for fore and after chace poyz 38 cwt	04
FFor Castle	Di Cullver for 10 foote for ye chas poyz 38 cwt	02
	Di Culver of 8 foote poyze 18 cwt	04
Waist	Di Culver of 8 foote poyze 18 each	06
Und quarter	Deck Di culver of 8 poyze 18 each	06
Grate Cabin	Di Culverin of 8 poyze 18 each	02
Cuddye	saker Cutts poyes 8 cwt each	02

(WO 47/4, 4v)

A second contract was let on the same day:

> In pursuance of the desires of ye Councell of State of ye 13th of this instant month it is ordered that the officers of ye Ordinance doe forthwith contract & agree with Mr Browne and Mr ffolley, for ye 141 peeces of ordinace mencioned in ye list annexed remayning in their hands at ye cheapest Rate as possible they can to bee delivered into the stoare with all convenient speede & to bee paid In forme following Vizt one Third part vallew therof in hand one other third part upon delivery & the remainder two months after delivery And to certify these procedings theruponunto this Committee...
>
> The ordinance in Mr Browne and Mr Foleyes hands which are to bee contracted for: Vizt.

	Cwt	no
Culverin drake of 9 foote poyze each	27	02
di culverin drake of 8 foot 1/2 po each	20	13
culver fortified of 9 foot poyz each	33	06
culver fort of 8 foot poyz each	30	06
di culver of 9 foote poyz each	28	04
di culver of 10 ffote poyz each	26	02
di culver of 8 foot poyz each	20	60
sakers of 9 foote 1/2 poyz each	25	04
sakers of 9 foote poyz each	23½	04
Sakers of 8 foote poyz each	15	20
Di culver Cutts poyz each	12	20

Total	141
(WO 47/2, 5)	

In Powell's contract either the description or the weight of the first set of demi-culverins in the forecastle is in error as this is too heavy for this type of gun. In the Browne/Foley contract the guns were specified as either drakes or fortified; these terms will be discussed later.

These two contracts make an interesting comparison; the Powell guns appear to be ordered from scratch while the Browne/Foleys were guns already in existence. George Browne and Thomas Foley's partnership is relatively well known; Browne's family had held the position of King's gunfounder for two generations; they had access to several furnaces and presumably an experienced workforce. At this period Browne and Foley were consistently given twice or three times as many orders as the more shadowy Powell. Powell is more of a mystery; he was a lawyer based at Ewhurst, wealthy enough to buy Bodiam Castle in the 1640s and a baronetcy for his family in the Restoration. It is unknown where his works were; it seems likely he operated from the area round Ewhurst, including furnaces at Robertsbridge, Brede and Beckley. Possibly he was the 'frontman' for the ironfounders based in that part rather than an ironmaster himself. Further research is needed into this important figure.[1]

As the situation deteriorated during May, the Ordnance and the Committee for the Navy hastened to arm its new ships; contracts are referred to on the 6 May 1652 for a 'frigott building at Woolwidg' for 28 guns from George Browne and Thomas Foley to be delivered 12 July and 18 guns from Nathaniel Powell to be delivered 31 May (WO 47/2, 10v, 11). These seem to be separate contracts from those already dealt with, but are not detailed. War finally broke out in May, 1652. The Navy was harrying the Ordnance to arm new ships and replace lost or damaged guns. Contracts for increasingly large numbers of guns were let.

27 August 1652

It is ordered that ye office of the ordnance doe forthwith Contract & agree with Mr Browne and Mr ffoley and alsoe Mr Powell for ye 259 peeces of Iron ordnance menceoned in this list annexed at the Cheapest rates as possibley they cann to be delivered into the Stores with all Conveneient speede...

By Mr ffoley & Mr Browne
Iron Ordnance

Culvering drakes of 8 foote	60 }	fine metall
Di culveringe drakes of 8 foote	40 }	
Di cilveringe of 7 foote ½	50	
Di culveringe of 7 foote	20	
Di culveringe Cutte	30	
Total	200	

By Mr Powell

Culveringe Drakes of 8 foote	4 }	fine metall
Diculvering Drakes of 8 foot	14}	
Saker Drakes 8 foote	41 }	

(WO 47/2, f25r).

The Navy ordered a further 500 guns to be cast in June, consisting of 200 demicannon of 9 foot, 200 culverin drakes of 8 foot and 100 demiculverin drakes of 8 foot, (WO 47/2, 27). In September the Board came to an agreement with the founders (WO 47/2, 26v; 31v). In the meantime Foley and Brown had also been given orders for shot; the last order included 56000 round shot from cannon of 7 to 3 pounders and 18000 rounds of cross-barred shot (WO 47/2, 27). Orders for stores for proofing at Snodland show that guns were arriving (eg 24 December 1652, WO 47 2/43). Yet still more guns were needed and new contracts were drawn up.

28 December 1652
Whereas this Committee hath Contracted with Tho. ffoley & George Browne Gunfounders for Iron Ordnance hereafter mencioned Vizt

Iron Ordnance made of ffine mettall

Culverin drake of 8 foote poiz 26 cwt each	14

Di Cul	dra of 10 foote	poiz 24 each	06
Di Cul	dra of 8 foot	poiz 19 each	04
Saker dra of 8 foot		poiz 16 each	24
Total			48

To be delivered into ye stores within ye office of ye ordnance at or before ye last of ?Feb Instant att ye rate of 26 lib per ton. Tower proof.

Iron Ordnance made of course mettall

Di Cul ffortified of 7½ foote po 20 cwt each	10
Di Cul ffort of 7 foote po 19 1/4 cwt each	30
Total	40

To be delivered into stoares by ye last Decbr instant at 17s 6d per ton. Tower proof.

Iron Ordnance made of ffine mettal

Culv Dra of 8 foote po 30 cwt each	50
Cul Dra of 10 foote po 40 each	10
Di Cul dra of 10 foote po 28 cwt each	40
D Cul dra of 8 foote po 20 each	100
Total	200

To be delivered into ye stores att or before ye last day of Aprill 1653 att ye rate of 26 lib p ton Tower Proofe.
WO 47/2, 68)

We can get an idea of how the founders were coping with demand from a list of deliveries sent in answer to a query from the Excise a year or so later:

(19 April 1655)
In pursuance of ye honours order dated 10th instant Theis are to certify that wee received into ye Stoares for ye use of the Commonwealth from 24 June 1652 to ye 29 Sept 1653 from Mr ffolley and Mr Browne ye Iron ordnance hereafter menceoned, but how many of the ordnance were made in Kent wee know not. Vizt.

DiCanon 9 foot	13 poiz	0574cwt: 2qr: 15lb.

DiCanon 8 1/2 foot	01 poiz	0044	: 1	: 24
Culver 10 foot	10 poiz	0371	: 1	: 06
Culver 9 foot	01 poiz	0027	: 2	: 00
Culver 8 1/2 foot	58 poiz	1791	: 1	: 01
Culver 8 foot	22 poiz	0621	: 2	: 02
	38 poiz	1130	: 3	: 24
DiCul 9 foot	01 poiz	0021	: 3	: 00
DiCul 8 1/2 foot	46 poiz	1068	: 0	: 09
DiCul 8 foot	42 poiz	0889	: 0	: 27
Saker 8 foot	26 poiz	0409	: 2	: 06
These were drakes		6950	: 1	: 02

DiCul 10 foot	06 poiz	158	: 0	: 01
DiCul 8 foot	02 poiz	048	: 1	: 16
DiCul 7 1/2 foot	08 poiz	160	: 3	: 00
DiCul 7 foot	07 poiz	138	: 1	; 08
Mynion 9 foot	02 poiz	043	: 0	: 21
These were home-bored poiz		548	: 2	: 18

poiz all ye ordance 374 tons 18 cwt 2 qr 20 lb.
(WO 47/3, 99)

As more ships were built, prizes taken and lost ships replaced, the Navy increased its demands for ordnance. Fifteen hundred guns were ordered but the Ordnance were unsure of the details; throughout the war there were two main decisions in ordering guns, first what sort of metal: coarse or fine? Then what type of gun: drake or home-bored or fortified? The Admirals of the Fleet, Robert Blake and Richard Deane, themselves gunnery experts, wrote to the Ordnance from aboard the Triumph:

> (13 February, 1653)
> As to ye 1500 peece of Ordnance that are to be new Cast whether they will doe best to be made drakes or home bored it is our advice that, provided they be made of the same weight and you allowe ye same Mettall as you doe for whole bored Gunns, ye drake bored wilbe of most use otherwise to make them wholebored.

(WO 47/2, 54v).

The Ordnance made repeated inquiries to the Navy Committee whether fine or coarse metal should be used (WO 47/2, 55v; 62; 81). At last while they were holding proofs for previous orders, they got an answer:

> 18 May 1653
> Accordinge to an Order from your Honours dated 17th instant We ye officers of ye Ordnance doe humbly certifie that wee have treated with ye Gunfounders concerning ye price of ye fifteene hundred peces of Iron Ordnance propounded to bee made of fine Mettall who will not undertake them under ye same pryce mencioned in their proporcion vizt 26 lib per ton.
> And for ye difference between ye fine Mettall & ye Course wee humbly conceind ye fine to bee farr tougher more free from honeycombes & not so subject to breake and when they doe, they rend like brass & doe not fly into severall peeces and ye others doe and therefore are not so dangerous to ye men & shipps. They are Also much lighter and so of greater safe to ye shipps and friggots all which wee humbly present to your honourable consideration.
> (WO 47/2, 87v)

The drakes were guns which had a conical bore at their breech unlike the guns bored straight i.e. home-bored. The drakes were lighter and took a smaller charge so that they were considered both better value as they were cheaper, while ships could carry guns throwing a heavier broadside for the same weight.[2]

At last the Ordnance split up and let the contracts for the 1500 guns; Nathaniel Powell received the following share:

> (12 July 1653)
> Iron Ordnance to be delivered att or before ye last of November 1653
> Cul dra of 8 foote po 30 cwt each 30

Di Cul dra of 8 foote po 24 cwt each	60
Di Cul dra of 10 foot po 30 cwt each	10
Saker dra of 8 foote po 18 cwt each	40
	140

To be delivered att or before the last of ffebruary 1653(1654)

Cul dra of 8 foote po 30 cwt each	30
Cul dra of 8 1/2 foote po 34 cwt each	30
DiCul dra of 8 foote po 28 cwt each	60
Saker dra of 8 foote po 18 cwt each	20
	140

To be delivered att ot before the last of July 1654

Dicann dra of 8 1/2 foote po 40 each	10
Cul dra of 8 foote po 30 each	80
Cul dra of 8½ foote po 34 each	20
DiCul dra of 8 foote po 24 each	60
	170

To be delivered att or before ye last of October 1654

Dicann dra of 8½ po 40 each	10
Cul dra of 8 po 30 each	80
Cul dra of 8½ po 34 each	30
Cul dra of 8½ po 24 each	80
	200

ffor which ye said Nath Powell is to paid by ye tresororer for ye Navy att the rate of Six and Twentie pounds per Tonn....It is ordered that ye office of ye Ordnance doe take notice of the said contract and carefully serch & prove ye said gunns and upon receipt of each proporcon into ye Store to make Certificate thereof unto this Committee.
(WO 47/2, 114)

George Browne and Thomas Foley were given larger orders:

Iron ordnance to bee made of ffine mettall and delivered into ye stores in or before ye month of october next

Dicannon of 8 foote poiz 40 cwt each	10

Culv of 8½ poiz 36 each	10
Culveringe of 8 poiz 34 each	30
DiCulver of 8 poiz 30 each	10
DiCulver of 8 poiz 24 each	50
Sakers of 8 poiz 17 each	50
	160

To be delivered in or before ye month of ffebru 1653

DiCannon dra of 8 foote poiz 40 cwt each	20
Culver dra of 8½ poiz 36 each	20
Culver dra of 8 foote poiz 34 each	60
DiCulv dra of 10 poiz 30 each	10
DiCulv dra of 8 poiz 24 each	50
Saker dra of 8 poiz 17 each	70
	220

To be delivered into ye stores in or before ye month of June 1654

DiCannon of 8½ poiz 42 cwt each	25
DiCannon dra of 8poiz 40 each	25
Culver dra of 10 poiz 40 each	10
Culver dra of 8½ poiz 36 each	30
Culver dra of 8 poiz 34 each	66
DiCul dra of 10 poiz 30 each	10
DiCul dra of 8 poiz 24 each	114
	280

To be delivered into ye office in or before ye month of October 1654

DiCan dra of 8½ poiz 42 cwt each	23
DiCan dra of 8 poiz 40 each	27
Culver dra of 10 poiz 40 each	14
Culver dra of 8 poiz 34 each	60
DiCulver dra of 8 poiz 24 each	116
	240

Att the rate of xxvi lib per tonn Tower proof.
(WO 47/2, 114v)

Having let these contracts, the Ordnance switched attention to shot supply, a worsening problem as the war continued and existing supplies were depleted. While ships and guns might come through fighting unscathed, rounds of shot were used up and needed replacing, their need becoming even more pressing than finding guns. Early contracts were let to Browne and ffoley (WO 47/2,20v; 25). In March 1653 a convoy was arranged to escort 'two vessels from Rye, laden with shot' (WO 47, 2,70). In the summer of 1653 the office began casting its net wider. Overtures were made to Messrs Quyntyne and Strudwick (WO 47/2,118v).

> 15 July 1653
> ...we have contracted with Mr Quyntyne for one Hundred Tonns of Round shott, 30 tons whereof wee have already had, & ye remainder will be delivered into ye stores between this and ye first of October But we humbly councell it wil be necessary that 400 Tonns more bee provided by that tyme which wee desire may to tymely considered of
> (WO 47, 2, 13).

> 23 July 1653
> We have this day received from an Instrument att Portsmouth whereby we understand that accordinge to your directions hee hath Contracted with Mr Strudwick for 60 tonns of iron shott att 12 li' a tonn for ye supply of the Navy Stores there to be delivered in or before ye 10th of October next, To be paid one Moneth after delivery, & he is Content accordinge to your Honors' proposalls to take 40 Tonn of broken Iron Ordnance remaining there at 5 lib per tonn in part payment. He offers likewise to cast 60 Tonn more of Iron shott att ye same rate to be delviered by ye 10th January."
> (WO 47/2, 116).

This mention of broken iron ordnance is intriguing and raises the possibility that the shot founders had access to some form of air furnace for re-melting the iron.

These terms were quickly agreed upon (WO 47/2, 117). However these were still not enough. Thomas Newberry, the Ordnance deputy storekeeper in Portsmouth, went in August 1653 to visit various ironfounders. His report has already been published in the Calendar of State Papers. Domestic Series 1653-1654 in which he notes meeting Peter Farnden, Mr Everden, Mr Akehurst, Walter Burrell, Mr Strudwick and Mr Yalden.

> ...Travelling charges into Sussex for seaven days by our directions for sumoning ye Iron Masters to repair to Whithall for making of contracts with us for Iron shott for ye use of the fleete.
> (28 October 1653; WO 47/2, 154).

This journey is presumably related to the note dated 13 August 1653:

> That ye officers of ye Ordnance doe forthwith treat and contract With Mr Powell, Mr Johnson and Mr Burrell all or any of them for ye Casteing of Round Shott of Such Natures & proportions as ye said Officers shall think fitt and at ye lowest rates and prizes for ye best advantage of ye State
> (WO 47/2, 126).

A note at the end of the Volume notes where Burrell could be contacted:

> Att the Talbott in Southwark, att his house in Coockfield called Holmsteed in Sussex.
> (WO 47/2, 180v).

Further orders for shot were placed on the 16th November 1653: with Waltar Oake, agent for Powell, for 120 tons to be delivered before the following April; John Akehurst of Warbleton for 140 tons before June and Henry Strudwick of Crouchland in Sussex, 100 tons to be delivered before May 1654. (WO 47/2 158v; 161v; 162). Agreements were also made with suppliers outside the Weald, such as George Sitwell of Derbyshire.

Meanwhile, throughout the winter, regular proofs for guns were held (e.g. WO 47/2, 166v, /3, 5). Powell was given a debenture for guns over and above his contracts delivered to the Office; these were of smaller natures and cast in coarse metal. However negotiations between the two nations were in progress, and, despite the sporadic actions in the early spring of 1654, the Treaty of Westminster was agreed upon in April. The Office of Ordnance ordered its founders to cease casting immediately and notify them exactly what had been cast (WO 47/3,19v).

By 12 May the Ordnance Office had ascertained how the contracts stood:

> Whereas Officers of the Ordnance have on ye 11th of this instant May certified that of the last Contract made with Mr Nathaniel Powell for 650 peeces of new cast Iron ordnance there hath been & proved & received 155 that their remayes to be proved 272 and that there are yet uncast 223. Upon full debate and consideration of this business of by and with ye consent and agreement of both parties It is Ordered that there shalbee only 123 peeces of Ordnance of ye said 223 cast which are to be of fine mettall homebored and to be accompted in full of ye said contract and all other former proceeding contracts made with Mr Powell either by ye late Committee of the Navy and ordnance or officers of ye ordnance.
> (WO47/3, 18v)

A similar agreement was made with Browne and ffoley with different figures: Of their 900 guns, 390 had been received, 430 were yet unproved and 80 uncast. They were to proceed with casting the last guns (WO 47/3,19).

The shotfounders were also being wound up. In April 1654 Johnson and Strudwick were asked to take away the broken iron ordnance allotted to them and deliver the remaining shot (WO 47/3, 17v). On the 12th June 1654 the office ordered a debenture for John Akehurst

for 60 tons of shot delivered into the Navy stores, less than George Sitwell who delivered 100 tons of shot to Hull (WO 47/3, 36v).

Historians of the Navy tend to be scornful of the response of the Office of Ordnance to national emergency as the admiralty could build ships more quickly than the ordnance could arm them. The effectiveness of a navy depends on a complex balance of factors including ships, men, and guns. In this war the Navy could supply the ships; men and guns were more difficult. However lessons were learnt; it seems likely that the Wealden founders had met the Navy's demand by sub-letting contracts and working together - otherwise it seems impossible that two sets of furnaces could have produced so much guns and shot in such a short time. The Weald had succeeded in its own terms, if not those of modern historians. From later in the century these years would be looked back on by the founders as a golden age.

Part 2: The cannon of 7.

There has been much interest in early casting of iron cannon of 7; one such example from the late 1650s seems to have been neglected. A lone volume in the Minute Book series gives some details of the work involved. By this period Henry Quyntyne was also acting as agent for the Browne/Foleys.

The officers of the Ordnance wrote to the Admiralty on 22 May 1657:

> Wee ye officers of ye Ordnance... doe most humbly Certifie your Honours that this Board Henry Quyintyne gunnefounder hath made certain ordnance of iron vizt Cannon of 7 inches diameter (the like whereof hath not been cond by any other in this Nation) Sixe of ye said Ordnance we proved with a higher allowance then usually hath beene given to brass of ye like weight and diemensions which they held very well, wee judge them equally Serviceable with brass And it is our humble opinion that ye said Service deserves your Honour's incouragement that it would bee a good increase of strength to

ye Navy if there were a considerable number of ye said Ordnance provided and disposed of to such Shipps, as are fitt to Carry them, All which according to your Duty...
(WO 47/4,15).

30 June 1657
Order for stores for proof of three cannon of 7 (WO 47/4,27).

26 September 1657
There was some proposalls made by Mr Henry Quityne in his letter to us of ye 4th of February 1656 which was about that tyme prescented to your Honours and is as wee beleive upon record before you touching ye furnishing ye London then setting forth to Sea with some iron Cannon of 7 and whereas Your Honours were pleased to consent to ye same and did then order us to receive ye said ordance into your stoares, we did (in pursuance of your command re ye same and shipt on board ye London)
ye number and particulars vizt being as follows
Cannon of 7 of iron of 8 foote ½ 9:

1 po.	49.1.14	4 po.	48.3.00	7 po.	48.1.07
2 po.	49.2.10	5 po.	49.1.00	8 po.	48.3.23
3 po.	49.1.00	6 po.	48.2.14	9 po.	48.2.09

Now because it was propounded in ye said letter if ye said gunnes were not well liked of after sixe monthes experience to take them again or otherwise to bee paid after ye rate formerly given for ye best sorte of iron ordnance Wee humbly take leave all his earnest request (ye terme tyme menconed by the proposer beinge expired) to minde your Honours thereof that soe ye wilbe pleased to Issue your Order for making out a debenture for them at ye rates menconed in his letter or otherwise that he may receive such satisfaction as your honours shall thinke meete...
WO 49/4, 58v)

Finally a further three iron cannon of 7 were proved at Gunfields the following February 1659 (WO 47/4, 239). The enterprise seems

forgotten after this; perhaps it was related to the ships' carriages broken in the proof. Anyway, by the next decade the experiment appears to have been forgotten.[3]

Notes and References

1. Information on the Brownes from H. F. Cleere and D. W. Crossley, *The Iron Industry of the Weald* (2nd edition, Cardiff, 1995) and Sarah Barter Bailey, *Prince Rupert's Patent Guns* (Royal Armouries, Leeds, 2000). Information on Nathaniel Powell from A.J. Fletcher, *A County Community in Peace and War: Sussex, 1600-1660* (1975) and Jeremy Hodgkinson, pers. comm.
2. For a discussion on the these topics, see G. M. Wilson, 'The Commonwealth Gun', *International Journal of Nautical Archaeology*, 17 (1988), 87-100; and Sarah Barter Bailey, *ibid.*
3. For further information see Robert D. Smith, 'Cannon of 7', *Journal of the Ordnance Society*, 4 (1992), 9-20.

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