

# Wealden Iron

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Bulletin of the  
Wealden Iron  
Research Group



WEALDEN IRON RESEARCH GROUP

BULLETIN NO. 11

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The Group records, with deep regret, the death of Philip Willmott, Honorary Secretary.

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## Reports on Field Work

### Introduction: the Field Group in 1976

By the end of 1975 the task of visiting, and recording on questionnaire forms, all the known Wealden water-powered iron-working sites was virtually completed. Most of the visits were made by the old Buxted Group but a substantial number were seen by the now defunct Slaugham Group, by Dr. Peter Ovenden in the western Weald, and by other individual members.

After consultation with David Crossley, who will do the final writing up on the Medieval and Post-Medieval periods, it was decided that the Field Group should now turn their attention to bloomeries. It was felt that a fairly intensive search, in a given area, would show the degree of exploitation and relate the sites to the geology and geography of the chosen area.

The area decided on, at present only an approximate one, is roughly defined by TQ44 west to TQ60 east and TQ21 south to TQ35 north. This area covers about 160 square kilometres and extends over a range of Wealden geological and geographical conditions. Within it many bloomery sites have already been recorded by the old Buxted Group, the Crowborough Local History Research Group (with whom we have close links) and individuals such as Charles Cattell.

To record past, present, and future discoveries, a composite 1:25000 map (Ordnance Outline Edition) has been prepared to include the area chosen, and coloured to indicate the geological features relevant to the iron industry, i.e. iron-ore-bearing clays and the Ashdown Sand. Red spots indicate bloomery sites of which about 160 are already known to occur in the chosen area.

The weakness of the scheme is of course the impossibility of dating the majority of the sites found, as their age could range over 1500 years. To only a few, where there has been excavation, carbon-14 dating or chance finds of pottery, can dates be assigned.

However, when the final results are analysed, much will be learned about the location and distribution of bloomeries, their relation to the geological areas where iron ore is found *in situ* and the ability of iron workers to locate iron ore, even when it is not *in situ* but derived from eroded strata.

## **Sources of Iron Ore for Bloomery Furnaces**

It has often been postulated that the earliest ironworkers sought their ore by searching the Wealden streams, often running in geological faults, which cut deep into the existant land surface. Secondary evidence for this belief is the existence of large numbers of bloomery sites along the banks of streams that cut deep into the base of the Wadhurst Clay, where ore is likely to be found. However actual evidence of ore being exposed by streams is rare, except for the odd nodule occasionally found in stream beds.

An exception to the above was recently pointed out to the Field Group in Rotherfield parish. In a stream near Spratts Bottom Cottages, at TQ 566 320, a large quantity of siderite can be seen in the stream bottom and left bank. It is mainly in an immovable mass and would, one would think, have been a rich strike for a bloomery worker. There is no sign of slag in the stream near it and one can only assume that its exposure is of recent date. It has lately been exploited by members of the Crowborough Local History Group in their experiments to produce iron by the bloomery method.

## **The Late Use of Bell-pits at Ashburnham**

Straker (*Wealden Iron* p.105) refers to mining by bell-pits as an exceedingly ancient method of mining, as exemplified by their use for flint mining on the South Downs. This method seems to have been in use up to the end of the iron industry in the Weald.

In April 1967 Mr Jack Harmer, forester on the Ashburnham Estate, pointed, out some mine pits in Combe Wood (c.TQ 693 131), near Standard Hill Farm. These proved to be bell-pits, spaced about 6 feet apart and measuring about 15 feet from centre to centre. Mr Harmer, who knows the whole area intimately, is confident that these are the only pits or quarries in the neighbourhood.

From information in the Ashburnham Estate Ironworks Accounts of 1812 and 1813 (East Sussex Record Office) mine was then being drawn from Standard Hill Farm and it seems certain that these bell-pits represent the workings at that time.

It is of interest that, except where the digging of marl was also involved, this primitive mining method persisted to the end of the iron working period.

## **Pippingford Cow Park Bloomery – preliminary report**

In the spring of 1976, Mr A. Morriss of Pippingford Park, and his son Richard, noticed black soil and small slag fragments dug out by rabbits, half way up the hill slope east of the now dry pond of Pippingford Furnace, at TQ 452 309. On investigation by the writer the site was found to be on a natural terrace on the hillside, apparently improved by artificial levelling. It was distinguished from its surroundings by growth of grass in contrast to the surrounding bracken. A small trench dug near the rabbit hole showed that about a foot thick of fine bloomery slag mixed with charcoal impregnated soil lay on the old land surface, itself trodden down hard to form a level floor. A sherd of pottery, of probable 1st century AD date was found in the slag.

The site, on what was once a part of Ashdown Forest, has almost certainly never been cultivated and is open, uncomplicated by tree roots. As permission to dig was readily forthcoming from the army authorities it was decided that an excavation might prove helpful in adding technical details to the very few 1st-century furnaces excavated so far, and in recovering, a plan as to how such a site was laid out. Its probable connection with the nearby Garden Hill Iron Age and Roman site was also obvious.

Throughout the summer and autumn W.I.R.G. members have worked at the excavation at weekends and valuable help has been given by unemployed school leavers from Crawley, through the good offices of John Gibson Hill, and under the leadership of Richard Amos.

At the time of writing three furnaces have been found, in a triangular layout on the NE. side of the site. They are of the Wealden domed type (H. Cleere's classification Group BI.II.), and similar to those excavated by J. H. Money at Minepit Wood, and by the writer at Pippingford. Close by each furnace is a small re-heating hearth, and a heap of roasted ore was located nearby. Nearby, too, was found what appears to be the remains of a rectangular block of iron that may be an

anvil, with hammer scale scattered around it. At the west side of the site more pottery has been found, but much still remains to be done. Some 30-40 W.I.R.G. members were able to visit the site on the open day in October and it is hoped to continue the excavation throughout the winter.

### **A water-powered bloomery at Woolbridge, Mayfield**

In January 1977 the Field Group held a foray to explore the course of the Rother and its tributaries at Woolbridge, about 1 mile west of Mayfield, an area rich in iron ore and bloomeries.

At N.G.R. TQ 5710 2655 a previously unrecorded bay, crossing the Rother valley, was discovered. It was about 70 yards long, in places 6<sup>1</sup>/<sub>2</sub> feet high, and complete except where breached by the Rother towards its west end. At its extreme west end had been a spillway to a ditch leading through a small pond to join the main stream lower down. Near the bay the spillway and ditch were banked to prevent the working area behind the bay from flooding.

The earthworks present the common pattern of a forge or blast furnace site, but on a rather small scale. However the difference lies in the waste material to be found in the area behind the bay and in the river bed. Here were found considerable quantities of apparent bloomery cinder and tap slag together with some large pieces of clay furnace lining. Samples of these have been preserved. No examples of the conventional blast furnace or forge slags were found.

Although all the above evidence is circumstantial it seems possible that the site could be one of the long-sought Wealden water-powered bloomeries.

C. F. Tebbutt.

## **Inventory of Water-powered Sites**

### **CHITTINGLY MANOR FARM FURNACE WEST HOATHLY TQ 346 322 *Wealden Iron***

**p.408**

This picturesque site is situated in one of the steep wooded valleys, with rocky sides, characteristic of this part of the Weald, and the rather small, but probably deep, pond is still in water.

The bay, in good condition, is about 95 yards long and curves away from the pond. It is 10-11 feet high on the downstream side. From a "tumbling bay" weir at its west end a stream turns sharply east along the back of the bay to about its centre, where it turns south away from it. Here perhaps it is following the course of the wheel pit and race as, just to its west side, and extending back from the bay, is a pear shaped mound that could represent the site of the furnace and bellows. West of this is steeply rising ground that would be an appropriate place for a loading ramp.

There is a heavy scatter of dark glassy slag all over the area behind the bay which has been recently planted with larch.

### **MELHILL FORGE, PEMBURY TQ 6151 3814 *Wealden Iron* p.264**

Here the stream was diverted to serve the forge, but the county boundary of Kent and Sussex follows the old course. There are large pieces of forge cinder in the side stream, and some in the main stream. A much overgrown track crosses the valley at this point and probably once served this forge. Slight undulations may represent a silted up bay and a hollow the site of the wheel pit.

### **BREECHERS FORGE, FRANT. TQ 6266 3844 *Wealden Iron*, pp.264-7**

This was an early forge and Straker makes a surprising statement, in reference to this site, Benhall, and Dundle, "it is very probable that in their early history they produced bar iron direct from the ore".

At the supposed site, at the junction of the original stream and the present diverted stream, nothing could be found, nor further down. However some cinder was found in the path and field at TQ 627 387.

**TOLLSLYE FURNACE LAMBERHURST & FRANT TQ 632 371 Wealden Iron p.268**

This furnace site is very remote from public roads but a public footpath passes it at the south end. Unfortunately when visited by the foray party the tenant refused permission for them to examine the site in detail, without his landlord's permission. The bay, thickly covered by rhododendrons, can be seen to be a substantial one and from the Ordnance map appears to be c.133 yards long. There is much glassy slag on the estate roads in the vicinity.

**KITCHENHAM (or ASHBURNHAM LOWER FORGE TQ 679 135 Wealden Iron p.371-2.**

From the public road, just N. of Kitchenham Farm, a public footpath leads to this site, part of it going along the top of the bay. The forge symbol, on Straker's map, places it, incorrectly, about  $\frac{1}{4}$  mile further north.

Documentary evidence, quoted by Straker, mentions varying pond sizes, from 30 acres (1611) to 25 acres (1634) to finally 10 acres (1667). The dry area defined by the present bay is small and must be the latter area. This bay, now very low, is an unusual one, and reminds one of that at Rudgwick and Bibleham Forges. It does not span the wide lower valley of the Ashbourne stream but merely encloses part of it up against the higher ground comprising Hammer Wood. No convincing signs of a bay to form either of the larger earlier ponds, mentioned in the documents, can now be seen.

This smaller pond would seem to have been fed by a leat, at least 1000 yards long, and now represented by a shallow ditch along the NW. boundary of Hammer Wood. Parallel to this channel the course of the Ashbourne is here plainly straight and artificial, possibly so made for the purposes of navigation. Could this not be the reason why it was necessary to separate it from the forge pond? If so then it would not be difficult, higher up, to direct the main stream into either the navigation channel or the forge pond leat at will, as required.

There is another interesting problem at the SE. end of the bay, behind which is irregular ground and much cinder, indicating the forge site. From here a ditch runs nearly due S. and, some way downstream, crosses the valley to join the main stream. This must be the mill race.

However at its beginnings, and joined to it, is a short deep channel, almost at right angles, running NW. to join the main Ashbourne. We know, from the documentary evidence mentioned above, that Kitchenham Forge had navigation rights as far as Boreham Bridge, and it seems likely that this short channel was dug to get the forge products, by barge, on to the navigation channel (the Ashbourne), and possibly to receive pig iron, sows, etc., from the furnace higher upstream.

It is suggested that this channel and the mill race, now joined, were once separated and never intended to be joined. In fact water sometimes now flows from the above channel into the mill race and in negotiating the right angle corner has eroded a large hole in the bank, exposing, incidentally, large cinder beds. Kitchenham is an interesting site that would repay further study.

#### **PENHURST FURNACE TQ 705 163 Not in *Wealden Iron***

This furnace site was discovered by the W.I.R.G. field group while examining the possible Ashburnham leat or aqueduct with Messrs. J. Martin and C.C. Ennever in March 1976.

The site of the pond is now ploughed and the west half of the 100 yard long bay has been levelled to add to the arable field. However its line can still be faintly traced and there is a scatter of glassy slag along its course. The intact portion of the bay is still 6 feet high on the upstream side and 8 feet on the downstream. Behind the west end of the intact portion is a large oak tree, growing on a mound, with a large concentration of slag, and more occurs all along the top of the bay. It is dark green in colour and tends to be light in weight and porous.

This is a surprising discovery in what was probably once part of the Ashburnham estate. The possible Ashburnham aqueduct appears to have its origin just above this furnace site, to tap the stream above the furnace pond, and then to run just above its NW. bank. The two systems could not have been contemporary as the aqueduct would have robbed the furnace pond of its water. It was noticed that in spite of drought conditions the stream had a good flow.

## Sites Scheduled as Ancient Monuments

In the past the Group has recommended that the Department of the Environment schedule selected Wealden Iron sites as Ancient Monuments. It is therefore pleasing to record that a further list has just come to hand of new schedulings as recommended:-

- 398 Cotchford Forge, Hartfield. TQ 471 338  
Bay 100 yards long up to 5 feet high
- 399 Newbridge Furnace, Hartfield. TQ 455 324  
Large area both sides of road.
- 400 Bloomery, Pippingford Park, Hartfield. TQ 446 314
- 402 Minepits in Tugmore Shaw, Hartfield. TQ 458 372
- 403 Far Blacklands bloomery site, 4<sup>1</sup>/<sub>2</sub> acres (Great Cansiron)  
Forest Row. TQ 448 382
- 407 Pounsley Furnace, Framfield. TQ 529 219  
Bay and large area included.
- 408 Crowborough Furnace, Withyham. TQ 496 321  
Bay, furnace foundations and bridge, etc.

## Iron Sites on Ashdown Forest

**C. F. Tebbutt.**

Through the courtesy of Cmdr. P. Angel, clerk to the Conservators of Ashdown Forest, I have been able to search through some bound volumes of MSS., the property of the Conservators. These consist of translations and copies made about 100 years ago, of original Duchy of Lancaster papers, Court Rolls, etc., all relating to the Forest. The first volume contains MSS. dating from 1234 to 1609. The location of the originals is not given and one may perhaps assume it to be the Public Record Office. Some however are stated to be in possession of Earl de la Warr. They are all obviously subject to possible errors by copyists.

Among many items of interest referred to in the papers are a number relating to the various iron mills and their operation, on the Forest, some of which do not appear to have been published before. The mills were the property of the Duchy (i.e. Crown property) let to tenants.

The earliest references are to Newbridge Furnace and Forge, and the Steel Forge, obviously contemporary and on different sites but not always distinguishable, viz:-

1510 "Information against Pouncelot and Lambard, occupiers of our Iron Mills within our Forest of Ashdown, for destruction of woods and decay of the Mills."

1512 "Warrent to sell to Lambert (and) Symart as much wood as is sere and dead in the top and underwood as may best be spared as will suffice to make 20 loads of Coles for the making of iron of the said Lambert; and to fell for the tenant of our iron mill there, called the stele mill, as much wood as will supply the mill with coles."

At the Acostomall Court of the tenants of Ashdown Forest, held on 10th October, 1520 the tenants presented:-

"That a third part of the King's woods within the Forest be cut down and made coles for the Iron Mills to the great hurt of the King and his customary tenants."

"That the wood ground of the Common of Quabrook is cut down to make coles by Wm. Mogeliweck and sold to the stele forge."

"That in time past the forest hath (been) digged for iron by which man and beast are in jeopardy."

1528/30 Minister's Accounts:-

"80 loads 'HURE' (ore) from the Forest at Newbridge at 2d a load."

1539 Ashdown Forest Survey and Valuation including Iron Mills and Steel Forge:-

"South-Ward. There is iron ore digged upon the said Ward by one Wm. Levett, Clerk (of Buxted) to the value of 6d."

"Costeley Ward. Price of carriage of 80 loads hure from the Forest at Newbridge - 13/4"

". . . . Nysell, occupier of the King's Iron Mills at Newbridge, hath enclosed 4 acres of Forest ground."

"Newbridge. The King's Iron Mills are in a good state of repair saving the furnace there (which) is clearly decayed and removed from the said Newbridge to a place without the said Forest called STUMBEGH (Stumblets) where the said furnace is well and sufficiently repaired by the tenant and occupier of the same."

[Note. Stumblet or Stumblets Common was outside the Forest but still belonged to the King.]

"It is also certified that the Stele Forge which is also standing upon the brook of Newbridge and in distance from the said iron mills the space of 2 flight shots or more and yearly rented to the King's Majesty at 13/4 is in utter ruin and decay and will not be made tenable without the bestowing of 100 marks at the least wherewith ... fermer of the same resteth and standeth bounden unto the King's Majesty, at the expiration of his years, to leave the same in good and sufficient repair and estate."

- 1554 Under the grant of the Forest to John Gage by Queen Mary there is mention of the "Stele Forge" and the "Iron Forge" and a furnace called "Stumblers".
- 1558 A very detailed perambulation of the Forest was recorded giving, with a wealth of place names, the boundaries of not only the Forest but of the three 'Wards' and their 'walks'. In this there are several mentions of the "Stele Forge" at the junction of Deepdene Gill and Millbrook (i.e. TQ 449 312)
- 1558 Queen Elizabeth recorded as owner of a furnace called "Stumblers".
- 1590 There is a very short reference to Parrock Furnace when ... Elliot is accused of taking stone from the Forest for his furnace, without licence.

Unfortunately Volume 2 does not follow consecutively from Volume 1 and only contains copies from originals dating from 1681 - 1816.

However, as far as the iron works are concerned we fortunately have the full Parliamentary Survey of 1658 (see *Sussex Arch Collections* 23 (1871) pp.242-313) which partly fills the gap.

In these surveys the Newbridge iron works are referred to as derelict but the "Steel Forge" and "Steel Forge River" is used as a boundary at the junction of Deepdene Gill (Stoneybrook) and Millbrook.

The 1664 Lists of Sussex Ironworks contains no mention of any going concerns on Ashdown Forest.

In the documents being considered the next mention of iron works is in a 1684 Table of Profits of Duddleswell Manor which contains headings "Steel Forge and Iron Works" but with no sums of money against them, and one wonders if they were headings copied and re-copied from older accounts.

We are now entering the troubled period when the total enclosure of Ashdown Forest was attempted by land speculators, after obtaining Crown concessions. This was vigorously contested by commoners, assisted by local landed gentry who also had common rights. The final Decree and Award of 1691 divided the Forest into 2 almost equal parts between the commoners and the private developers. Of these latter the Staples family of Plaw Hatch seemed to be the most important and their land transactions the most complicated.

There now appears among the MSS. a copy of an important indenture dated 16th October, 1696 between Alex. Staples junr. of Plaw Hatch and Mary his wife, and Alex. Staples the elder of the first part, John Staples clerk of East Grinstead of the second part, James Hooper Esq. of Middle Temple, London, and Francis Diggs of London, gent., of the third part, Richard Lechmere of London, merchant, of the fourth part, and John Asgil, Esq., of Middle Temple of the fifth part. The property concerned is described as "All that piece of land lately marked out to be enclosed .... by estimation 200 acres .... on or near Broadstone Walk .... in the Forest of Ashdown being part of a parcel of land called Garden Hill abutting East from Newbridge Gate to Stonebrook Gill [sometimes called Deepdene, TQ 449 312] on the land of Nicholas Lechmere of London, and on the South by other lands of the said Nicholas Lechmere, West on other lands of Alex. Staples junr. and on the North upon Table Gill, .... upon which said piece of ground there hath been lately erected several houses and buildings in order to the making of iron. To hold to the use of Hooper and Diggs together with houses, bays, water

courses, common profits and apparatus .... belonging, in fee. In trust of the said John Asgil .... by Staples junr to pay the rent charge of £60 per annum and to discharge the 200 acres therefrom."

This must refer to Pippingford Blast Furnace excavated in 1973/4 (see *Post Medieval Archaeology* Vol. **9** (1975) pp.1-37).

It is perhaps of interest also that James Hooper appears as Steward of the Court Baron of Duddleswell Manor in 1700.

The above quotations throw a little more light on the operation of Newbridge Blast Furnace and Forge, Stumblets Furnace (at TQ 401 307) and the Steel Forge. This latter is a tantalisingly elusive works, the site of which recent intensive field work has failed to locate. However, the construction much later of the Pippingford Furnace is fairly narrowly dated from the above documents and may well have obliterated all trace of the Steel Forge while utilising its pond. It is also difficult to understand why there is no mention of Crowborough Blast Furnace (TQ 496 322) the site of which is still on the commoners' Forest.

## **An Aid to Ashburnham Navigation**

It is, we think, well known how important navigation was to the business success, over a period of nearly three centuries, of the Ashburnham ironworks complex. This is briefly referred to by Straker (*Wealden Iron* p.372) when in 1664 the rights of navigation from Kitchenham Forge to Boreham Bridge were re-affirmed. From Boreham Bridge there were, of course, navigational facilities to the sea at Pevensey.

It is not, we believe, known how difficult this navigation was in drought conditions but it would appear that an attempt was made to store water against such an emergency. This was done in the Ninfield valley between Ashburnham Park and the Ninfield ridge, i.e. from just above Boreham Bridge at TQ 675 122 to the vicinity of Coombe Hill Farm TQ 698 136. Mr Jack Harmer, of the Ashburnham Estate, told us of the existence of four bars across this valley, although all the ponds that they once supported are now dry.

The top pond, of no great size or dimensions, is situated just above the road bridge at TQ 698 135. The next downstream is a much larger bay near the corner of Combe Wood at TQ 695 134. Still further downstream is a very high bay across the valley in Luxfords Wood at TQ 691 132, which also has a channel diversion. The last is a longer, but lower, bay across the widening valley at TQ 688 130, between Wildings and Luxfords Woods.

The stream and area below the lowest bay downstream, and indeed below all the others, was carefully searched but no slag or other signs of industrial activity could be found. It was however noted that the stream was flowing freely in spite of the drought conditions of early May 1976.

In view of all the above evidence we conclude that these water storage works could only be for the purpose of supplementing the depth in the navigation channel.

C. C. Ennever

C. F. Tebbutt

# The Casting of Bronze Guns in the Weald in the Seventeenth Century

R. Towes

(Note: Guns cast in the sixteenth and seventeenth centuries from an alloy of copper and tin were called, at the time, "brass" guns. In modern times, the term "bronze" has been applied to that alloy - "brass" being reserved to an alloy of copper and zinc. Hence, modern historians write of sixteenth and seventeenth century "bronze guns", and this example has been followed here, except when quoting.)

The castings of bronze guns at Brenchley, in the Weald of Kent, has been overlooked in the many excellent accounts of Wealden gunfounding. Yet the Browne family of gunfounders were casting bronze guns there from 1634 to (approximately) 1670, and John Browne in 1638 cast the 102 bronze guns for the famous 'Sovereign of the Seas' - the show-piece of Charles I's ship-money Navy, the first English three-decker, with a distinguished record in the Dutch Wars of the Commonwealth.

Casting in bronze is of ancient origin and bronze guns were cast in Flanders and elsewhere in the fifteenth century. Henry VIII purchased bronze guns from abroad, but also brought foreign founders to cast bronze guns at the Tower. One of these gunfounders, Peter Baude, was persuaded to go into Sussex to attempt the casting of iron guns at Hogge's furnace, in 1543, with highly successful results.<sup>1</sup>

In the sixteenth and seventeenth centuries, English founders cast bronze guns at Hounsditch and Vauxhall, the chief founder holding the post of "His Majesty's Founders of Brass Ordnance".<sup>2</sup>

Bronze guns were highly expensive, but held in high esteem by successive Lord Admirals and their advisers. There was an advantage in weight over iron guns of similar calibre of about 3:4, and this was highly important at sea where an over-weight of guns could be disastrous. Yet, in the seventeenth century, the shortening of guns ("cutting the culverin") and the increase in the size of ships diminished the advantage in weight of the bronze gun.<sup>3</sup>

The pattern of use which developed, after the introduction of cast iron guns in 1543, was that the armed merchant ships (comprising the greater part of England's strength at sea) carried iron guns; the quite small number of powerful royal ships carried bronze guns. Iron guns were used in the forts.

The prestige of the bronze gun, and its ornamentation, undoubtedly influenced naval captains.<sup>4</sup> It is significant that in Elizabeth's reign, privateers carried iron guns in their dangerous trade, and, later on, the great ships of the East India Company (comparable in size with the royal ships) carried iron guns almost exclusively.<sup>5</sup>

When Charles I embarked upon his extensive building programme in 1632, with the aim of building a Navy to equal that of Elizabeth, he armed the new ships almost entirely with bronze guns. The cost was high: £130 to £150 for bronze guns against the mere £13. 6s 8d per ton for cast iron guns (£35 a ton for Browne's iron guns of "refined metal").<sup>6</sup>

It was in connection with this naval building programme of 1632-1638 that John Browne, the royal founder of iron guns and shot (a post held by his father, Thomas Browne and himself since 1598) became in addition "one of His Majesty's founders of brass ordnance".

In February, 1634, Browne offered to cast bronze guns in addition to his normal work in casting iron guns. The offer was immediately accepted by the Officers of the Ordnance and by August of the same year he was at work on melting down obsolete bronze guns and casting new ones from the metal.<sup>7</sup>

Browne at this time was in dire financial trouble, through unwise speculation in the export market for iron guns, and had to appeal to the King for protection against violent men" - his creditors.<sup>8</sup>

His reputation as a gunfounder stood high and the Lords of the Admiralty were anxious to keep him in business. Not only was his offer to cast bronze guns accepted, but in 1635 he was given a monopoly in the casting of iron guns (including sales to the merchants) and a monopoly in the casting of pots, pans and firebacks.<sup>9</sup>

There was a danger at this time that the casting of bronze guns would die out in England through lack of founders (a fear expressed by Robert Norton in *The Gunner*, 1629). Philips, a founder of bronze guns, had recently died, and one of the two Pitt brothers - Richard Pitt - was soon to give up; though Thomas Pitt continued to cast bronze guns for many years to come after 1634 sharing the work with Browne. The

Pitt family had been casting bronze guns since Elizabeth's reign.

It was proposed, in 1634, that Browne should use the foundry at Houndsditch after repairs had been done, but he suggested that money would be saved if he built a foundry for casting bronze guns in Kent at about the same cost.<sup>10</sup> This was agreed, but it was in fact a dubious claim, because copper and tin had to be carried via the Medway to Millhall or Yalding,<sup>11</sup> and thence by land carriage to Brenchley; and the finished bronze guns had to make the same journey in reverse (the total cost involved was 32 shillings a ton).<sup>12</sup>

From 1634 onwards John Browne, and after his death in 1652 his son George, in association with Thomas Foley and other partners, cast bronze guns at Brenchley and iron guns at Horsmonden. It is impossible, in a short space, to give details of the various orders for bronze guns carried out, but it is worth looking at the order to cast bronze guns for the 'Sovereign of the Seas' in 1638.<sup>13</sup>

Browne cast 145 tons of bronze guns at a cost of £23,525 - this cost included engraving each gun with the rose and crown, sceptre and trident, anchor and cable; with the addition of 'Carolus Edgari sceptrum stabilivit aquarum'.

The guns were tested on the spot at Brenchley, instead of at Millhall or at Artillery Yard. The sum of £3 was paid to the owner of the ground, with £3 more "for the ground where the shot did fall being much spoiled". The existence at Brenchley today of Flightshott Farm suggests that this might be a good place to look for iron round shot cast by John Browne and used in the Master Gunner's double proof.

Despite this order for guns for the 'Sovereign', the casting of bronze guns remained subsidiary to the main business of the Brownes which was that of casting iron guns and shot.

The work done at the "brass-works"<sup>14</sup> at Brenchley was of course of a different nature from that done at the Brownes' iron furnaces - apart from the actual casting process.

Copper, smelted at Keswick by the Society of the Mines Royal, and tin smelted in Cornwall, arrived in bars. All that was needed was to mix them in the right proportions in a melting furnace (that built in

1634 had a capacity of ten tons, after which it had to be re-built).

No description is available from contemporary sources of the Brownes' foundry, though it may well have been a reverberatory furnace such as that used at the Royal Foundry early in the eighteenth century, described in great detail in *Eighteenth-Century Gun-founding* by Melvin Jackson and Charles de Beer.

Some interesting facts emerge from debentures made out at the Ordnance Office. The proportion of copper to tin was normally 14 of copper to one of tin, and the founder was allowed for waste "ten pounds of copper upon every hundredweight and. 1cwt. 2qrs. of tin for every ton".<sup>15</sup>

Although Robert Norton in *The Gunner*, citing foreign authors, stated that a small proportion of "latten" was included with the copper and tin (latten was another name for calamine, a zinc oxide), this was certainly not done at Brenchley. Norton's figures for the proportion of copper to tin were also widely at variance with that used at Brenchley - yet another indication that writers of technical books at this time copied from earlier books, rather than writing from observation.

Perhaps the most interesting gun cast by John Browne was a saker in 1637. A certain Captain Whitmore transmuted iron into copper ("as he affirmed", as the Ordnance Officers put it) and the copper was despatched to Browne who, after a suitable in-mixture of tin, produced a bronze saker. The King was present when the gun was tested but Captain Whitmore, who was paid £202 (hardly, perhaps, the "rate for the job" even at that date) is not heard of again.<sup>16</sup>

Charles I paid Browne the compliment, in 1638, after the completion of work on the guns for the 'Sovereign', of visiting the foundry at Brenchley. A bronze gun cast by Browne is inscribed "October 5th. 1638 John Browne made this piece. Mountjoy, Earl of Newport, Mr of the Ordnance". Sir Charles ffoulkes notes that Secretary Nicolas wrote in a letter "The King goes to Kent, from Hampton Court to-morrow and will not be back till Saturday": the date of the letter was October 2nd. 1638.

Four model bronze guns, thirty inches long and an inch in calibre inscribed "John Browne made this piece" and with "C.P." under the

Prince of Wales feathers are in the Tower. They were evidently presented to the King, for Prince Charles, on the occasion of the visit of the King to Brenchley.<sup>17</sup>

It is unfortunate that details have not been preserved of the Brownes' melting furnace, and that its precise location at Brenchley is so far unknown; but the above notes on the casting of bronze guns in the Weald may suggest that this "spin-off" from the casting of iron guns is worthy of further study.

## Notes

1. For the manufacture of bronze guns in Europe: C. N. Cipolla, *Guns and sails in the early phase of European expansion*, 1965
2. An account of foundries castings bronze guns in and around the Tower is given in C. ffoulkes, *The Gunfounders of England*, 1937.
3. In 1626-1630 when an attempt was being made to reduce the weight of guns, the "old weight" of a bronze culverin was given as 32 cwt. and the "old weight" of an iron culverin as 40 cwt. (PRO- SP 16/91/34 and SP 16/13/97). With the shortening of guns, a slight difference in length could make an iron gun hardly more heavy than a bronze gun of the same calibre: Browne cast an iron demi-culverin drake of 17 cwt in 1637 (PRO- WO 49/65) and similar bronze guns cast in 1635 weighed 16-17 cwt. (PRO - WO 49/70). The lengths are not stated, but the iron gun was probably shorter than the bronze guns.
4. Iron did not lend itself to the elaborate ornamentation of the bronze gun. The bronze gun was a work of art; the iron gun a cheap (but effective) mass-produced product.
5. For the armament of privateers: K. R. Andrews, *Elizabethan Privateering*, 1964. For the armament of East India Company ships: K. Chaudhuri 'The East India Company and its shipping' *Mariners Mirror* Vol. **49** (1963)
6. PRO - WO 49/70, 72, 75.
7. PRO - WO 49/65
8. PRO - SP 16/279/27
9. PRO - SP 16/293 - 4: the monopoly in casting iron guns was temporary, but confirmed in 1639.

10. BM - Harl. MSS 429 and SP 16/475
11. The Medway was not made navigable above Maidstone until 1635, when it was improved as far as Yalding. Previously, the Brownes sent their guns by land from Horsmonden to Millhall, a few miles below Maidstone (*Journal of Transport History* Vol.5 No.2)
12. PRO WO 49/65
13. PRO WO 49/75 This gives the full, final cost of the work on the Sovereigns' guns, in full detail.
14. The term "brass-works" is used in Dyke-Hutton MSS. GB/AC/WmDyke No. 611, to describe the foundry at Brenchley.
15. PRO WO 49/70
16. PRO WO 49/70
17. C. ffoulkes *The Gunfounders of England*, 1937

(We are much indebted to Mrs. Judith Brent, N.A., of the East Sussex Record Office, for not only drawing our attention to the following correspondence between Sir Edward Gage and Sir Richard Sackville, between 1560 and 1562, but for her work and for transcribing the texts. We are also grateful to Lord Gage and the Sussex Archaeological Society for permission to publish these extracts.

From the point of view of the Wealden iron industry the correspondence throws light on mining methods, good and bad, in the 16th century but also shows that the large landowners were taking advantage of the unsatisfied demand for ore at the time. It is interesting also that whereas Straker (*Wealden Iron* p.414) gives 1574 as the earliest reference to the Sackvilles (Lord Buckhurst) at Sheffield Furnace, from these letters it is evident that they had it in 1560.)

### **A dispute over Iron Ore between Two County Grandees**

Given below are extracts from correspondence between Sir Richard Sackville and Sir Edward Gage in 1560 and 1562 which is deposited with the Sussex Archaeological Society. (G6/50) Sir Richard Sackville, first cousin to Anne Boleyn, the mother of Queen Elizabeth, had established himself as a prominent member of the rising gentry before her accession,

having grown rich by the exploitation of secularised monastic and chantry property. In 1558 he was elected M.P. for Kent and in 1563 for Sussex. Sir Edward Gage's father, Sir John Gage, a prominent and successful courtier under Henry VIII and Queen Mary, had also waxed rich through the purchase of monastic properties but the continuing allegiance of Sir Edward Gage to Roman Catholicism may have sapped somewhat his local standing and power. Rest Hills, the copyhold in question, lay on the northern edge of Ashdown Forest in the Manor of Maresfield but in the parish of East Grinstead adjoining the highway from Newbridge to Forest Row and consisted of 11½ acres of arable and 51½ acres of woodland. (see G6/10).\*

An attempt has been made to reproduce the original spelling as far as possible, given Sackville's extremely difficult handwriting and the faded condition of the Gage letter in parts. Some additional punctuation has been added if felt necessary for the sense. Words in brackets are suggested readings mainly after study of the document under an ultra violet ray lamp.

\* The present Ryst Wood (TQ 437 346). Much of this is now developed for housing, but there is still evidence of quarrying in it.

### **1. Sir Richard Sackville to Sir Edward Gage on 14th June 1560:**

Sir I commend me most hartly to you and to my lady your wyff Ryght glad to here of your good helthes, wyshyng the longe contyneuance of the same, havynge thys day perseved by a letter sent me from you by my cossyn your son, that suche as have the charge of my works at Sheffeld shuld enter into a pore mans lande, a tenant of yours, of the lande you last had of the queense majesty without hys knowlege, or yours, Wherof I dyd myche marvell, consyderyng that longe Before you whent throghe with the same purchase I dyd understande of the same myne (Written mynde) to be in the same lande, and was by my friends advertysed of yt with advyce for the staye of the same lande for that Respecte, wyche made me to sende and speke also to Almerly my servant in that matter, to move you in yt, who dyd advertyse me yt Rowlande the myner had not only moved you in yt and had reseved anser to have yt with hartly good wyll, payyng for yt, as was before tyme payd ther, But also dyd advertyse me of the full consent and aggrement of the copyholder of that lande, so that I am assurede you shall not fynde yt, that any towards me would usse any man in suche sorte as your letter declareth, yf I myght truly understande

of any suche man towards me that woll usse any man after that sort I wold soon dispatche hym, and that I dyd bothe speke and wryte to Almery to move you of yt, and that he dyd so, as he sayes, by the mought (?mouth) of the same Rowlande, my cossyn your sone dyd thys day here Almery affyrme no lease than I now wryte unto you, and tochyng the holes dyggede yf they be not ussede as they owght to be, I shall cause them to do yt, and I have spoken with Almery for that purpose, and I do assure you, yf I wold have byne perswaded by some that love me well, aswell for the consyderaton of that myne in yt as also for the nernesse of yt to the manor of Allyngton, to have procured yt for my self, I culd have done yt, but I trust not to lyve, that any proffet or other respecte, shall make me breke my promes with my frende and yf I may not with your good wyll and the tenants ther, have the myne for my mony, I wyll not medle with yt ...

## **2. Sir Richard Sackville to Sir Edward Gage on 15th May 1562**

Sir I dyd not meane in my letter but to anser you accordyng to reason, as well for the myne alreddy taken and spent for any other usse then for the usse of ordenance and shott, as to do the same her after but I thynke you shall fynde lytle of the myne that came from you converted to any other usse then only for shotte, yf ther dyd, they that have the charge under me telle me untruly whose trewghte (?truth) herin I shalbe wylllyng yf you mistrust them to examyne them Therin and my nowe boks shall not be hyd from you in yt, for I had no small stoke of myne from other places, when I began to dyge in the lande that ys nowe yours and as I am informed I have yet left of that myne to serve me thys yer above vii<sup>e</sup> lode off Sheffelde myne and yt dyd come from other place besyde yours whyche dyd never cost me of any man above 1d a lode and yf my good wyll to you and the consyderason of my promes to helpe you to that lande, had not byn more in me towards youm then the consyderasyon of my nowe proffet, you had not had the occasyon to have axed to dere a pryce and so far dyfferyng from other mens of me now, and for that wyche never cost you penny nor was rattede unto you as you best know ... and thefore for the myne that ye or shalbe convertede to my nowe usse, wherine I have geven charge they shall make as trew declarasyon to you as they shall do to me, how myche of yt was spent to sowes and iarne and how myche of yt to shot, I wyll anser to you for that ys past and that shalbe that wayes spent as you wyll after the peruesyng of thys my letter say you wyll have for yt, but yf iiiid be your prysse I wylbe swor I wyll occupy as lytle as I can to that usse and for that wyche ye convertede to the

quenaes usse for making of thyngs for her assayers yf I shuld pay ii parts of these, more then ever I dyd and have agen no penny more then I had x yers past, I thynke I shuld do as Rafe Hoge and som others have done, glade to geve up or be dreven to geve up the servyng that wayes that must besyds as you know pay to the workemen and for the stuff redde mony and reseve yt agen as that may be, how long tyme of forberying I wyll not wryte and therefore of them that you wryte of, yf they wyll be bonden to serve the quense majesty as I am bounde at the pryces I do, I shall at your desyer any tyme when thys monthe yf you sende to me yeld up all that I make at Sheffeld that waysse unto them for that I wold not your hynderance of them that wyll bothe serve of the pryce I do, and geve you iiiid for a lode of myne as you wryte to me, I thynke yf they contynue one yer they wyll not carry out the other and therefore comyssions be ever granted to them that serve the pryce assayers and with the clause that you wryte ever in ther conysson aggreying with the parties whyche ever hetherto hathe byn ussed that yf the party wold ax (ask) duple of the pryces that was before or ii parts more in iii then before to have by the next justyce praysons to be chossen and that pryces to be the aggrement, wherwith the party ys to be contented as the same was done between you and me, and wyche I caused advysse before hand to be taken, after I herd of the sendyng of your son for the unladyng of the carts of myne, beyng the first offer of unkyndness (?which) I wyshe had never byn done and yf ye ii cheff justyces shall say to you that the praysement made by them for that was dyggede ther, was not good in the law, I shall pay you as myche for yt as they wyll say you can axe for yt by the lawe...

### **3. Sir Edward Gage to Sir Richard Sackville on 30th May 1562**

And concerninge my myne, notwithstandinge all the consideration before, your dyger and myners did set in to digge myne without speakinge anie worde to me, and when I knewe of it I came to Buckhurste and enformed you of theire doinge, and you sowre to me it was unknowen to you, but seinge they had founde myne there so necessarie to your worke you desired frendlie and gentlie of me, to have it for your money, and I as fendlie and gentlie presentlie graunted you the lawfull plesure I might therin, so your myners wolde use the grounde and my poore tenante otherwise then they had done, for they had made shamefull spoils of his grounde, and filled not the pitts after them, so that the grounde (as they lefte it) were not possible to be eared and sowed, not to pasture

with cattell, but in danger for base therof, and then you promised me you woide take present ordre for the reformation and this was in the latter ende of the whitson weeke, or the weeke after, for I remembre I came from Arundell castle from my lorde Lyefftenant with lettres directed to you and me for the ordre of the este parte of the shire, your answeere wherin you beste remembre, from that time to the lente followinge I never came thither myselfe nor sente anie man for me, supposing all thinges shulde have bene performed as you had promised the which indeed, when my sonne and my servants founde favour ther with them they spoke to Browne your servante, and tolde him that if they used my land so, that they shulde digge no more myne there and (upon this ? report) made to me and lettres sente to you and (the thing not ...ed) I com(?manded) your mynores to (?leave ...) and then Browne your servante said to my servants that your myners shulde Digge there still notwithatandinge my commaundemente, for if you mighte not have it by my licens you wolde have it by your owne intereste, wherupon indeedde I caused John Gage to goe thither and discharge your myners and carryers, and then you procured the Quenes Comission, the which Browne broughte to the grounde with myners, dyggers and caryers and my sonne readinge the Comission, (beinge by chaunce there) at their commynge, asked Browne whither he had bene with me to comme and agree with me for the price of my myne, and Browne said noe. Then my sonne said to Browne and all the rest of the myners, caryers and Cunstable that was ther, Masters you heare the wordes of the quenes comission that he shulde firste repayre to my father, the which is not passinge vii myles hence, and comme to agree with him, the which seinge he saith he hath not, he shall not digge nor carie none hence till that he have so done, then said Browne, beare recorde Masters he disobeies the quenes comission, nay said my sonne, you abouse the quenes comission, for I doe and will both obeye and honour her graces comission, as longe as your Master was contented to take it by and with my fathers frendshippe, so longe fath he had it frendlie and gentlie, but seinge you will have it firste by the lawe and nowe unfrendlie and unkindlie by comission you shall have none hence till my fathers pleasure be knowen, and upon this because I wold not graunte the myne to Browne for a ld a lode, the which I thoughte not reason, my cosin Thomas your somme and Mr Lunsforth with Mr shirif and such others as your owne sonne or your men for you did procure did come to my grounde, and there without knowledge geaven to me therof, with suche persuasion made by my cosin your sonne to those prisers that were

procured and chosin by your servante without my beinge there or anie men for me, by my knowledge and commaundement to sale what I culde for myself, my myne in deede after this sorte was prised at lease then a lode a lode, where in deede I knowe you geave more a great deale, and withall caused (a privie sittinge at Flet) chinge, wherof if I had not chaunced prively by my frendes there to here of, and so sente my sonne thither to be there (before those were) examyned of the carriers and mynors (...? then they culde saie nothings) but honestlie and trulie of my sonnes lawfull and humble behaveoure at the extreme entrie Browne wolde have made, for if they culde of lykely (had) he had heard of it to his paines, and yet all this not sufficing, beinge to you and yours as I am, and of summe reputacion in the cuntrie, to be sent for by a persevante to as muche discredit and reploache as culde be, all these causes you drive me to revive and repeate because you charge me with suche sore termes of ingratitude, of which both occasions and demayners if they were all trulie and plainlie declared betwene you and me with somme of our mutual kinsmen and frendes present, I truste you nor they shall finde no suche ingratitude and unfrendshippe broken and shewed without a great and good occasion to and for the same, And Sir I praie you weye and considre the case indifferentlie, eaven as I were in your case, and you in myne, whither you wolde thinke anie frendshippe or kindnes in me if I were as you are, and you contente to showe me the like frendahippe and frendlie libertie at my firste motion, havinge my whole commodytie one whole yeare of you at any reasonable price I wolde my selfe make, and then when I had taken my comoditie to your damage and wolde not reforme the same, but by all meanes to seke to procure it spite of your (?tethe)\* so muche to your discredit reproche and hindraunce without thanks or frendshippe, wolde you thnike I beinge in more authoritie and estimacion then you, and shulde use you as I am used, in your owne conscience, I used you well or frendlie I thinke surelie maye and so I praie you cosin Sackvile waie my case to be youres and youres to be myne indifferentlie, and I truste you will judge of me otherwise then you do.

And cosin Sakvile fewe or no men are used as I am, for the Quens Majesty take no comodytie of anie, neither of myne, beves, muttons, come or anie other thing, everie yeare and alwaies of one man till her grace hath had all, but somme of one and somme of another, one year of one man, and another yere of another, and likewise one with another and

therfore I praie you Sir let me be considered, you have a great deale of my myne yet to imploye all readie to the quenes use and your owne, and yet you have taken it marvuluslie to my hindruance and discommoditye, for your men have taken but the upper parte of my myne for their great gaine and for little price for that digginge, and for lacke of digginge somewhat deeper have lefte as mucche and more behinde them, the which is nowe so drowned and spoiled that it is not to be comme by but with great charges, the which if it had bene taken all with one worke when they were in the same, there wold have risen as mucche more and of the beste and greatiste myne for somme purposes with a verie little charge. And Sir so you will beare with me and shewe me your lawfull frendshippe, contentinge yourself with that you have allreadie, imployed, as yet to be imployed, and take from henceforthe of other men as well as of me indifferentlie, I culde the better be contente to shewe you the reasonable frendshippe you culde desire of me in the price of all that you have had alreadie, the which I truste you take for good reason.

\* Displeasure. Cf. tetchy.

## **Comment and Review**

**G. Hammersley - "The Charcoal Industry and its Fuel, 1540-1750"**  
***Economic History Review* 26 (1973) pp.593-613.**

Although the apparent destruction of woodlands by the charcoal iron industry led to many voices being raised in protest, praise was also expressed for their sound management (see, for example, Lower and Straker). It is clearly of considerable interest to try and determine just what the true position was, but this is a formidable task. For not only is much of the relevant quantitative data hidden in scattered records, but some of it is given in units not easily rationalised. The analysis has, however, been successfully achieved by G. Hammersley in this impressive and comprehensive paper. Among his conclusions two are of special significance. One is that pressure of the industry on the woodlands never caused their general destruction, and did not unduly hasten the ultimate decay of the industry. The other is that whatever were the local economic problems in the supply of charcoal, these were not so severe as themselves to have stimulated development of the coke-

fuelled industry. Other economic factors are considered to have been dominant in both cases. The long survival of the industry, together with increasing furnace productivity, certainly seems to belie the idea of diminishing fuel supplies. However, it is conceded that the industry could not expand sufficiently to compete with the high and increasing level of imports, though some imported iron was inevitable because of its superior steel-making quality.

In the overall analysis, available data for wood and charcoal production are a little more speculative than those for actual furnace operations. One difficulty is that wood and charcoal were accounted for by packed volume, thus leading to wide variations in actual quantity. Charcoal consumption is tabulated in "loads", derivable from so many cords of wood. The standard cord (as used in the Weald) was 128 cu.ft., though the Welsh cord was 175 cu.ft. The actual amount of wood ranged over about 0.5-0.8 of the superficial volume. The author combines the higher figure with a quoted, but unqualified, coppice productivity of 100 cu.ft. of solid wood per acre, per annum\*, thus implying a productivity of just about one cord per acre, per annum. This is a most useful figure to bear in mind, and it is a pity that the author does not exploit it explicitly as a working parameter to simplify his manipulations; indeed, these may well daunt the casual reader. The average charcoal load was a little over 3 standard cords. (Coppices, incidentally, were only cropped about every 16 years or so.)

The total amount of charcoal used in producing one ton of refined bar fell over the period from about 16 to 5 loads. For pig iron alone the amount was about  $2\frac{1}{2}$  loads in the latter part of the period; and approximately  $1\frac{1}{3}$  tons of pig was required for each ton of bar. Thus it follows that a large furnace, producing about 800 tons of pig iron, would have been satisfactorily sustained by 7000 acres of woodland, with another 6000 acres if all had been refined. Assuming that a third of the countryside was under wood, the overall figure of about 50,000 acres represents a working radius of about 5 miles. This was about the limit for reasonable transportation, but is a high estimate since, on average, only a proportion of all pig was refined. The likely availability of so much woodland is, unfortunately, not discussed (but see below). For the country at large the precise scale of the industry is difficult to assess, but the number of operative furnaces fell, from

a maximum of around 90 to about 50 in the later more efficient phase. Corresponding numbers for the Weald were about 50 and 12, indicating a relatively fast decline.

The Weald furnaces remained small with an average productivity of about 200 tons of pig (or castings) at peak development. Hence 1600 acres of coppice would have sustained production, representing about 7<sup>1</sup>/<sub>2</sub> sq. miles of countryside. Only a small proportion was refined, so total requirements would have been found within 10 sq. miles representing a radius of about 2 miles. The author sees such a situation being met "without difficulty", and suggests that the limited size of Wealden furnaces may have been due partly to easy markets, partly to the limited and erratic water supply in the region and partly to exceptionally difficult transport problems discouraging long-range operations. Going now a step beyond the author, and relating the peak number of about 50 furnaces to about 1000 sq. miles of countryside, it is evident that, on average, each furnace occupied more than twice the critical area, thus apparently confirming an easy situation. But one cannot disregard a multitude of other competing interests, all no doubt trying for the more accessible woods, and thus leading to some fierce rivalry. One may therefore incline to the less favourable interpretation that the Wealden industry was indeed restricted by charcoal supplies, though this may not have been the only factor in limiting development. But some furnace situations must have been better than average, and so presumably the factors indicated above were also responsible for discouraging higher productivity in these cases. And, indeed, it is implied that it was because of such factors that the Wealden industry could not, in the long run, compete with better-endowed fields, although initially it was very effective.

By contrast, the relatively small but highly concentrated Dean industry was, at the beginning of the 17th century, encroaching on neighbouring crown forests for half its charcoal supplies. This led to an untenable situation, and toward the end of the century the industry stabilised at 7 furnaces of about 500 tons productivity (with some of this being refined) which would have just matched the available 50 sq. miles of the Dean Forest.

Finally discussed is the high and ever increasing cost of charcoal, which amounted to more than half the total cost of iron. This led to

the threefold improvement in furnace efficiency over the period. But prices, though high, were not highly profitable to landowners who usually had a vested interest in seeing the iron industry achieve an economic balance. Thus charcoal prices were more stabilising than disabling.

Very broadly then, this paper demonstrates that nationally the industry managed to stabilise itself at a modest but economic level with efficiency rather than expansion the keynote to success. But some cases of woodland depredation would not have been improbable. Ultimately it was the failure to meet ever increasing demands that slowly led to the decline of charcoal in favour of coke fuelling.

I. B. Mason.

\* A communication from the Forestry Dept., University of Oxford, indicates considerable variation with species and soil with an optimistic average of about 70 cu. ft. per acre. But this, combined with a lower, more realistic, packing fraction still results in about one cord per acre.

**THE BEWL VALLEY IRONWORKS by David Crossley, published as a Royal Archaeological Institute Monograph, 1975.**

This account is not likely to be readily available to the public and it is thought that members would like to have a short summary of its contents.

The Bewl Valley is located in the centre of the triangle formed by Wadhurst, Lamberhurst and Ticehurst on the Kent and Sussex border. The River Bewl is a feeder of the Teise, which is a tributary of the R. Medway, and the valley is the location for a new reservoir which has submerged both the Chingley Furnace and Chingley Forge sites.

Very little surface evidence remained of the forge, apart from a ditch which represented the tailrace and a very slight indication of the position of the bay - the latter having been levelled and ploughed out over many years. The furnace was in a narrow steep-sided valley and the bay was still easily visible.

The documentary evidence indicates that iron was being produced at Chingley in the early 1300s, and it is probable that this refers to the forge site. The first reference to Chingley Furnace in the Robertsbridge Steelworks accounts is in 1565, and it is mentioned again in the 1574 enquiry into Weald Ironworks, but by 1588 it is reported as "fallen down and utterly decayed". The forge, after a period of disuse, was in operation again in 1588 and continued at least until 1637, some time after which date it was again out of use but was once more re-furbished, since it appears in Fuller's list of 1717. Final closure date is not known but probably in the mid-18th century.

#### The Forge.

Three periods of operation were identified during the excavation, each using a separate and generally superimposed wheelrace. In Period I the wheelrace was built of heavy oak timbers mortised and tenoned to a remarkably high standard of workmanship. Fourteenth-century pottery fragments were found in the filling round the timbers of the race, confirming the dating of this phase. A fragment of a waterwheel consisting of one sideboard and three bucket boards was found, indicating a diameter of 8' 3" and a width between sideboards of 1' 1", probably an overshot wheel. It is supposed that this waterwheel powered the forge, but no anvil support relating to this period was found. A fragment of a gear wheel was found but its use could not be identified. It is believed that operation of this phase ceased about mid-fourteenth century.

In Period II, late sixteenth century, a new wheel pit was built, partly over the earlier structure. The construction, again of oak, was wider and heavier than the first, and apparently designed to accommodate a pair of wheels mounted side by side on the same axle. This construction would have provided a greater torque than a single wheel and would have overcome any difficulty about building a double width wheel of adequate strength. Again the most likely purpose of this wheel was the operation of a hammer, but no evidence of an anvil pit was found, possibly due to the alterations involved in the construction of the Period III plant.

In the early seventeenth century the site was redeveloped, the bay further strengthened, and two wheel pits constructed, one in stone, for wheels to operate a hammer and bellows for the finery and chafery hearths.

The foundation for the anvil was of extremely stout construction, consisting of a 7 foot vertical length of oak tree trunk resting on sleepers and strutted laterally from timbers lining the pit in which the foundation had been built. The iron anvil had not been left but its imprint could be seen on top of the foundation.

The Furnace.

This had been a stone tower, 18 feet square, and had survived to the extent of 4 or 5 courses. The corners of the tower had been braced by vertical timbers, some 10 in. square. The hearth, which had been built in a stone-lined chamber within the tower, had in part survived, and the remains of the lining and adherent slag were clearly visible. It seems probable that the casting beds lay over the culverted tailrace of the bellows wheel, but no pig beds were found, nor did there appear to have been a gun-casting pit.

The bellows had been placed between the furnace and the dam, and two pivot posts survived, together with a portion of the camshaft and an oak bearing block. The camshaft had at least two sets of three cams, staggered to give an even blast, and had probably operated by lifting the bottom boards of the bellows. Part of the overshot water-wheel had survived, set in a timber lined wheelpit, and had an outside diameter of 11ft 2in. and a width between sideboards of 10 inches. The furnace was probably out of use by 1588 after a life of some twenty odd years.

The paper describes the construction and the various phases of the forge and furnace in very considerable detail and gives a clear picture of the methods in use at the various periods. It is fully supported by plans, diagrams and photographs, and also by comprehensive schedules of the various finds, which included pottery and many artifacts of iron, together with descriptions and comments on these by a group of specialists. This closely reasoned interpretation of a very complex site is a valuable contribution to our knowledge of the iron industry.

Philip Willmott.