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Contents of WIRG Newsletter No. 73

WIRG's New Experimental Furnace

Tim Smith

Sadly, many of the 'old guard' operating the Experimental furnace at Pippingford have passed away, the most recent being Brian Herbert who died in August.

Prior to his death, Brian, who was the coordinator of the site, agreed with the construction of a new, smaller furnace, the third on the site since the programme was restarted around 1986.

The previous furnace (No 2) was large, 1.5m high with a domed hearth 60 x 70cm at the base, the stack tapering to 30cm at the top. Construction was based on the excavated furnace at Little Furnace Wood, Mayfield. We completed 16 smelts in this furnace over a period of 8 years. Furnace No 1 was much smaller and simpler, standing 1m high with an internal diameter of 30cm over its entire height and it withstood 36 smelts over some 20 years. Dimensions were based on Romano-British furnaces excavated on the Weald.

We had recognised that the larger furnace (No 2) would require far more ore and charcoal to operate and be much longer to pre-heat, restricting smelts to two a year which limited the number of parameters we could investigate.

The aim of the experimental smelts is to produce slag similar to that which we find in the field, while still producing a workable bloom. To investigate a greater number of smelting parameters to achieve this, it was agreed to revert to a smaller furnace similar in size to the first and to reduce variability of the charge by breaking and roasting all of our remaining ore to create a blend of size and composition. We now have around 360kg of blended Wealden ore from Beacon Wood, near Benenden, Kent. We find the composition varies with size on breaking – an indication of the hardness of the ore – and the blend we are currently using assays at 47% Fe and 18% Si giving a bloom potential of 6.65 (below 4 indicates no bloom as all of the iron is combined in the slag).

A new supplier of charcoal was sourced by Victor, as our previous supplier had been providing unsuitable charcoal for recent smelts. Victor has delivered around 120kg of lump chestnut charcoal which has proved an excellent source.

Following the easing of COVID-19 restrictions in June last year, Stephen and Tim undertook the preparation of the ore, the dismantling of the front of the old furnace – while preserving the brick slagging arch painstakingly built by John Baillie. On dismantling the old furnace we discovered that upright sticks, joined with horizontal rings of woven hazel, which we had used as a framework to reinforce the walls, had burnt away on the side where the original tuyere penetrated the furnace wall leaving a vertical split where the sticks had been, so weakening the wall. Thus, and following archaeological evidence, we did not use sticks in the new furnace.

Sectioned Furnace 2 with former for F3 in place

Building the furnace

Clay for the new furnace was prepared containing 20% of grog (fired clay) from the old furnace and handfuls of hay to reduce cracking on drying. The base of the furnace ie the hearth bottom, was lined with broken slag to improve insulation and provide drainage. This was capped with clay, and the job completed in a day, ready for constructing the furnace to full height.

In late August, Tim and Stephen were joined by Simon and Victor who, with Stephen, undertook the mammoth task of mixing further clay while Tim completed the furnace build moulding 'sausages' of clay around a central former. The former, constructed by Stephen from a sheet of corrugated iron, beaten flat (to the delight of his neighbours!), was curved into a tapered 1m long cylinder around a wooden frame. The diameter at the base was 28cm increasing to 30cm at the top to aid extraction once the build bas completed. To further aid extraction, the surface was greased and the whole rotated a quarter of a turn as each course of clay was built up to prevent adhering to the former. The 28cm base defined the diameter of the furnace hearth. The wall thickness of the furnace is around 30cm, to ensure good heat retention, and is a similar wall thickness to the previous furnaces. We have retained the back wall of the previous furnace, reduced to 1m high, to provide additional insulation – a feature sometimes found in excavated furnaces which were built into banks.

The advantages of using a smaller furnace are a shorter preheat time – we use wood then charcoal, setting a fire the day before – enabling us to be ready to smelt by 11am on smelt day, rather than 1pm with the previous furnace. This enables a longer burn down time and time to consolidate the bloom in the forge. At a quarter of the volume of the previous furnace, there is also a much lower consumption of ore and charcoal. The ratio of ore to charcoal we commonly use during smelting is 1 : 1, but we consume twice as much charcoal by weight due to its use during preheating (10kg) and during a two hour burn down (4kg).

For both smelts we used a 25mm internal diameter steel tuyere placed through the clayed-up slagging arch inclined down 22° and inserted about 75mm beyond the internal wall. The inserted part is consumed during the smelt, a weight loss of 0.355kg was recorded for smelt 2.

By smelt 2, we had acquired an anemometer, modified to be temporarily attach to the input pipe of the tuyere. This recorded a blowing rate of 18.7m/sec which equates to a volume of 9 lit/sec. Since similar blower settings were used for smelt 1 we can assume a similar blowing rate.

First two smelts

Following a couple of weeks of air drying, the inaugural smelt was conducted on 19 September 2020 with the four 'builders' and Bob present, thereby ensuring the COVID-19 'rule of six' was met. A bloom weighing 1.35kg from a charge of 14kg of ore resulted giving a yield of 18.2% based on available iron in the ore which averages 47% Fe. A spontaneous flow of tap slag weighing 2.7kg occurred after 96 minutes, during burn down – the period after the last ore

New furnace F3 air drying with former in place

has been added and only charcoal is added. Later analysis of this tap slag by Alan showed it to be unusually high in silica at 36% (around twice that of many previous smelts) and totally lacking in wustite (FeO), the phase which results in the formation of the bloom. This phase is frequently seen in tap slags collected in the field and in previous experimental tap slags.

The second smelt, conducted on 17 October under similar conditions to the first, (apart from a breakfast of sausage, black pudding and bacon cooked on the furnace) was to compare the output of the new furnace, which had no slag lining the hearth walls, (ie the previous Smelt 1) with that of a 'conditioned' furnace in which slag adhered to the hearth walls. Despite a failure of power to the blower during burn-down causing the last charge of ore not to be fully reduced, a bloom weighing 2.15kg was produced from 14kg ore giving a yield of 28.9% based on available iron. This conclusively shows the advantageous effect of slag protecting the furnace walls which prevents pick-up of additional silicon from the wall. Silicon robs the bloom of iron as iron has a greater affinity to combine with it to form slag than to produce a bloom. Tap slag again flowed spontaneously after about 90 minutes, amounting to 1.35kg.

Analysis of the tap slag from smelt 2 by Alan shows it to contain 25.1% SiO_2 , some 11% less than tap slag from smelt 1 and to contain a fine dispersion of wustite (FeO) which was absent in Smelt 1 tap slag. The SiO_2 level of tap slag smelt 2 is, however, some 10% higher than that from smelts in the previous larger Furnace. Comparing the iron content of tap slags 1 & 2 we have 42% and 47% respectively. Analysis of the furnace slags (ie slag raked out at the end of smelting) of smelts 1 & 2 in the new furnace show greater differences with SiO_2 values of 45% and 85% respectively and iron contents around 36% and 11% respectively.

Analysis of the iron blooms showed a variable carbon content in bloom 1, a maximum value of 0.55% occurring at 0.8mm below the surface, then dropping off to a constantly low value of around 0.03% at a depth beyond 3.5mm. We have found such a profile in previous smelts, although a notable effect in this smelt was a value of 0.3% C at the surface, indicating some decarbonisation here.

Smelt 2 did not show such a profile having a carbon content around 0.03% from surface to core. Average temperatures measured at the upper thermocouple were similar in each case at 898°C (20 readings) and 905°C (11

Spontaneous slag run Smelt 1

readings due to failure of the thermocouples after charge 12) for smelts 1 & 2 respectively but failure of power during the burn down period of smelt 2 resulted in a lower burn down temperature – not measured due to failure of both thermocouples (after charge 12).

We have now put the site 'to bed' for winter as the nights draw in fast in our woodland setting once the clocks go back. We plan to restart smelts in April. Should anyone wish to join us next year please contact Tim by e-mail secretary@wealdeniron.org.uk or Telephone 01403 710148

Weathering as a stage in the preparation of iron ore in the Weald.

Jonathan Prus

In *The Iron Industry of the Weald* Cleere and Crossley (1995) mention weathering as a possible stage in the preparation of ore for blast furnaces. An extract of the *Diaries of Sir James Hope* published in *Wealden Iron* (1st. Series Vol. 4 pp. 15-20) contains a description of the appearance of ore in different stages of treatment, including those with which we are familiar from experimental preparation of the most common local ore. Amongst other things Hope tells us of blacks, blues and reds. These colours are those we commonly see as sequential stages in the roasting process.

The ore that produces these colours on roasting is a clay ironstone. It is mainly the mineral siderite in a clay matrix. Usable ores are overwhelmingly composed of siderite, although silica, alumina and calcium content are very variable. Siderite is a form of iron (II) carbonate, which, when pure, is white. The colour of freshly broken (or cut) Wealden clay ironstone is usually grey. On roasting carbon dioxide is released and, *via* a series of reactions, the end product is iron (III) oxide. Typically this is deeply red and strongly ferromagnetic.

The purpose of this note is to report a completely accidental observation. I received a number of bucket loads of sideritic ore from the Horam site excavations recently reported in this newsletter. Most of this I roasted and bagged up for future use. However, I left several buckets open and unattended over the winter during which time they were wetted and frozen several times. The result was that the ore (originally composed only of large lumps) was transformed mostly into brown flakes. (See accompanying photo.) Hope tells us that he saw some ore which "lyeing in the aire mullens (crumbles) and cleives into brattes (flakes)". This is consistent with a weathering process such as that seen in my buckets.

The local clay-ironstone weathers to a group of minerals often called limonite. The principal constituent of this limonite is the mineral goethite, an hydrated iron (III) oxide. On heating the chemically bound water is released and the principal product is iron (III) oxide.

A question arises: although Hope seems to imply that all the ore was processed by roasting, is this an *essential* part of the process? Might, for example, some bloomery sites lack evidence of roasted ore because weathering alone produced ore of a useable size and quality?

Bloomery Festival Woodford 2020 & 2019

Below are links to five of what I consider to be the best videos recorded as part of the Woodford Smelting Fest. Normally held near Cork in Ireland, in 2020 it was impossible for participants to travel to Ireland so they recorded their activities at their home locations.

I have selected three from the Yakutia region of Siberia which specialize in making knives, one of the Tatara furnace in Japan and one from the 2019 festival in Ireland on forging. There are 10 videos in all should you wish to watch them.

At Yakutia (Satagay Republic) Siberia former USSR
(backround music Jew's Harp)

(1) Yakutia Kantik

Operating the furnace, extracting the bloom and consolidating it in forge

Running time 9.5 mins

https://www.youtube.com/watch?v=mYy0WnX8Rjk

(2) Yakutia Nam Traditional smelt from striking the fire with flint. Exhibiting bladed products but no details of actual smelt.

Running time 24 minutes with translation

https://www.youtube.com/watch?v=zX3ThLedeoI

(3) Yakutia Khangalass

Folk museum illustrating products, removal of bloom from furnace followed by consolidating

Running time 11.5 mins

https://www.youtube.com/watch?v=Xu9A3Z7iVRk

(4) Japanese Tatara furnace

A scaled down furnace using the principal of the traditional Tatara furnace from 6th century, originally from Korea and later used extensively in Japan. A full size Tatara furnace is made of clay as a box construction 3.64m long and 4.85m wide built around a pit 2.73m deep which is filled with charcoal.

Running time 30 mins with sub-titles.

https://www.youtube.com/watch?v=waZSIqQ4jvM&t=49s

(5) 2019 Forging

Running time 9.5mins

https://www.youtube.com/watch?v=H6jC_hN32IE

WEALDEN IRON WAS A DANGEROUS TRADE

Jeremy Hodgkinson

Nowadays one hears frequent complaints of 'health and safety gone mad' when one or other new restriction is placed on activities that we were formerly free to indulge in. But it is worth reflecting on how a lack of safety measures in the past resulted in risks that are unacceptable in the present day and caused accidents that even then were notable. Iron-making, not surprisingly, ranks among the more dangerous trades and there are several references in the historical record to tragic incidents associated with the business. Most, as might be expected, involved people working in one or other occupations associated with iron-making, such as ore digging, transport or at a production site. At the coroner's inquest held on 16th September 1591 it was recorded that Peter Gobbet had been killed the previous day at Beech Furnace, near Battle, when he was digging earth there under an overhang. The earth above him, which must have been a substantial quantity, collapsed onto him. Perhaps William Atkins was engaged in a similar activity in 1613. The brief reference in the Horsham parish register merely states that he was 'killed in a mine pitt'. Or did he fall in, like Richard Winchester whose drowned body was discovered in a mine pit in the Little Park at Worth in 1590? He may not have had any connection with iron mining; perhaps he was simply taking a short cut in the dark as evidently there was no-one with him at the time of his demise. The pit must have been newly dug as it was customary for them to be filled in.

The fire in the furnace took its toll in two cases, both in the 1760s, and both appear to be related to night staff at ironworks. Thomas Todman, described as a labourer at the newly-built Gravetye Furnace, which had only just been blown in, succumbed to the lethal gas that was produced by the burning charcoal. The report of his death in the *Sussex Weekly Advertiser* in October 1763 expressed the view that he had been asleep at the time. Two years earlier an unnamed man at Barden Furnace, near Tonbridge, was also asleep when his clothes were set alight and those who came to his aid were unable to extinguish them before it was too late. It was early March so the furnace would have provided a source of warmth for someone whose job may have entailed being on hand if the furnace needed charging or the speed of the water wheel needed adjusting.

Detail of 'Visit to a foundry' by Léonard Defrance, 1798. A Belgian rather than an English furnace, but nevertheless frequented by small children.

There were dangers inherent in transporting heavy loads, notably guns. The lost records of James Sparrow, the Preventive Officer in the Customs service at Rye in the mid-18th century recalled the tragic case of Miles Chandler, both of whose legs were broken when unloading guns at the wharf there. In another similar accident, presumably some years later, Chandler was to lose his life. The biggest guns being made at the time - 32 pounders - each weighed more than

2½ tons, so they need securing carefully when being winched from ship to shore or *vice versa*. Securing the guns poorly or unevenly distributing their arrangement on board may have contributed to the sinking of a barge near Rye in December 1763, though fortunately no lives were lost on that occasion. Movement of guns at Lamberhurst Furnace may also have been the cause of the tragedy to befall Thomas Lambe who worked there in the 1760s. His death, recorded in the Brenchley register in 1766, recounted how he had been maimed, necessitating the amputation of his leg, and dying as a result. But with misfortune to parallel that of Miles Chandler, mentioned previously, he had lost his other leg as a result of an earlier accident.

The youth of yesteryear were no less prone to ill-considered larking about than their counterparts today. The coroner's court at Wadhurst in October 1592 heard of the antics of Simon Watle and another youth who were climbing on the frame of the revolving waterwheel at John Payler's Coushopley Furnace. Watle must have missed his footing for his head was crushed between the wheel and an adjacent piece of timber, the result being instantly fatal. There had been an earlier fatality involving a waterwheel in July 1588, this time at Hoadly Hammer, near Lamberhurst. But on this occasion the victim was Joan Blackamore, described as an infant. She had been standing on or near the 'hammer gate' by which the water from the pond was released to flow over the wheel that lifted the hammer. The hammerman, Richard Smyth, raised the gate to let the water through, which set the hammer in motion, but caused the little girl to fall between the wheel and the pit, killing her. Smyth would not have seen where Joan was standing as he was inside the forge building and will have lifted the gate remotely by pulling on a rope to operate a lever.

Ironworking ponds were potential sources of danger. The Horsmonden register of 1592 recorded the drowning of another young child, the three-year-old son of Nicholas Jerrat, a founder at the furnace. With dreadful irony it was in the furnace pond that the little boy's life was lost. Animals could be frightened by the noise from ironworks, and it was just such a case that caused the drowning of both Richard Heather and his horse at Peter Bettesworth's furnace at Iping in 1630. The sound of the furnace and the movement of the bellows caused Heather's horse to rear up and plunge them both into the pond. Perhaps something similar happened to 11-year-old John Allen, who fell off his horse into Catsfield Furnace pond in 1572 and drowned.

The small number of accidents here described will not have been all that occurred during the iron industry's long history but may, nevertheless, suggest that they were not all that common either.

Ritual, religion and magic among pre-modern iron-workers.

Jonathan Prus

Judie English made valuable comments touching on ritual, religion and magic in two recent articles. (*Changing Attitudes to Iron,* WIRG Newsletter No. 72, Autumn 2020, and in *Iron Working Gods and the Wealden Iron Industry, in Wealden Iron* Vol. 38 in 2018). It is unfortunate but inescapable that we have so little historical knowledge of these matters as they affect the Weald. We are fortunate that Judie has brought together the available information that demonstrates the connections between some strikingly odd beliefs and iron-working.

My purpose in this note is to argue that these odd beliefs and practices were not random and irrational bolt-ons to technological practice, but rather an integral part of the technology as it was then understood. This is not the prelude to an argument for cultural equivalence: a modern technology underpinned by a modern scientific understanding wins every contest. However, those ideas and practice that we might be tempted to categorise as "ritual" or "magical" or "religious" were probably not the spurious imaginings of primitive people but, rather, integral to their understanding of what they were doing.

Because we lack complete understanding of any belief system held by Wealden iron-workers for any pre-modern period we have to fall back on comparisons with other parts of the world. The best sources for this are the anthropological studies of African societies. The best secondary source for these of which I am aware is Hebert's (1993) *Iron, Gender, and Power*, which pulls together examples from a wide range of studies. One of the common themes she finds among African iron-workers is that the smelting process is understood in terms of human reproduction. It is usual to interpret this understanding as understanding-by-analogy. For example, the extraction of a bloom may be described as a birth, or slag-tapping as a menstrual flow (These are not universal features of African iron-working beliefs, but human reproduction is an extremely widespread theme).

It is possible that because the ins-and-outs of biological reproduction were obvious and pervasive that these processes provided an obvious template for understanding smelting. This template would lead to a self-consistent bundle of explanation and routine.

The power and pervasiveness of this mode of understanding goes some way towards explaining the instances of missionaries opposing indigenous iron-working: it was clearly a context in which non-Christian beliefs held sway. And furnaces with secondary sexual characteristics like breasts could have been awfully embarrassing. However, it is only fair to say that indigenous iron products competed strongly with imports from Europe and that the actual drive against local products may have had a commercial origin.

I would not be inclined to argue that no iron-worker who held a pre-modern belief system was completely unaware of contradictions or intellectual flaws. We are perfectly familiar with the possibility of a person holding beliefs that are mutually incompatible. We see this more often in others than in ourselves, but cognitive dissonance may well be one of the well-springs of technological and/or scientific advance. However, for the most part and for most of the time, beliefs are not spurious extras, they are the way things seem to be. Washing the ore in a manner that pleasures a god, the same way, every time, may be quite useful.

PAULINE ARCHIBALD

1923-2020

We were saddened to learn of the death on 17 September 2020 of Pauline Archibald. Pauline had been a member of the Group for over 50 years and in the Group's early years had been an active fieldworker, and co-author of a couple of published notes on bloomery sites. She continued to attend Winter and Summer meetings until quite recently.

JEAN SHELLEY

1924-2021

Jean Shelley passed away in January. Although she had resigned her membership of WIRG a few years ago when she was no longer able to take part in its activities, she will be remembered as an active fieldworker in the Group's earlier days. She collaborated in the recording of several sites for the gazetteer, and was particularly knowledgeable on the history and archaeology of the area around Charlwood in Surrey, where she lived for a long time. She wrote about various aspects of the village and as well as being interested in ironworking she was a member of the Domestic Buildings Research Group, Charlwood having a wealth of timber-framed houses. She was a force in local studies in her part of Surrey and a call from Jean could always be received with the expectation of learning something new.

WIRG WEBSITE NEWS

Jeremy Hodgkinson

Photo Archive

The Group has assembled a collection of over 1500 digitised photographic prints and transparencies of sites, excavations and forays, and a selection has been added to the WIRG website (www.wealdeniron.org.uk). Some go back to the early days of the Group in the 1960s and 70s and include some historic images of early excavations such as the Roman sites at Bardown, Holbeanwood and Beauport Park, and the blast furnaces at Panningridge and Pippingford. Some of these early images come from collections of slides taken by Henry Cleere, Fred Tebbutt and Dot Meades. These have been scanned by David Brown, to whom we are greatly indebted. There are some notable omissions: we have only a very few images of the excavations of the water-powered sites at Maynards Gate, Batsford and Chingley, and of the Iron Age-Romano-British site at Broadfield, and none of Ardingly Forge.

Excavating the bath house at Beauport Park

David Crossley recording the casting table at Pippingford

Fred Tebbutt and others excavating the Cow Park bloomeries

We would like to add images of other subjects, where possible, and also supplement those already displayed. If you, the reader, can contribute images the archive can grow. Prints and slides can be scanned and returned to you.

Henry Cleere's smelting experiments

Among the papers donated to WIRG by Professor Henry Cleere's family last year was a collection of photographs, notes and diagrams relating to some experiments in bloomery iron smelting that Henry carried out at Horam in 1969. These were the precursor to WIRG's own smelting experiments that began nearly a decade later. Henry's papers have been scanned and are now included in the Experimental Ironmaking section of the WIRG website, which has been promoted to the main menu at the top of the home page.

The new format of the WIRG website has made it much easier to include new features, so take a look every now and then and see what has been added - www.wealdeniron.org.uk

Medieval bloomeries and their owners

Judie English

The great majority of bloomeries in the Weald are undated and, while the majority probably belong to the Romano-British period, later ones clearly existed in considerable numbers. By the High Medieval period production could not only supply local needs but generate a surplus to fulfil large, in some cases urgent, orders.

Royal building requirements included an order in 1253 for 12,000 nails from the bailiwick of Sussex to go to the King's House at Freemantle at Kingsclere (Hants) where Henry III had ordered the construction of a cellar, a hall, separate chambers for the king and queen, and an enlarged courtyard all recovered through excavation in 2005 – 2011. The castle at Guildford had been extended to provide palatial accommodation during the 13th century with a Great Hall with coloured glass in the windows and wall paintings

X-ray of the iron key for the cellar of the King's House, Freemantle reproduced by kind permission of Kingsclere Heritage Association, and Kristian Strutt and the Engineering Department of Southampton University

including the story of Dives and Lazarus to remind the king of the need for charity and Henry's private chamber painted green with silver and gold stars. In 1254 the palace was severely damaged by fire and the next year there was an order of two cart loads of local iron to be taken to the Keeper of the King's Works at Guildford for repair work.

Military requirements are also evidenced during the 13th century. 8,000 horseshoes and 20,000 nails to be taken to Portsmouth in 1242 may relate to a disastrous military adventure in France in that year, and the 30,000 horseshoes and 29,000 nails in 1254 to an (unfulfilled) offer to Pope Innocent IV to finance his wars in Sicily if the Pope would grant the Sicilian crown to Henry's infant son Edmund. Further major orders were placed for iron wedges in 1275 and 1278 during Edward I's conquest of Wales, and of nails and horseshoes in 1320 and 1327 during the civil war between Edward II and the Despensers. Arrowheads were also ordered but it is unclear whether or not these were iron tipped although most for use in hunting and war were.

Clearly it was assumed that the Wealden iron industry had the capacity to respond to these requirements and payment would have enhanced the receivers' ability to participate in the cash economy. So, who responded? Did orders to divert energy from more mundane customers have to come from aristocrats or manorial lords, or could entrepreneurial yeoman farmers access those with the skill to produce iron?

Four sites in the Low Weald south of Guildford suggest the former. Surface finds of bloomery slag found at Monktonhook, Alfold were associated with 14th century pottery, the earliest found on site. The settlement was a holding of Waverley Abbey from at least 1325 and it is likely that one of the main resources exploited by the Abbey was iron (English 2013). Nearby, at Great Wildwood, also in Alfold, bloomery tap slag was found associated with shell-tempered ware, S2 in the Surrey type series, and dated to 1050-1150 English 2002). The position, close to a moated site, lies within the demesne of the Wildwood Manor, a sub-infeudated holding of Albury Manor to the north. The name is first mentioned in 1294/5 and in the early 14th century the manor was held of the Honour of Clare by the d'Abernon family, later by the Despenser family of the Honour of Gloucester. In 1391 Elizabeth Grey, Lady of Stoke d'Abernon Manor, granted the soil and wood of Wildwood except for the moat, grange and manorial rights to John, Duke of Lancaster (Close, 14 Rich II, m8d). This Duchy was heavily involved in the later introduction of blast furnace technology (Cleere & Crossley 1985, 112, 115-6).

Further south at Loxwood Place Farm excavation in advance of development produced evidence of iron smelting and forging associated with 13th – 15th century pottery close to a probable moated site (Stevens 2006). A high status medieval building in the vicinity is suggested by the presence of glazed roof tiles and the re-use of 14th century timber in an extant barn (Martin & Martin 1997). By 1338 the Knights Templar held land in Loxwood of their Preceptory of Shipley, some 14km to the north-west, and donated in 1125. Whilst no direct link can be found the site at Loxwood Place Farm may represent the Templar grange. A further Templar holding was that of the chapel at Knepp, held by the de Braose family who donated it firstly to the Abbey of St Floret, Maine et Loire, but, with the need to re-assign alien holdings during the wars with France, Knepp rectory and chapel were handed to the Templars. A park is recorded in the mid-12th century and a castle, probably built by the de Braose family, was in the hands of John, by 1210. It appears to have continued in royal hands through most of the 13th century but its later history remains obscure. Recent finding of bloomery slag close to the castle may evidence production of iron for use at the castle, or, as a resource to be exploited by the ecclesiastical holders.

Farther east a survey of 1325 of the Manor of Burgh (Banstead, Surrey) mentions the right to mine for iron ore from its Wealden holding at Horley which had been held by the de Bures family since before 1259. Also in Horley, a probable ore roasting hearth associated with 13th to 15th century pottery was found within the moated area at Thundersfield Castle (Hart & Winbolt 1937; Herbert 1972), a moated site on a holding of Chertsey Abbey between 933 and 1537.

Doubtless more links could be forged between medieval iron working sites and their owners but the impression from this small selection is that landowners of high status, secular or ecclesiastical, saw exploitation of iron reserves on their Wealden holdings as useful both for their own properties and, probably, for sale of iron on the open market. The sample is biased – it is these high status families whose records survive – but it would add to our picture of the medieval industry if more links could be studied.

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The Bodiam Mortar

Geraldine Crawshaw

On acquiring a rather rare copy of Curzon's 'Bodiam Castle' (1925), I came across this description of a 'stone - throwing mortar or bombard' dug out from the moat during the time of the Webster's ownership (1722 - 1828).

" It is at least as old as the earlier part of the 15th century. The interior is of cast iron and probably one of the earliest known specimens of iron in that form . The outer body is of wrought iron……...weight 150lbs, calibre 15.1in.,

Interior diameter of chamber 3.4in., length of chamber 14in., capacity of chamber about 3-5lbs, length of chase 34 in.; present weight 3 cwt. "(sic).

This was copied by Curzon from the 1862-1863 catalogue in the Rotunda Museum at Woolwich where he knew it was on display and indeed, still resides.

The modern accurate measurements are:

Barrel. 56cm long, bore 38cm, internal length 51cm

Outer muzzle diameter 46cm

Powder chamber 53cm long, 20cm diameter

Weight 6cwt.

The Bodiam Mortar had previously been on show at Battle

The Bodiam Mortar, pictured at Woolwich

Abbey, one time home of the Websters, as it is described by Vidler (1841) in the antiquities collection there...' a curious iron Mortar brought from Bodiam Castle '.

An interesting engraving of the castle interior showing the mortar lying on the ground, is given in Rouses's ' Beauties of the Antiquities of the County of Sussex' of 1825. (online books.google.co.uk). He describes it as being brought from Battle Abbey, whence it must have returned by the mid 19th century.

The date suggested, early 15th century and description 'of cast iron' seemed worth investigating as we in the Weald believe that the first iron cannon was cast as late as 1543 by Hogge and Baude under the direction of William Levett of Buxted.

The history of early siege artillery such as bombards, often shown in contemporary illustrations is quite fascinating. Extremely large examples were developed by the 1450's, such as Edinburgh 's Mons Meg, ' able to project a 19 1/2in. iron ball some 1,400 yards. ' (Artillery through the Ages , Manucy, 1994). Manucy's book has an illustration of an early, small wrought iron cannon dated to 1330, which is similar in form to the Bodiam Mortar.

And herein lies the enigma— stylistically the Bodiam example could be from the 14th century, yet in construction it would appear to be from the 16th century.

William Levett's guns, cast vertically in wood-lined pits, were known to be Italian in style, similar to the Venetian cannon made in the late 15th century and brought to England by Francis Arcano in 1523.

The mortar from the moat hardly fits this style, perhaps pointing to an earlier trialling phase. However, Levett is known to have cast two mortars for Henry VIII (Portsmouth and Southsea Castle).

The 'Padstow ' gun, our earliest surviving Buxted cannon was designed by royal gunfounder Arcangelo Arcano (See SAC vol 140, 2002, article on Buxted as the earliest cast iron production centre in England. Awty / Whittick).

WIRG members Kay Smith and Ruth Brown studied the history and conducted a thorough investigation through X-radiography and metallographic examination of the mortar from the moat in 1983, producing an excellent paper , ' The Bodiam Mortar' for the Journal of the Ordnance Society in 1990.

They concluded that very little of the earlier documentation is true. The breech and barrel were cast in one piece and the wrought iron bands added over its entire length. This lead them to believe the gunfounder was experimenting with the different properties of cast and wrought iron - the extreme hardness (but brittle nature) of the former, plus the strengthening technique of wrought iron bands welded around.

The authors suggest that the development of medieval artillery was not as rapid as previously thought.

In the 16th century, Henry VIII's best vessel, the Mary Rose still carried wrought iron ordnance. The ship sank with the cast iron cannon balls already loaded in wrought iron guns ready to attack.

Kay Smith and Ruth Brown found documentary evidence that cast iron guns were made in the Rhine Valley in the 15th century, but were possibly small pieces, quite unreliable and prone to bursting. Casting technology they say, had not advanced before 1500 to produce artillery of any size.

Where casting had come into its own was in the production of cannon balls and shot, which were meant to burst.

Because the Bodiam Mortar has a crude appearance, Brown and Smith suggest it may just be inexperience in design and technology, not a reason to give the gun an early date.

Their summary is worth quoting:

" It is very unlikely that the mortar was produced in the 15th century. All the available evidence points to it being made in the Weald at the beginning of the 16th century. We believe it is an early example of an attempt to make a cast iron gun and is, for want of a better term, a 'missing link' between wrought iron and cast iron artillery. "

Aside from the difficulty in accurately dating the mortar, we are still left with the important questions.......Where was it made ? and what was it doing at Bodiam ?

There is still the possibility that the gun was made on the continent, where the technology for casting iron was believed to be further advanced than in England and the need for siege artillery greater.

It may have been imported or captured from a foreign army or ship. When Edward III died in 1377 and for at least two centuries after, Rye and Winchelsea were subjected to numerous attacks from the French; but men from the south coast of England also plundered foreign shores as well as capturing ships.

A number of Rye's cannon obtained for the defence of the town and harbour were bought from privateers such as the famous John Fletcher, who died in 1546. (SAC vol 122, 1984, ' Rye and the Defence of the Narrow Seas', Mayhew). Of note is the composition of ordnance at Rye in March 1569.....there were only six cannons of cast iron (four sacres, two faucons), the remaining 14 were of brass. (TNA RYE 45/20).

Dan Spencer's recent work, ' Royal and Urban Gunpowder Weapons in Late Medieval England' (2019), shows through documentary evidence that in the 15th century, English kings kept up with new types of firearms on the continent, especially those devised by their enemies in France and Burgundy.

He claims " traditional interpretations of English technological backwardness can be firmly rejected ", while admitting the English were slow to adopt gunpowder weapons in a meaningful way such as in town defences.

Wealden iron ore has a low manganese content (around 0.3 - 2 %), yet the Mortar when examined by Smith and Brown showed the percentage of manganese to be as high as 7. Their metallurgical analysis could mean the ore used for the gun was very high in manganese, perhaps pointing to a continental origin. Straker was inclined to a foreign source for the mortar.

A note is given by Tim Smith at the end with a resume of the manganese content of Wealden ores.

The high manganese content in the mortar resulted in the formation of white cast iron which is very hard compared to grey cast iron. Brown and Smith believe the metal was so hard and brittle that if it had ever been fired, it would have burst.

Perhaps the gun was never more than some kind of ' trophy '.

In older literature, dates for the Bodiam ' bombard' have ranged from mid 14th century to the 16th century. Looking over the entire period, why would such a gun, perhaps one of many, be there ?

The castle itself is about 13 miles inland from Rye, sited on the river Rother. Built by Sir Edward Dallingridge in 1384-1389, he would have been aware of new artillery designs from his lengthy periods fighting abroad. The Battle of Crécy in 1346 (the year Dallingridge was born), had a minimal number of small cannon on the field.

The gun loops, (inverted keyhole shape openings) built into the original castle walls were a nod to the new defensive gunpowder guns, now shown to be mostly for 'show'. The castle had grand living accommodation with no real potential for a sizeable garrison.......a very beautiful building set into a medieval designed landscape.

Coulson, in an analysis of Bodiam (Ideals and Practice of Medieval Knighthood IV, 1990), appropriately describes fortification as " most surely metaphysical as well as material; a matter of imagery and symbolism not just of technology ".

The mortar could never have been used from inside the castle as its calibre is too large. Was it therefore bought to the castle to use as a siege weapon at some point in its history ?

Damage to the outer walls is negligible, implying the castle never sustained a serious attack. Dismantling or ‘slighting’ of the interior was probably gradual over the years.....it was still partially habitable in the 18th century.

The two occasions when cannons might have been employed were: during the Buckingham Revolt of the War of the Roses in 1483 when Yorkist supporters of Richard III ‘seized’ the castle from its Lancastrian owner, Sir Thomas Lewknor; or during the Civil War in the 17th century by the Parliamentary army.

Curzon has proved both of these ‘seizures’ were peaceable affairs with little damage if any to the building. The 15th century date now seems too early for any cast iron artillery and in the Civil War, a Mortar such as this would be considered out of date.

During the early 20th century draining and excavation of the moat, a large stone ball 14 in. diameter was found. Whether it was for a 14th century mangonel or trebuchet or a stone throwing mortar, Curzon could not tell, nor if it was from the castle or the other side of the moat. A number of other stone and iron balls were retrieved.

Often underestimated is the effect of gunpowder artillery on the architecture of late medieval/ early modern fortification. Castle and town walls had to adapt to ever more powerful guns. One has only to compare Bodiam with Camber Castle built just 150 years later at the mouth of the Rother by Henry VIII around 1539-1543. This fort was initially equipped with 28 brass and iron guns. The age of chivalrous knights had indeed passed, with the advent of Shakespeare’s ‘ Villanous saltpetre ‘

It appears the Bodiam Mortar is a rare survivor of its kind....we may never know if it had travelled from beyond the Sussex Weald.

There is a reference to an early cannon dug up near Buxted bridge which was of cast iron with a wrought iron band shrunken on to the muzzle to strengthen it. Might this be of a similar age ? Or perhaps another experiment in cannon design. It is described by Dawson (oh dear !) in SAC vol 46. He does give a good early photograph, pre- 1903, of the mortar at the Rotunda Museum though.

An exact replica of the gun is exhibited at Bodiam Castle today.

Note from Tim Smith

In roasted Wealden siderite ores, Bernard Worssam found a maximum of 4.55% Mn_3O_4 (ie 3.28% Mn) and from various siderite ores analysed by others MnO contents of 0.4 to 2.32 (ie 0.3 - 1.8% Mn).

A somewhat higher content from this group was found in Ragstone (from bog ore) from Snape Wood of 3.3% MnO

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