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MAGIC IN THE IRON

FIREBACKS FOR SPIRITUAL PROTECTION

(Fig. 1)

This fireback, which is now in a house in Old Heathfield, used to be in the Warbill-in-Tun Inn at Warbleton (now, alas, a private house). The quasi-symmetrical arrangement of decorative elements will have been deemed pleasing to the eye, no doubt, when it was cast sometime in the late-16th or early-17th century. But behind the placing of the ends of an iron firedog, and the saltires formed with two different lengths of rope probably wrapped around a piece of dowel, may lie an apotropaic, or evil-averting, purpose.

Since the Middle Ages, at least, people had been conscious of the power of the Devil and his familiars, such as witches, to cause crops to fail and accidents to befall them. In the Tudor period two Witchcraft Acts were passed to enable the prosecution of those who

> *... use devise practise or exercise, or cause to be devysed practised or exercised, any Invovacons or cojuracons of Sprites witchecraftes enchauntementes or sorceries*

and despite attempts, such as Reginald Scott's *Discoverie of Witches*, published in 1584 (whose son-in-law, incidentally, owned Cansiron Forge), to rationalise those fears and discredit those who fuelled them, deep-seated beliefs in malevolent spirits persisted and, to some extent increased. James I, himself was a fervent believer and had published his own guide to the power of 'the dark side' in his *Dæmonologie* of 1597. And another Witchcraft Act was passed shortly after his accession to the throne of England in 1603.

So householders resorted to all manner of stratagems to protect themselves, their families and their homes. Many of you will be familiar with the marks sometimes found on mantel beams in old buildings: scratched Vs and Ms, circles and burn marks. All were intended to invoke protection in the most vulnerable part of the house, which was the chimney. Unlike windows and doors, it was the one opening to the outside that could not be closed. Iron was also believed to have protective properties and the hanging of horseshoes, concealing of knife blades and, less commonly, the placing of an iron plate beneath a doorway (such as at the Priest House in West Hoathly) were believed to be efficacious. In houses that could afford an iron fireback the decoration of its surface with motifs that invoked the protection of religion would have been seen as a powerful safeguard. Thus, the saltires on the fireback above - signs of the cross - and the display of *three* fire-dogs, the number associated with the Trinity, were thought to be potent.

This fireback in Figure 2 is in the Manor House in West Hoathly and as well as saltires, there are double-V or M shapes - *virgo virginum* (virgin of virgins) or *Maria* - and single Vs. Seeking the protection of the Virgin Mary seems to have outlasted the Reformation by many decades. The roundels, with their crosses formed from hearts, may also be apotropaic. The same stamp is on another fireback that is in the collection of the Sussex Archaeological Society in Lewes. The writer has recorded over 60 examples of firebacks with evil-averting motifs.

Jeremy Hodgkinson

Figure 2. Fireback in West Hoathly

Wealden Iron. **The Bulletin of the Wealden Iron Research Group. Potential contributors are reminded that the copy date for the 2023 Bulletin is the end of April.**

Contribtions to the editor *via* jshodgkinson@hodgers.com please.

KITFORD MEAD, COWDEN

This striking cottage stands at the eastern end of Furnace Lane, just in the Sussex parish of Hartfield but a short distance from the little Kent village of Cowden. In 2010 it was the subject of a survey by David and Barbara Martin, who remarked on the number of impressive features. These included the fact that, apart from a small number of additions to the exterior of the building, the original two-bay structure had remained unaltered with the chimney at the southern end, the two-storey, east-facing bay windows, the two-room, second-storey garret, and the en-suite garderobe set into the chimney and accessed from the principal first-floor room. They were impressed by the quality of the timber framing, and the decorative combing on the wattle and daub infilling which was evident on both interior and exterior surfaces. This was not a grand house but it was extremely well built. They estimated that it dated from the 1570s and had been the home, not of a farmer, but of a wealthy craftsman. Years later the owners, Christian and Helen Viola, discovered a partial date, '157' inscribed in one of the upstairs daub panels.

Its proximity to Cowden Furnace, a third of a mile along the lane to the west, offered a tempting connection. In the 1574 lists two names are connected with a furnace in Cowden: Michael Weston; and the somewhat enigmatically named Quintine. Weston, of Leigh near Tonbridge, also had interests in Birchden Forge, Cansiron Forge and the furnace and forge at Robertsbridge. The lists noted that he had been established as a gun founder for five or six years and as his only other furnace, at Robertsbridge, was not known as a gun-foundry at that time, it can be presumed that Cowden was. Brian Awty, whose extensive research into the families of immigrant ironworkers will be well-known to many members, originally considered that Quintine had probably been associated with Scarlets Furnace further up the Kent Water to the west, but the evidence he produced in his monumental work, *Adventure in Iron*, has established a firm connection with the lower Cowden furnace nearer to Kitford Mead. Awty has identified him as Quintin Tyler who was first noted in Cowden in 1559 when he took on the administration of the will of the widow, Katherine Tyler, who may have been his sister-in-law. Quintin had been born in Neuville-Ferrières in Normandy in 1514 and had emigrated to England in 1531. When he was required to obtain letters of denization in 1544 he was working for Nicholas Eversfield who owned Pounsley Furnace. This was also a gun-foundry in the 1540s and later, so it may well be that Quintin Tyler was practised in that craft. Thirty years later, his mention in the lists in the State Papers suggests that he was probably managing Cowden Furnace for Michael Weston.

When Quintin Tyler died in 1579, aged about 65, probate for his estate was granted by the Prerogative Court of Canterbury, indicating that he owned property in two dioceses. Both Hartfield and Cowden are in Chichester but unfortunately Quintin's will does not tell us where, other than in Hartfield, he owned property. He left bequests to his three sons, Charles, Roger and John and to his wife Dionise. All three sons continued in the iron trade and it is from Roger, who became founder at Knepp Furnace, that we get the tantalising evidence that Quintin Tyler, the successful iron founder, probably built and lived in the well-appointed little house at Kitford Mead. In his will of 1617, among several domestic items that Roger Tyler left to his namesake son, was significantly "a Rd table at Kytford". Evidently the house was still in the family's possession.

I was invited to view Christian and Helen's house and they would welcome other WIRG members to see the property, perhaps in an organised group.

Jeremy Hodgkinson

WIRG experimental bloomery smelting normally takes place on the first Saturday of the month April to October, although are presently (July & August) suspended as a fire risk due to the tinder-dry conditions around the site. We have been kindly gifted an electric reciprocating blower by renowned, now retired, smelter Peter Crew which we will use to simulate the pulsating action and greater air pressure achievable when using bellows.

Contact secretary@wealdeniron.org.uk if you would like to participate.

ACCIDENTAL AND EXPERIMENTAL ARCHAEOLOGY 2022

A Report by Tim Smith (Hon Sec WIRG)

On the 10-12 June 2022 the Wealden Iron Research Group (WIRG) participated in the Historical Metallurgy Society's conference and demonstrations 'Accidental and Experimental Archaeometallurgy 2022'. Teams gathered at The Ancient Technology Centre, Cranborne, Dorset to participate in demonstrations and accompanying conference.

WIRG decided that they would perform a smelt as authentic as possible to archaeological evidence by taking advantage of additional team members and event participants to conduct the smelt using board bellows connected to a blow hole through the furnace wall, rather than an inserted tuyere, as tuyeres are seldom found on the Weald. A furnace was constructed of similar dimensions to that presently used by WIRG at their Pippingford site on Ashdown Forest, East Sussex, which in turn is based on some excavated Romano-British furnaces on the Weald.

Because of the short time available to build and dry a furnace, conduct a smelt and demolish the structure to return the site to its original condition, WIRG decided to part pre-fabricate a furnace at Pippingford. Local Wealden clay, which contains around 88% silica, was used with added grog in the form of previously demolished furnace wall, to reduce shrinkage. Hay, chopped to around 50mm, was incorporated to provide fibre reinforcement.

A wooden mould shaped in the form of a truncated triangle was constructed which was filled with clay and then compressed under a car jack acting against an overhanging tree stump. The blocks were air dried within an open front shelter over a period of a few months. Each block provided a wall thickness of 150mm and weighed around 9kg. The dimensions of the blocks were such that, eight blocks, 'cemented' together, would produce a circular hearth of 270mm diameter. Allowing for one absent block per course to create a slagging arch, 14 blocks were required to lay two courses. In the event, 20 clay blocks were made to provide spares should any be damaged in transit.

At Cranborne, the clay blocks were wetted by brief immersion in water prior to being 'buttered' with sieved Pippingford clay, wetted to a plastic state. The blocks were positioned around a sheet steel former, each joint being tamped to ensure gas tightness. Since all 20 blocks had survived transit, 60% of a third course of pre-cast blocks could be laid to a height of about 330mm.

The shaft above the blocks was built to a height of 1000mm using clay provided at Cranborne. This was a ball clay sourced from Devon and arrived as compressed dried sheets about 10mm thick. No analysis was available but the main constituent of a ball clay is kaolinite $Al_2Si_2O_5(OH)_4$ and so has a significant alumina content. To dilute this constituent and render the clay more mouldable, about 60% by volume of sharp sand was added when mixing the clay. The mix was kept as dry as possible to reduce drying time and the risk of slumping, and chopped hay added to the mix to provide some reinforcement.

The shaft was built against the former, around which cling film had been wrapped and soft paraffin wax smeared to prevent adhesion of the clay as it was packed against the former. To further guard against adhesion, as each layer of clay was completed, the former was rotated one-quarter of a turn (opposite to the wrapping direction of the cling film) by inserting a toggle bar. The former was slightly negatively tapered from 270mm diameter at the base to 300mm at the top to aid removing it vertically when the build was complete. To further mitigate slumping during the build, eight bamboo rods were inserted vertically mid thickness between the pre-cast blocks and secured near the top into notches cut into a thick carboard ring . The wall thickness of the shaft tapered from 150mm above the pre-cast blocks to 100mm at the top. The walls were constructed of 'sausages' of the clay mix kneaded by hand and incorporated against the former by impacting with the fist.

A slagging arch was created by leaving out two vertically aligned pre-cast blocks in the lower two courses, the gap being bridged by a pair of 10mm thick wrought iron flat bars as a lintel to support the clay of the shaft above this.

A 25mm diameter blowing hole, inclined down 23°, was made above the slagging arch. Measured on the outer wall, this was 360mm above the base, thus providing an exit in the inner wall calculated as 296mm above the furnace base.

The build commenced on the Friday afternoon and was completed by 12-30 on the Saturday. The former was lifted out without problem revealing a good smooth and consistent inner surface to the shaft. Lighted embers were charged to the furnace to commence drying and an air inlet block, which had been incorporated into the clay of the sealed slagging arch, removed.

The smelt

A Wealden Siderite ore collected from a stream bed at Stepney Ford Bridge, Kent was selected. This was a relatively rich ore by Wealden standards assaying at 36% Fe and 4.5% Si content. The average analysis by wet methods is indicated in Table 1.

Table 1 Analysis of raw Stepney Ford Bridge siderite ore (wt %)

Fe_2O_3	SiO_2 & in-solubles	Al_2O_3	CaO	MgO	Water	Vola-tiles	Not De-termined	Total	Total Fe	Total Si
51.38	9.53	6.06	2.14	0.0	0.86	29.00	1.03	100	35.96	4.50

We find that it requires at least four times the amount of iron to silicon (Fe/Si > 4) to create a bloom as much of the iron is lost to the silica as slag. We call this the 'bloom potential' and, for this ore, the value is 36/4.5 = 8. This is only an indication as it does not take into account any Si absorbed from the furnace lining, or the role of other element fluxing with Si in preference to Fe eg Ca & Mn.

The 'Accidental' element of the event came to the fore when it was discovered that the Wealden ore brought to Cranborne for smelting had not been fully calcined, necessitating in-situ calcining during the smelt.

Since roasting is a violent reaction with particles exploding as the volatiles are released, the uncalcined ore was broken to 10-15mm size to minimise internal pressure build up. Our normal procedure of topping up the furnace with charcoal to the very top and sprinkling ore onto this over a period of time as the charge level burns down (typically over 10 minutes or so) proved unsuitable at Cranborne as exploding ore was shooting out of the furnace. Hence we lowered the charge level to around 100mm below the top of the furnace and added ore prior to the charcoal so that the latter contained the violence of the reaction within the furnace. We also reduced the quantities of ore and charcoal added at each charge from our usual 1kg each to 518g. Interestingly, despite calcining being an endothermic reaction, no drop in furnace temperature was observed, as measured by thermocouples.

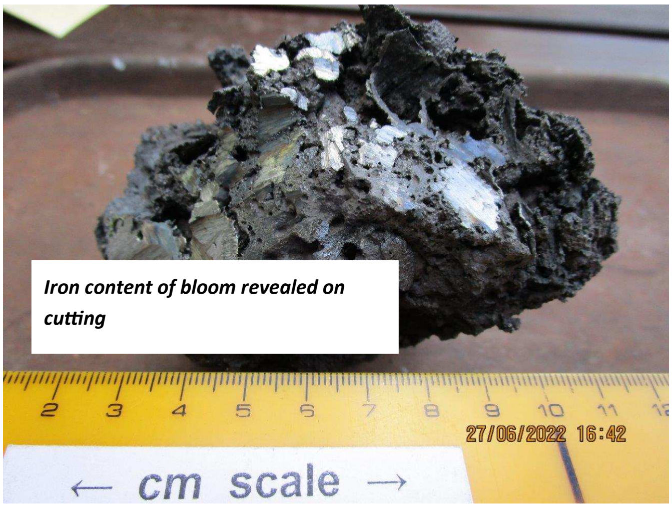
On smelt day, the intensity of the wood fire in the furnace was increased by blowing air with an electric blower. Once the temperature near the top of the furnace exceeded 700° C, the electric blower was disconnected and a pair of board bellows connected. These were pumped continuously for the next $4^3/_4$ hours by the two younger members of the team – Jack and Ethan - and any spectator who came within reach!

A total of 14kg each of ore and charcoal were charged at a ratio 1:1 for a period of 165 minutes. An additional 2kg of charcoal was then added in batches to feed the burn down period, air still being delivered via the bellows. The burn-down period lasted 120 minutes.

Attempts to tap slag from the furnace by penetrating the clay at the base of the slagging arch failed to produce a slag run. Indeed, a hollow was detected within the furnace above the base.

Following a two-hour burn down the slagging arch was broken open. Several masses of hot material were pulled out and hammered using a wooden mallet on a wooden anvil (tree stump). The first few pieces immediately disintegrated indicating them to be wholly slag. A heavy mass was then extracted which proved malleable under the mallet but eventually broke in two. Consolidation continued on both pieces with periodic returns to the remaining embers in the furnace to reheat but was stopped when sufficient re-heat could no longer be achieved in the part dismantled furnace. Once cooled below the Curie temperature, the material responded to a magnet.

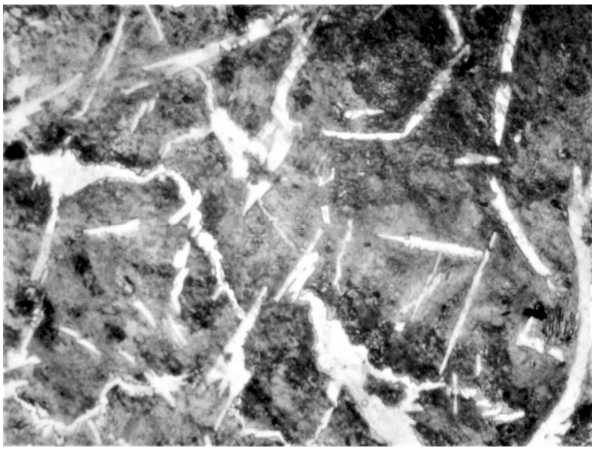
Subsequent to the event, the bloom was sampled metallographically showed it to be steel of composition ranging from 0.67 to 0.8%C. This high degree of carburisation is in contrast to what is generally achieved at Pippingford where, for example, a recent smelt of almost the same duration produced a bloom averaging just 0.13%C.



Iron content of bloom revealed on cutting

The lack of tap slag is attributed to the slag within the bloom consisting largely of Pyroxene (63.2%) of nominal composition $FeSiO_3$ which has a flow temperature of 1490°C, much higher than the lower flowing point fayalite $Fe_2(SiO_4)$ which runs at around 1256°C. Such fayalite slags are more commonly experienced at Pippingford. In addition, the high alumina content of the ball clay contributed to the formation of Plagioclase ($CaAl_2Si_2O_8$) as the second highest constituent (22.18%), constituents not normally associated with Pippingford slags.

The extensive carburisation of the iron bloom at Cranborne had evidently taken place. The viscous nature of the slag trapped in the bloom, consisting of 63% pyroxene, is suggested to have caused the burden to drop more slowly through the peak carburization temperature, thereby absorbing carbon to produce a high carbon iron. Pyroxene forms at a lower temperature than fayalite. Hand pumping of the bellows over such a long period, no doubt contributed to the lower average temperature of the smelt.



Cranboune smelt bloom iron: nital etch F&P x100

PHILIP RIDEN: A NEW PRESIDENT FOR WIRG

The Annual General meeting of the Wealden Iron Research Group appointed a new president.

Philip Riden graduated from Oxford and taught history at Cardiff and then Nottingham Universities. He is a prolific author of articles and books on local history (general, South Wales and Derbyshire) and aspects of the iron industry, editor of the Victoria County History of Northamptonshire 1996-2001 and Derbyshire (since 2001) and Nottinghamshire from 2009, and of Derbyshire Record Society (of which he has edited or written several volumes)

Our new president may be best known to WIRG members as the author of *A Gazetteer of Charcoal Blast Furnaces in Great Britain in use since 1660*, (1987) (2nd ed. 1993) and (*via* Merton Priory Press) publisher of H. Cleere & D. Crossley, *The Iron Industry of the Weald*, 2nd edition 1995. He also provided significant help in the preparation of and subsequent review of B. G. Awty , *Adventure in Iron* (published by WIRG in 2019)

COWDEN FURNACE WORK HOUSE

On what is the most informative map of an ironworking site in the Weald, the 1743 map of Cowden Furnace drawn by John Bowra, a 'work house' is marked in the centre of the site, between the furnace and the boring mill (Fig. 1). Not, of course, a house for the poor this was probably where the moulds for guns were made, Cowden being a gun foundry throughout its working life. In 2003, as part of their summer meeting, WIRG members visited Furnace Mill, which it has been called since it was repurposed as a corn mill sometime around the turn of the 19th century. They speculated then as to whether the building shown below, in the same location as the work house on the 1743 map, might have been a survival from when the furnace was working but access was not possible and, as can be seen, vegetation had taken over part of it (Fig. 2).

The present owners, Mr and Mrs Jenkins, are seeking to restore the building to some form of use and have commissioned a Heritage Statement from Archaeological Services Lewes to accompany a planning and Listed Building consent application. The author was invited to inspect the building now that it has been opened up and the structure made visible (Fig. 3). Some of the original roof trusses have survived unaltered and stylistically suggest a date from the 17th century. This could coincide with the use by the Browne family who operated the site producing guns for the Dutch Wars.

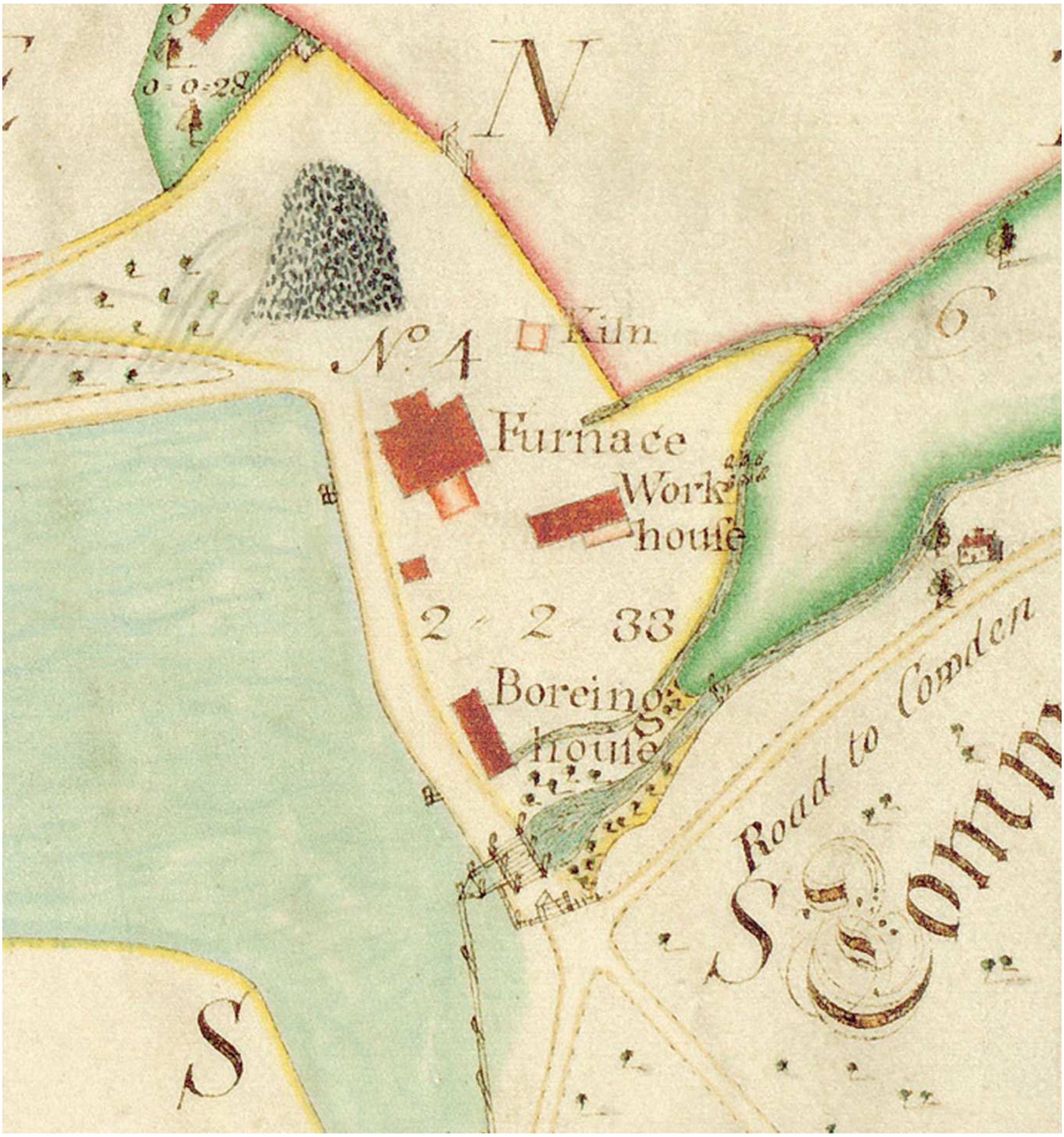


Fig. 1 Detail of the map of Cowden Furnace 1743 (Kent History Centre, Maidstone, U650/P1).

Significant alterations have been made to the building subsequent to the cessation of iron production, which has caused changes in some of the roof timbers as well as to the brick walls.

Fig. 2 The Work House from the SW as it was in 2003; the porch was built in the 1930s.

Fig. 3 The interior of the Work House in 2022 looking west showing original queen trusses.

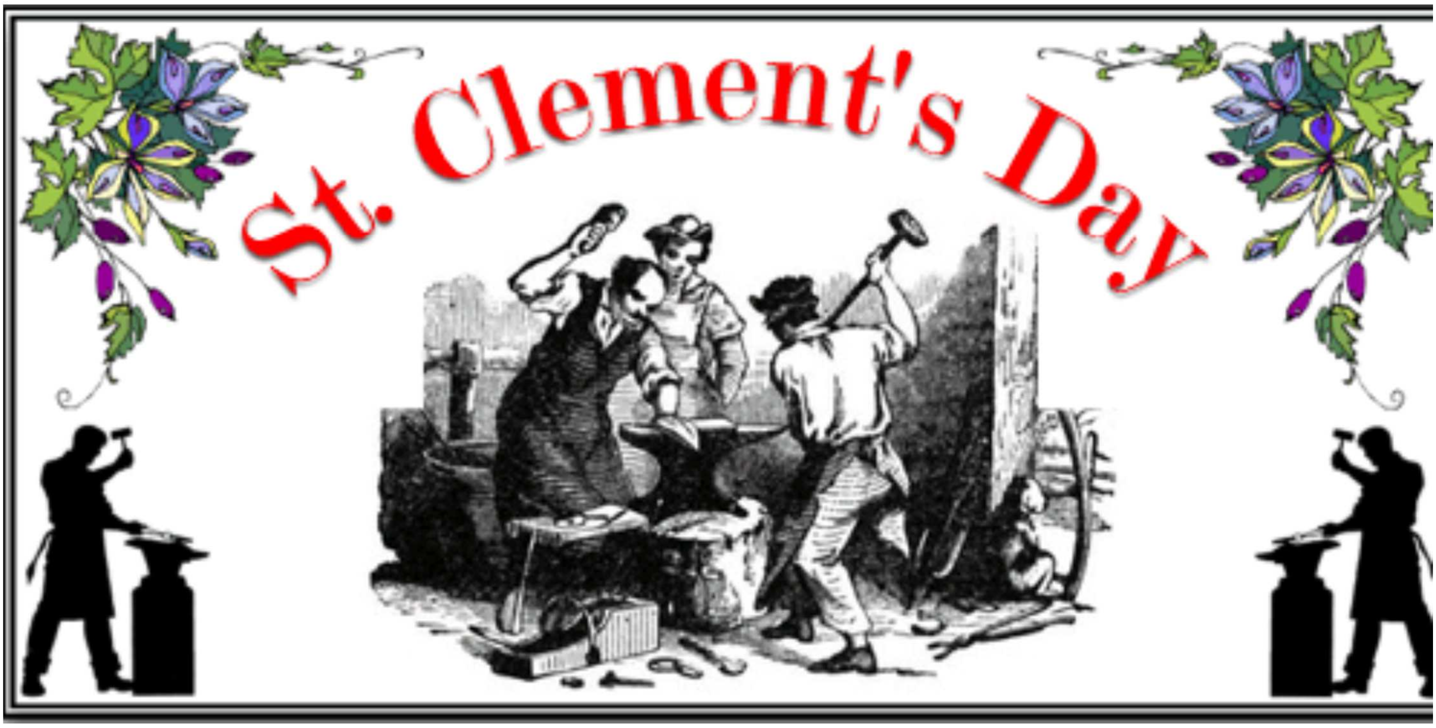
A lack of evidence of mortises in the wall posts makes it possible that the work house had brick walls from the outset, but very few of the bricks there still are of early date. What may be original windows are no longer in their original locations, and there is evidence in several places of former doors or windows being blocked up (Fig 4).

Fig. 4 The Work House viewed from the NW in 2022; the lean-to is a later addition and the chimney stack

The conclusion, nevertheless, is that the building is the one marked on the 1743 map and that it had been there, perhaps, for a century before that. Thus it is a very rare survival of a building contemporary with a Wealden ironworks. It is one of only three that I can think of, together with the house called 'Furnace' at Ashburnham and the Furnace Mill House at Lamberhurst, both of which have culverts beneath them that carried water from and to their furnaces respectively.

I am most grateful to Lisa Jane Fisher, of Archaeological Services Lewes, and to the owners for arranging access for me.

Jeremy Hodgkinson



SAINTLY PROTECTION: ST. CLEMENT

Pope Clement I, Bishop of Rome from 88AD, died a martyr in 99AD by being tied to an anchor and thrown into the sea. Besides being the patron saint of metalworkers and blacksmiths, St Clement is considered a patron saint of mariners and carpenters. St Clement's Day is the 23rd November. An early winter feast and festival for all workers in Iron was (and in some places still is) celebrated on 23rd November, St Clement's Day, each year while the population was still in the season of plenty. Iron craftsmen would have included those working in blast furnaces and forges ,rolling mills, foundries, nailers, chainmakers, lock smiths, bit and spur makers and of course, blacksmiths.

The tradition of celebrating the day of their patron saint must pre-date many of these trades, to times when Iron was produced in a more primitive way and blacksmiths were highly regarded for their skill.

Already by 1541 (in the formative years of blast furnace technology) Henry VIII had banned children from ' costuming' as St Clement on the feast day, a rare and localised custom that must have persisted from a former era.

Customs celebrating this festival in November stem largely from the iron-working districts of England, particularly Staffordshire and Sussex, gaining in popularity from the later seventeenth century onwards.

On 23rd November iron workers would be given a whole or half day holiday which began with soliciting for gifts towards the evening feast. The begging was imitated by children who would go from house to house ' clementing' begging for food and treats. The rhymes which accompanied the begging customs were seen to make it legitimate.

St Catherine's Day, the 24/25th November, had customs which became merged into those of Old Clem amongst the begging children. She was the patron saint of wheelwrights, martyred in 307 AD.

In the late nineteenth century the Rev W.D. Parish observed that in some parts of East Sussex, children still kept the custom of ' catterning and clemmening'. He recorded this version of their rhyme;

> Cattern' and Clemen' be here, here, here.Give us your apples and give us your beer.
> One for Peter
> Two for Paul
> Three for him that made us all.
> Clemen' was a good man, ' Cattern' was his mother,
> Give us your best
> And not your worst
> And God will give your soul good rest.

The blacksmiths themselves would begin the day celebrating Old Clem by ' firing the anvil'. The hole or depression on the anvil would be filled with gunpowder and a wooden plug inserted. After boring a hole through the plug, more powder was put in and then ignited.

An effigy of St Clement or a young blacksmith would be carried aloft on a chair around the village, sporting a wig, beard, pipe and cloak. The other workers and smiths would provide a boisterous musical entourage, demanding free beer, food or money for the evening ' Clem Feast'.

In Walsall, south Staffordshire where the iron trade was prevalent, each St Clement's Day was marked by throwing out apples and nuts from the town hall windows (eight hundredweight of apples !). The feast of Old Clem was also celebrated in some of the government dockyards.

Effigies of St Clement are known to have been put up by the door where the evening feast was to +take place. This custom is still remembered in Bramber, Steyning and Burwash in Sussex. An article by Frederick Sawyer in the Folk-Lore Journal of 1884 records the order of the St Clem feast in Sussex taverns:

The oldest blacksmith took the chair with the youngest sat next to him. The first toast began

‘ Here’s to old Vulcan as bold as a lion,
A large shop and no iron,
A big hearth and no coal
And a large pair of bellowses full of holes. ‘

This would be followed by the well known blacksmith’s anthem,
‘Here’s to the jolly blacksmith the best of all fellows
Who works at his anvil while the boy blows the bellows. etc.’

A second toast would be proposed

‘ True hearts and sound bottoms
Check shirts and leather aprons’.
Followed by another song
‘ Tubal Cain our ancient father sought the earth for iron and ore
More precious than the glittering gold be it ever so great a store.’

The chairman would then rise saying

‘ Gentlemen I invite you to drink with me the toast of the evening:
to the memory of Old Clem and prosperity to all his descendants ‘.

Another toast may have been added ‘ May the face of a bright hammer, and anvil never rust for the want of a job.’

A particular legend has often been related to illustrate how iron workers and many other trades all depended on one important staple product. This particular version brings in Old Clem and was taken down in 1883 by Edmund Young of Steyning , ‘ from the lips of a poor old fellow in deep decline’:

“On the 17th March AD 871 in the time of King Alfred, it was decided to appoint a Tradesman King from the Seven Trades.

A banquet was arranged for a representative of each trade to attend with a specimen of his work and the tools he used. There was:

A blacksmith with his hammer and a horseshoe

A tailor with his shears and a new coat

A baker with his peel and a loaf

A shoemaker with his awl and a pair of shoes

A carpenter with a saw and a deal trunk

A butcher with his chopper and a joint

A mason with his chisels and a corner stone

The guests were overwhelmed by the beauty of the coat and declared the tailor the winner. The horseshoe, bread, shoes, trunk, meat and cornerstone were thrown aside.

It is said that in the same year on 23rd November, St Clements Day, King Alfred needed a blacksmith as his horse had cast a shoe. The disgusted smith was nowhere to be found. The same day the other tradesmen broke their tools.

They determined, along with King Alfred to break into the forge and mend the tools themselves. In the general confusion of their inability to repair the tools, the anvil was knocked over and exploded.

Now, in comes the blacksmith arm in arm with St Clement, who seemed to enjoy the discomfort of the King and other tradesmen.

The King, making a humble bow to St Clement and the Smith said;

“ I have made a great mistake in allowing my judgement in this important matter to be governed by the gaudy colour and stylish cut of the tailor’s coat and in justice to the blacksmith, without whom none of us can do, proclaim him King of all the Trades.

Later, to restore harmony, songs were called for, beginning with the ‘ Jolly Blacksmith ‘.

After the tools had been mended and all were singing around the table, the tailor crept underneath and slit the blacksmith’s apron into a fringe.”

At the time this story was written down, blacksmith’s aprons still had this slitted feature. In the nineteenth century, Mr Henry Colgate of Fletching, Sussex, maintained that the five slits in the corner of a smith’s apron stood for a lion’s paw which proclaimed a smithy as a freehold even if it were put up on the waste by the roadside.

What a wonderful story, probably related each St Clement’s Day to explain many of our local customs.

Gerry Crawshaw

Editorial comment:

I am grateful for this contribution: readers will note that the customs reported draw on several traditions, including that of the Graeco-Roman pantheon. Direct recourse to biblical text with the reference to Tubal-Cain is also interesting because, although Tubal-Cain is believed by fundamentalists to be the fount of iron-making know-how, exegesis provides little or no support for that idea.

It seems possible that Vulcan and Tubal-Cain have been co-opted, perhaps to facilitate and/or make acceptable to Christianity, pre-existing beliefs about iron.

The chronology of such co-option is a key unknown.

MEMORY SET IN SLAG: BURTON FORGE

Burton Forge lies approximately 3.5 miles South of Petworth in West Sussex. It was located at SU 9795 1805, now behind a row of out sheds, associated with the later Burton Mill. Built in 1780, this water mill has been restored to working condition and is open to the public on the Heritage weekend in September and on the Sunday of National Mills weekend in May. The pond is in water and the mill stones are driven via a turbine today.

Imprint of bellows nozzle in slag

I took the opportunity to visit the mill during this year's Heritage Weekend and was intrigued to see a piece of forge slag with the imprint of the bellows nozzle clearly showing. A rare example enabling us to see the dimensions of the nozzle of a forge bellows. One would expect this to be from the finery hearth where a greater quantity of slag would accumulate as the tip of the sow was gradually burnt off reducing the carbon content. In contrast, the chafery hearth, where reheating of the 'loop' of iron during its consolidation by the hammer, would produce little slag.

Location of Burton Forge

The earliest known date for the forge is 1635 and the latest documented date 1667. The map shows a typical location of a forge beneath the Bay with two channels of water flowing past opposite sides of the forge, one to drive two wheels for the finery and chafery bellows, and the other to drive the hammer.

Tim Smith

FERNHURST FURNACE OPEN WEEKEND

The Fernhurst Furnace Preservation Group has held open weekends for many years to raise money to enable the restoration of the spillway and pond bay that was damaged in the 1980s and which subsequently placed the site on Historic England's 'At Risk' register. Now that work has been completed, at a cost of over £600,000, which has included consolidating the surviving remains of the furnace watercourses, the FFPG's task is to maintain the site so that walkers and other visitors can learn about and appreciate the remains that are visible from the bridleway across the bay. The site is one of only two in the Weald where significant remains have survived, the other being at Ashburnham.

The sad and sudden death of Her Majesty Queen Elizabeth two days earlier did not cause the 2022 Open Weekend to be postponed; too much preparation had been put in place. So visitors on the 10th and 11th of September were able to enjoy stalls devoted to countryside crafts, demonstrations of falconry and Civil War re-enactments by the Sealed Knot, as well as tours of the ironworking site and food and drink. The Wealden Iron Research Group was there with a display organised by Tim Smith, and throughout both days received a steady stream of visitors asking and learning about iron-making, bringing finds of slag and other artefacts for identification. On the first day Meridian Television came and interviewed the WIRG members manning the stall, a follow-up to filming at the Group's experimental bloomery at Pippingford the week before.

Thanks go to Tim and Judy Smith, of course, and to Judie English, Jonathan Prus and Alan Davies for fielding the various enquiries over the two days.

Jeremy Hodgkinson

SIMULATING THE EFFECT OF BOARD-BELLOWS

To better simulate the action of blowing the Pippingford furnace with bellows – as would have been the case of old, we have been donated a reciprocating blower by Peter Crew who conducted many smelts with this machine in North Wales.

This 'Ultimate Blowing Machine' (UBM), as they named it, can deliver an adjustable quantity of air by adjusting the position of a crank which controls the length of each stroke. The rate of pumping (strokes per minute) can be adjusted by means of a variable diameter pully. The maximum delivery is 5.76 lit/sec and the minimum 2.7 lit/sec. The higher values accord well with what we found with manual pumping with our pair of bellows at Pippingford which, over an extended period, can maintain 4 to 6 lit/sec.

The UBM consists of a cylinder and piston driven by an electric motor via a belt around the adjustable pulley and a worm gearbox to reduce the speed of the crank driving the piston. The adjustable crank sets the travel of the piston and so the volume of air delivered at each stroke. The pulley diameter can be adjusted to alter the speed of each stroke by changing the tension on the belt.

The UBM had not been used for 20 years and had suffered mouse damage to cables. After repairing this and changing lubricating oil and greasing the cylinder and piston with Carnauba wax – a high grade car polish, we set the UBM to work.

The machine worked well, but the first smelt failed as we had too short a stroke set on the piston and also connected the blower to the furnace via a flexible tube which caused turbulence in air delivery. Learning from this, for the next smelt we set the crank for maximum delivery and connected the UBM to the air hole in the furnace wall via a short straight length of aluminium tube to streamline air deliver. This smelt was successful, producing a bloom of iron, but no tap slag, until we broke open the slagging arch to deliver the bloom.

Using the UBM, the most notable observation is the pulsating action of the flame at the top of the furnace. Also, the change in the luminosity of the flame is evident, this becoming smaller and more transparent as reduction proceeds and then returns during the burn down period when we add just charcoal to the furnace. This occurs as, during reduction, carbon monoxide, which otherwise burns above the furnace as a large luminous flame, is consumed.

A sequence of three short videos illustrating this is available on the WIRG website at

https://www.wealdeniron.org.uk/2022/09/01/the-ultimate-blowing-machine/

The temperature profile during the smelt also shows a fall in temperature during the period of reduction. The consistency of blowing using the UBM enables this to be recognised as a real effect, whereas manual blowing with bellows can lower the temperature if operators tire.

Tim Smith

The UBM at work

Participation in experimental smelting events.

See note at bottom of page three of this newsletter