

Wealden Iron

First Series No 4
Summer 1972

Bulletin of the
Wealden Iron
Research Group

Contents

Editorial	Henry Cleere	1
Notes from the Chairman:		
The WIRG and Archaeology	C.F. Tebbutt	2
Chemistry and the Wealden Iron Industry	P.J. Ovenden	3
Miscellanea	Brian K. Herbert	10
Aliens in Wealden Iron districts 1524-5	Joseph Pettitt	11
Notes and Queries		14
A contemporary description of John Brown's gun-founding furnace at Barden, Kent (1646)		15
Shorter Notes		
Marinus and Wealden Iron	C.F. Tebbutt	21
A Simple Pantograph	Brian K. Herbert	22
Local Team Reports		
Buxted		24
Crawley	John Gibson-Hill	25
East Grinstead	Brian K Herbert	26
Hastings	Alan Scott	29
West Sussex	Peter Ovenden	29
Slag Road in Surrey	Brian K. Herbert	30

Wealden Iron Research Group

BULLETIN

No. 4

Summer 1972

Published by the WEALDEN IRON RESEARCH GROUP

Secretary Joseph Pettitt
42 Silverdale Road
Earley,
Reading, Berks

Editor Henry Cleere
Little Bardown
Stonegate
Wadhurst, Sussex

Editorial

I signed the last Editorial as "Acting Editor"; however, having unwisely been abroad at the time of the last meeting of the Committee, I have found myself drafted formally into the job.

The Editor has a double role: to collect and to select. For the present issue, both of these functions have been discharged with his usual gusto by the Honorary Secretary, Joe Pettitt, but I hope to be more fully in the editorial chair by the time the next issue is prepared. It would help me very much if you were to supply me with material for publication without having to be "chased". If you make an interesting discovery, if you evolve a new theory that you would like to try out on your fellow members, or if you want information, just send me a note about it, to the above address, and I will do the rest.

The present issue is a short one, but it has some very interesting contributions in it. We have some more material in the pipeline for later issues, including a contribution by Bernard Worssam on those tantalizing materials, the Wealden iron ores, bibliographies on the prehistoric and Roman periods, and more gleanings from the records by Joe Pettitt. There will also be progress reports on this summer's excavations - David Crossley at Pippingford and Chingley, Fred Tebbutt and James Money at Garden Hill, and Gerald Brodribb and myself at Beauport Park.

Finally, an acknowledgment to the United Nations Industrial Development Organization, since it is on one of their typewriters in Vienna that this issue has been prepared, appropriately enough in the Roman province of Noricum.

H.C.

Notes from the Chairman

The WIRG and Archaeology

I have felt lately that it may be opportune to write a short note on archaeology in relation to the work of the Wealden Iron Research Group, in view of the frequent opinions that I have heard expressed which seem to imply that the two are separate disciplines. The phrase has often been used "It is a good thing to have an archaeologist attached to each branch of WIRG." This all goes to highlight the unfortunate popular misconception that archaeologists are "people who dig up things." This is only true of some archaeologists: some do excavations while others do field work, such as that being done by members of the WIRG. This is just as good archaeology as digging and is usually more important. Furthermore it can be done by less experienced people and is not destructive.

There are, of course, archaeologists who have had special training or long experience in digging, and it is very wrong for archaeologists without that training to attempt to dig a site. Digging almost inevitably means destruction, or at least the destruction of the evidence that could make the site add its quota to our knowledge of the past and so make history. A badly done excavation, not properly recorded or published, is inexcusable. Today, in my opinion, there should be few excavations on non-threatened sites unless they are likely to add vital knowledge to some unknown phase of history. There is so much to record that is about to be destroyed, in building and road development, that efforts should be concentrated there.

How does all this apply to the WIRG? First, let members be under no doubt that if they are doing field work and recording what they find they are archaeologists doing a first-rate job, far more important than attempting an excavation for which they have little experience in interpreting results or publishing their findings. The field archaeologist trains himself to interpret what he sees on the ground and, if his early efforts are amateur, they lead to no destruction. The excavating archaeologist must train himself first by working under experienced masters. Both have to learn how to record and finally publish their results. Their work is complementary to that of the excavator and is great fun.

C.F. Tebbutt

Chemistry and the Wealden iron industry

by P. J. Ovenden

(The material presented in this paper formed part of a lecture given to the Horsham Museum Society on 30 March 1972)

The future development of industrial archaeology, particularly in the study of bygone technology, may well depend on the systematic application of chemistry, metallurgy, and mineralogy. Since smelting is a chemical process that may be of archaeological interest, the systematic application of chemistry to the Wealden iron industry cannot be avoided for much longer. What is required is not the odd analysis to round off a paper on a hitherto unknown site, but a standard scheme to be applied without exception, whereby a comprehensive body of data may be steadily built up with a view to resolving the more general archaeological problems. It is the purpose of this article to discuss the nature of these problems, and to indicate the type of chemical information required and some of the difficulties in the way.

The analysis of artefacts demonstrates the present uncritical and, essentially, qualitative approach; since a single analysis can only confirm the nature of the artefact. The only quantitative result is derived from a collection of similar objects, say a hoard of "currency bars", when analysis would permit them to be grouped to indicate a number of possible sources. Nothing can be said of these sources without matching analyses of the possible ore bodies concerned, which is a considerable undertaking. By narrowing the field of possibilities, there is a fair chance of success and to illustrate this point I have chosen three examples from the Western Weald.

A fireback in a Fernhurst cottage* has a simple rope-impress design, the religious motif associating it with the nearby ruins of Shulebrede Priory. Such an association, if justified (but see Schubert, p.260) would place its date of manufacture certainly before 1539.¹

Three possible sources are likely, in any case, for such an early style: the continent, the High Weald, and a local furnace. Trace analysis of the corrosion products and the relative ore sources of the last two possible districts would resolve this question.

In his note on Standford furnace and forge [sic]. Straker (p.450) mentions a local tradition that the raw material was obtained from Weaver's Down, where

* The author wishes to acknowledge the interest and patience of Mr and Mrs Gandy of Vannlands, Fernhurst.

a hard coarse ferruginous ragstone prominently outcrops. Since this ironstone also contains significant amounts of cobalt, analysis of the products for this metal is all that is required.

The third example concerns the raw material for an early bloomery at Coombeswell, discovered some time ago by Mr A. Chandler, the then owner of the property. Since this site lies well away from the nearest clay-ironstone, a ragstone may again feature as the ore. None has been located so far, but assuming conformity with Weaver's Down ragstone a negative approach is possible, since the Wealden clay-ironstone contains manganese but no cobalt.

The apparent simplicity of these solutions is largely offset by the need to know in which product of smelting and to what extent the key elements will appear. The same requirement is more evident when considering general questions of the development of smelting technique.

It is intellectually more satisfying to regard the development of iron smelting as following two parallel but mutually exclusive paths from two archetypes: the open camp fire and the enclosed pottery kiln. The first culminated in the Catalan forge, whilst the second provided ultimately the modern blast furnace. Such a hypothesis will not be proved by archaeological excavation alone, since the essential key - the manner of operation - is not to be inferred in detail from the remains. Although certain clues are given, latterly, by historical records, the final confirmation must come from elemental analysis of the products and raw materials. A good illustration of the general situation is given by Brown's² comparative analysis of the Muncaster bloom and Tylecote's³ experimental bloom. The differences in the carbon and silicon contents may represent an "expected" variation due to the vagaries of what was essentially the same technique but could equally be real differences between two significantly different techniques. If the effect of the slag bath was appreciated at that time, as was true at a later period (Schubert, Appendix 13), then this could account for the low carbon and silicon contents of the original bloom.

This does not mean, of course, that the slag bath was always utilized in bloomeries; on the contrary, it may be an essential difference between the two lines of development. Nevertheless, it is an intriguing possibility that the rapid replacement of many bloomeries by conversion forges on the same site, on the introduction of the indirect process to Britain, was a result of the contemporary operators' awareness of the similarity between the two processes rather than a matter of convenience.

If we are to obtain more than a superficial appreciation of bygone technology, a reassessment in part of field techniques as well as a closer study of the metallurgy is called for. Natural materials, such as iron ore, show variations in composition. In addition, there is the variation in the smelting process by reason of the varying degree of control that the operator must have had over the factors governing the composition of the final product. Whilst we have to play down the variations in ore composition, the vagaries of the smelting process are of considerable interest. The establishment of a standard sampling procedure is of prime importance, but this has so far not been undertaken. The refuse tip at Bardown⁴ represents an opportunity to obtain the "between charge" variation of the bloomery process for the period of operation of this site.

The next question is to decide on the scope of any chemical analysis. Such collected data as are to be found⁵ suffer from a lack of clear direction and are generally incomplete for the evaluation of a smelting process in depth. The simple omission of cobalt from the list of elements would have been insufficient for two of the problems quoted above. There is, equally, no virtue in looking for every conceivable element - for example, those which in one form or another are volatile and would therefore be carried off in the exhaust gases. At this stage, the list of elements to be sought should be those which will appear in the solid smelting products as a result of reactions occurring in the furnace if these elements or their oxides were present in the ore or the fuel. A list of likely reactions is given in the accompanying table. The shaft reactions are relevant to the direct process, as also are some of the slag or hearth reactions if a slag bath is used (q.v.).

In the upper part of the furnace the reactions are straightforward and one simply takes note of the minimum temperatures for the reactions to proceed from left to right, bearing in mind that the rate will only become significant at somewhat higher temperatures.

In the immediate vicinity of the tuyere the carbon dioxide or, even, oxygen content of the gases may be high enough to re-oxidize some of the metal. A comparison of the dimensions of a modern and 17th century blast furnace may mean that the relative size of the air race in the furnace throat will cause a greater proportion of the metal to be re-oxidized in the smaller furnace. This relative size falls as the sandstone lining is worn away over the course of a blowing season and, if the remains at Surney Hatch⁶ represent the throat dimensions at the close of a season, this could mean that the level of re-oxidation could fall by as much as a factor of seven, and be a contributory cause

of the improved output, as the blowing season progressed, observed by contemporary ironmasters.

Slag and metal collect in the hearth and separate with the slag floating on top of the metal. Subsequently, metal droplets must fall through the slag in the hearth and there is a possibility of further reaction, depending on whether or not the slag contains an excess of iron, calcium, and magnesium oxides. If there is an excess, then carbon and phosphorus are removed from the metal; if not, the carbon in the metal continues the reduction processes commenced in the boshes.

Modern iron refining techniques utilize a basic slag, i.e. one containing excess lime, and the reactions in such a medium have been studied extensively. However, little is known of the behaviour of vanadium and titanium under such conditions. Although the fayalite slags that form the furnace bottoms and tap slag of bloomeries may be regarded as basic, the activity of iron oxide is lower than that of calcium and magnesium oxides and the extent to which a given reaction will occur in it is not certain.

The extent of possible reactions is dependent on the conditions in the furnace, and of particular interest is the reduction of manganese oxide and silica. Ambiguity arises when the same products are obtained both in the boshes and in the hearth. This can be resolved by the determination of hearth temperatures utilizing the work of Bowen et al.⁷ in conjunction with a mineral analysis of the slag, where this is not a uniform glass but contains other phases in crystalline form.

It is in this context that the practice of fluxing is to be studied. It has been variously stated that fluxing was not practised in the Wealden industry because the melting point of the slag is barely lowered by the addition of small amounts of lime, whilst larger quantities actually raise it. Also, the dissolution of lime is too slow for any beneficial effect to be obtained under the low-temperature conditions in the charcoal blast furnace. This latter objection is clearly disposed of by evidence that fluxing was generally practised before 1700 in areas other than the Weald, whilst the calculated residence time will offset the unfavourable temperatures (see table of dimensions). Bosley⁸ has shown that the slag in a modern furnace rapidly dissolves lime as it passes from the boshes to the hearth. In the 5-6 hours between successive discharges equilibrium had not been attained in the hearth but, nevertheless, because the hearth temperature was lower than that in the boshes, extensive de-siliconizing had occurred into the basic slag. A closer approach to equilibrium may be

THE BLAST FURNACE

Dimensions	Modern	1620
Mouth dia., ft	12	3
Shaft height, ft	50	15.5
Widest dia., ft	18	6
Bosh height, ft	12	2.5
Dia. at tuyere, ft	10	1
Throat height, ft	8	1
Hearth volume, ft ³	300	12
Charge, tons	300	6.75
Av. daily consumption, tons		
Ore	780	4
Limestone	195	0.5
Coke/charcoal	325	4
Daily output of pig iron, tons	400	1
Max. Temperature, °C	1800	1400
	(hot blast)	(cold blast)
Throughput time, hours	5.5	20

FREE-RUNNING TEMPERATURES OF SLAGS

Composition %			Free-running temperature
FeO	CaO	SiO ₂	°C
80	-	20	1220
77	-	23	1180
62	-	38	1180
58	-	42	1470
42	-	58	1700 (1470)
35	15	50	1180
30	20	50	1200
20	30	50	1320
10	40	50	1430
5	45	50	1500
20	36	44	1350
15	36	49	1400
10	36	54	1435
5	36	59	1435
-	36	64	1435

CHEMICAL REACTIONS IN THE BLAST FURNACE

At the tuyeres	$C + O_2 \rightarrow CO_2$	-94,200 - 0.2T
	$CO_2 + C \rightarrow 2CO$	40,500 - 41.70T (> 700°C)
In the shaft	$Fe_3O_3 + CO \rightarrow 2FeO + CO_2$	2,120 - 10.39T
	$FeO + CO \rightarrow Fe + CO_2$	-5,450 + 5.80T
	$NiO + CO \rightarrow Ni + CO_2$	-9,050 - 2.80T
	$CoO + CO \rightarrow Co + CO_2$	-11,600 + 3.85T
boshes	$\frac{1}{5}(P_2O_5 + 5C \rightarrow 2P + 5CO)$	89,400 - 89.1T (> 700°C)
	$\frac{1}{3}(Cr_2O_3 + 3C \rightarrow 2Cr + 3CO)$	62,550 - 41.65T (> 1230°C)
	$\frac{1}{2}(SiO_2 + 2C \rightarrow Si + 2CO)$	78,600 - 47.06T (> 1400°C)
	$MnO + C \rightarrow Mn + CO$	65,250 - 38.35T (> 1450°C)
	$\frac{1}{3}(V_2O_3 + 3C \rightarrow 2V + 3CO)$	71,150 - 39.67T (> 1520°C)
throat (near tuyere)	$Fe + CO_2 \rightarrow FeO + CO$	(>10% CO ₂ at 1400°C)
	$2Fe + O_2 \rightarrow 2FeO$	-124,100 + 29.9T
hearth (slag reactions)	$[Cr]_{si} + (Fe) \rightarrow [FeO]_{si} + [Cr]_{Fe}$	
	$[MnO]_{si} + (Fe) \rightarrow [FeO]_{si} + [Mn]_{Fe}$	
	$[Fe_3C]_{Fe} + [FeO]_{si} \rightarrow 4(Fe) + CO$	
	$3[Fe_3C]_{Fe} + [TiO_2]_{Fe} \rightarrow [TiC]_{si} + 9(Fe) + 2CO$	

expected in a 16th-17th century furnace, where the residence time is of the order of 24 hours, but this could possibly be offset by an even lower hearth temperature. A similar exercise on a bloomery furnace is certainly required and could be carried out quite easily.

The first objection to fluxing stated above is quite true. From the composition/temperature table we see that fayalite slags containing more than 60% FeO are free-running at 1180°C, but that there is a sharp rise in melting point to 1470°C at 58% FeO. Further decrease in iron oxide content results in an increasing amount of solid (cristobalite), although the apparent melting point remains constant, and the slags take on an increasingly fudge-like consistency. In the high lime - low iron oxide region, the melting point is still virtually constant at 1436°C, but again with a varying amount of suspended solid. However, for the stated compositions in the table the resultant melts are clear free-flowing liquids at the quoted temperatures. At a constant silica composition the effect of lime is quite distinct in producing free-running slags at markedly lower temperatures. We do not know if our 17th century predecessors were aware of all this, but a comparison of ore and slag composition would provide the answer. What is more likely is indicated by analysis of the Wadhurst clay-ironstone⁵, which reveals almost the correct amount of lime and magnesia to provide a free-running slag at 1470°C. What is not certain is whether or not this happy situation was true for the whole area, but it is probable that the imbalance of lime in districts other than the Weald would have produced slags of a viscous character on which the addition of limestone or forge cinder would have produced a marked effect in terms of free-running qualities.

To summarize, there is a distinct possibility of drawing satisfactory conclusions on the development of iron smelting provided that the following requirements are met:

1. The natural variations both in ore and smelting products must be determined.
2. For this, ore and slag samples weighing not less than 5kg must be taken in such a manner that the variation of composition within the lode is minimized and the variation of slag composition with furnace condition is maximized. Waste metal from a site requires careful cleaning to eliminate changes due to reactions with the surroundings.
3. Analysis of metal must include the following: silicon, sulphur, phosphorus, total carbon, graphitic carbon, manganese, titanium, nickel, cobalt, vanadium, and chromium. Analysis of ores and slags must, in addition, include the following : iron, aluminium, calcium, and

magnesium oxides and loss on ignition (carbon dioxide and water).
It is essential that any element should be shown to be absent.

4. The investigation of the acid and fayalite slag reactions of chromium, manganese, vanadium, and titanium.

REFERENCES

1. A. Ponsonby: "The Priory and Manor of Lynchmere and Shulbrede", Wessex Press, Taunton, 1920.
 2. G.T. Brown: *Bull. Hist. Met. Group*, 1971, **5**(1), 29.
 3. E.J. Wynne and R.F. Tylecote: *J. Iron Steel Inst.*, 1958, 339.
 4. H.F. Cleere: *Bull. Hist. Met. Group*, 1971, **5**(2), 74.
 5. R.F. Tylecote: "Metallurgy in Archaeology", Edward Arnold, London, 1962.
 6. P.J. Ovenden: *Wealden Iron Res. Group Bull.*, No. 1 1971.
 7. N.L. Bowen, J.F. Schairer, and E. Posnjak: *Amer. J. Sci.*, 1933, **26**(5), 193.
 8. J.J. Bosley, N.B. Melcher, and M.M. Harris: *J. Metals*, 1959, **11**, 610.
- Also H.R. Schubert: "History of the British Iron and Steel Industry", Routledge and Kegan Paul, London, 1957.
E. Straker: "Wealden Iron", G. Bell and Sons, London, 1931.
R.G. Ward: "The Physical Chemistry of Iron and Steel Making", Edward Arnold, 1962.

Miscellanea

In the Forest of Dean, during the 18th and 19th centuries, blast-furnace slag was collected, ground to a fine powder, washed, and then used for making glass bottles (from "The Industrial History of Dean", by Cyril Hart: David and Charles Ltd)

A forge with water-powered tilt hammer is supposed to be operating on Dartmoor this summer at a place called Sticklepath (SX 640 940), near Okehampton, the map reference of the actual site is not known by me.

A former forge and foundry worker from Croydon, who now lives at East Preston, has many interesting stories of the days before and after World War I. His technique may be a bit advanced for the WIRG, but it could be very enlightening to listen to him.

Brian K. Herbert

Aliens in Wealden iron districts 1524-5

by Joseph Pettitt

[This is an abstract of a longer article,
which is available on request.]

Straker and Schubert both record the presence of aliens in Hartfield in and after 1496. Such aliens had come from the Continent to work the new (indirect) process of ironmaking in blast furnaces and hammer forges. The writers also made use of parish registers, none earlier than 1538, and naturalization (denization) lists dating from 1544.¹ Neither made use of the Subsidy Rolls of 1524-5.² These may throw light on the spread of the new process. They are taxation lists and comprehend a wide social range from gentry to labourer - and alien. Nobility and clergy were excluded, hence the term "Lay".

Here are the general statistics based on a count.

Table I ALIENS IN SUSSEX IN 1524-5

Sussex	West	East	Total
Natives			c. 12700 ³
Aliens	127	339	466
Aliens in WI districts ⁴	6	141	147

One must not assume automatically that the aliens in Wealden iron districts were all engaged in iron occupations. The rolls are tantalizingly vague: occupations are not given and servants and labourers and aliens are seldom related to their masters. Since there were aliens in towns, in the rural chalk and coastal areas, and in the non-iron districts of the Weald, one is in complete doubt about whom to ascribe to iron occupations. The rolls do not consistently use the parish system, and it is difficult to delimit the

1. E. Straker: "Wealden Iron", 1931: Index, p.477 - Frenchmen H.R. Schubert: "History of the British Iron and Steel Industry ...", 1957: Index, p.440 - France, ironworkers from. The Denization Lists are published in W. Page: "Letters of Denization", vol. viii of *Publications of the Huguenot Society*, London, 1885.
2. Public Record Office: E.179/189/various rolls; these have been transcribed and edited by Julian Cornwall and printed in the Sussex Record Society's vol. 57 "The Lay Subsidy Rolls 1524-5", 1956, where the roll numbers are given.
3. Cornwall's estimate, *op.cit.*, p.xxxiv.
4. In parishes or parishes adjoining the parishes where a blast furnace or a hammer forge is known to have operated at some time.

districts named. Further, we do not know where, outside Hartfield, there were new-process sites in 1524-5; indeed, the purpose of this article is to examine the rolls to see if they suggest iron activity at all and new-process sites in particular. The material for such an examination is given in Table II.

Table II Aliens tentatively ascribed to the nearest Wealden iron sites

Notes: Fo(s) = Forge(s), Fu(s) = Furnace(s)

Several districts with 1 or 2 aliens have been omitted.

Aliens	Page in SRS 57	Tentative Ascription	Page in Straker
<u>West Sussex</u>			
Iping (1)	10	Chithurst Fo	430
Trotton (3)	12-13	Chithurst Fo	430
<u>East Sussex</u>			
Cuckfield (4)	86-87	3 Fus and 1 Fo in Cuckfield and Slaugham	404-6 416-7
Chiddingly (5)	123	Stream Fu	384
Wadhurst (4)	124	Several Fus and Fos	268-9
Framfield (4)	126	2 Fus and 1 Fo/Fu	391-3
Hartfield (36)	130-1	Several Fus and Fos	24-51
Ashburnham (3)	139	2 Fus and 1 Fo	362-72
Pashley in Ticehurst and Etchingham (11)	144	Pashley Fu and Etchingham Fu and Fo	296-8
Netherfield Hundred (7)	145	Fus and Fos in Brightling, Dallington, Mountfield, and Penhurst	306, 308-9, 326-9, and 363-70
Burwash (17)	146-8	Burwash Fo, Glaziers Fo, Socknersh Fu, and Broadhurst Fu	301-9, 287
Salehurst and Part of Etchingham (8)	149-50	Bugsell Fo and Etchingham Fu and Fo and Iridge Fu	300, 297-8, 320
Robertsbridge (5)	151-2	Robertsbridge Fu and Fo	310-8
Battle (10)	153-6	Beech Fu, Battle Fu or Fo	350

What can one deduce from these figures? Not much with certainty. However, one can safely ascribe some of the 36 aliens in Hartfield to ironmaking activities in view not only of the astonishingly high numbers but also of the evidence of Straker and Schubert which these figures confirm. Secondly, some of the 17 aliens in Burwash were probably working at ironmaking, more

especially since the 1525 list has this interesting note: "the seyd John [Collen] hath in his service viij Frenchemen."⁵ Now, among the ironmasters in the Lists of 1574⁶ was John Collins of Burwash Forge; he was 80 years old and too infirm to travel to London to sign his bond.⁷ Had he, or perhaps his father, in view of the famous grave slab,⁸ commenced production of wrought iron in a hammer forge by 1524-5? If so, where was the blast furnace supplying pig iron for conversion? A John Collins had Socknersh Furnace by 1535, and in that district there were 8 aliens in 1524-5.

Thirdly, Pashley district had 13 aliens; this is suggestive of early activity at Pashley Furnace and/or the site in Etchingham. The names of some of them are intriguing : Furbeys, Taylboy, and Wodetaller. Are these nicknames for Furnace, Cutwood (Taille bois), and Woodcutter (Wood tailleur)? Two French aliens in Withyham⁹ had the name "Colyar" and "Shoesmith"; neither name is French. If a demur is made here that these names do not at all suggest ironmaking activities, one can give the evidence of Schubert that aliens were brought in for activities indirectly associated with ironmaking.¹⁰ One assumes that before the sudden demand for cast and wrought iron in the late 15th century, production in the Weald was small, sporadic, and perhaps largely itinerant. To satisfy the new demand for iron and the derived demand for the raw materials needed, labour was brought in from abroad.

Perhaps this article will stimulate further search for documents throwing light, however vague, on the period under discussion. The Muster Rolls of 1539¹¹ show 49 Frenchmen in Netherfield Hundred; perhaps a rereading of the document will reveal alien surnames elsewhere, even if they are not labelled 'alien'. Perhaps historians with a detailed knowledge of the Weald and France at this time will tell us what non-ironmaking activities aliens worked at. And were the aliens pushed by circumstances in France or pulled by the wages drift in the Weald, such drift being the product of increased demand? And who did the recruiting and how?

Finally, did the direct process survive for a time in the Weald alongside the new process? Biringuccio and Agricola, writing in Italy and Germany respectively about the middle of the 16th century,¹² are not clear about the superiority of the new process; the capitalized mechanized workshop with division of labour, vertical integration of smelting and forging, conservation of heat and quantity production shown in Agricola's book is a combined bloomery and bloomsmithy, not a blast furnace and hammer forge. It implies a considerable efficiency. It is known that bloomeries survived in other parts of the country for two more centuries.

Footnotes to previous page

5. Cornwall, *op.cit.*, p.148.
- 6,7 Straker, *op.cit.*, pp.53-9 and 303.
8. Straker, *op.cit.*, pp.306-7; Schubert, *op.cit.*, pp.265-6. Is "Jhone" John, not Joan?
9. Cornwall, *op.cit.*, p.136.
10. Schubert, *op.cit.*, p.224.
11. Public Record Office: Summary in *Letters and Papers*, 30 Henry VIII, XIV, (1), 298.
12. Biringuccio, Vannoccio: *De la pirotechnia* (1540): translated and edited by C.S. Smith and M. Gnudi, New York (1943); information about bloomeries and blast furnaces on pp.61-6 and 319-21. Agricola, Georg: *De re metallica* (1556): translated and edited by H.C. and L.H. Hoover, London (1912) and New York (1950); information about bloomeries and blast furnaces on pp.420-5, the illustration of the bloomery-bloomsmithy is on p.422. Schubert discusses this on pp.149-51 and reproduces the illustration on p.150. Straker supposes two "modern" bloomeries on pp.270 and 431, but he is not convincing, and Schubert contradicts p.431, in his own Appendix V on p.380.

Notes and Queries

Q. Some field investigators carry test kits. It is possible for WIRG "forayers" to have a kit for testing ores? Some grey carbonate ores look just like a silty sandstone, and it would be useful to be able to reject non-ferrous material.

A. It would be easy to provide a qualitative test for iron but, because of the widespread occurrence of this metal, this would be insufficient. Generally it is the quantity of ferrous mineral present that makes a rock an ore. Colour is no guide with clay-ironstones, so density is the most certain indication of a good-quality ore. A working knowledge of the local geology is an additional help in identifying low-grade material that is known to have been mined.

A contemporary description of John Brown's gun-founding furnace at Barden, Kent (1646)

[This passage is reproduced from the *Diary of Sir James Hope*, edited by P. Marshall for the Scottish History Society, in whose *9th Miscellany* (Vol. 50 in the Society's series) it originally appeared. The Editor of the Bulletin is most grateful to the Council of the Scottish History Society for permission for this extract to be reprinted.

John Brown was probably the most prominent of the 17th century Wealden gun founders; he held the post of "His Majesty's Founder" in 1640, producing pieces at Brenchley and Horsmonden, as well as at Barden. In the 1660s, the family was to widen its interests still further, working Cowden, Hamsell, and Hawkhurst Furnaces in 1664, and leasing Imbham's Furnace (Surrey) in 1665.

The description of blast furnace operation is the fullest of its period, and gives valuable information on dimensions, as well as the preparation of the ore and the charcoal. The *Diary* also contains (pp.170-80) a valuable description of ironmaking in the Liège area, which should be read by anyone interested to compare English and Continental practice.

The passages quoted appear on pp.146-53 of the transcript printed by the Scottish History Society. Two short entries for 10 March and 11 March (the latter the first of two) have been omitted. The footnotes, which have been grouped at the end of the extract, are almost entirely those of the original editor.]

9 Moneday. Sir Umphray Steiles, and some uther countray gentlemen being to goe to Dover I resolved to goe with them and looke for passage there. Bot haveing a desyre to see the yron milnes besyde Tunbridge,¹ wee lett them goe the straight way to Dover, and my brother Sir Alexander and I and my man Robine went to Tunbridge, where we came being long 18 myles about 12 a clocke; bot our horses being some what wearie, we changed our horses there, and tooke fresh horses and ane guyde to the yron milne at Barden² some 4 myles off. When wee come neire we did first see heapes of the yron stonne, whereof ther wer severall sorts. One there was a blackish blew much lyke the colour of a loadstone, or lyke a hard parrett coalle or till stonne that is found besyde it. Ane uther riddish, much lyke a marle stonne, which by the varie lyeing in the aire mullers³ and cleives into brattes⁴ lyke it (above both thir wer crustie and u[n]regular). A third I observed, much lyke unto a gray cambe stonne,⁵ broke easilie into crusts, and cutt also with a knyfe smooth, bot not so easilie as cambe stonne. A fourth thinne lyke a solait, hard and blakish, gray and blew spotted within with starres. Of all thir kinds ther were severall sorts of intermediat colors and mixturs not so expressible as discernible. Besyd thir heapes there wer some of it lying mixed with charcoall burneing upon the varie ground, lyeing in disordor and a la negligence, not

in any kill.⁶ They begine at one end of any heape, and haveing mixed a certaine quantitie of it just as so wee doe lyme and sand, they putt fyre to it at the furthest end from the heape, which being burnt neire to the heape, they mixed more, casting it to the end of the former, and so use to continue it until al the heape be burnt sufficientlie.

March 9. All those severall stonnes are thus burnt before they goe to the furnace. Efter they are burnt they become some rid, some blackish, bot most part blewish; and some of them crakes and ryves in the midle like dryed clay, or hard yron that will not wall⁷ nor worke. The fornace is a blast fornace of bot tuo bellies bot varie large ones, being about 13 or 14 footts long forby the head. Where the fyr yrones did enter into the fornace there was ane open hole about halfe a foote ovenlyke by which they did observe the temper of the fornace. The bellies at the bigger end wer some 2 foottes over.

March 9. They rose in the blast tuo foottes skarce. They were blowne with wyppers and suoards⁸ lyke our owne, onely instead of a baake⁹ for raiseing of the bellies, everie one of them had a long vectis with a weght upon the end of it (such as we use to draw water with for salt pannes) which did both draw the blast long and raise the bellies. The exeltrie was above 2 foottes diameter, the waterwheel not above six semi diameter; upon the which the water was lett in from the damme above by a slouse raised and depressed with a vectis lyke unto that of a shippe pumpe.

The fornace was about 20 footes high and above, the wydnes therof at the tope a foott and ane quarter and a foott and ane halfe long. About midle fornace, as I was informed, it was about 5 foottes wyde and sex foottes long, and at the bottome againe about tuo foottes¹⁰ wyde and 3 footts long, and the panne about a foot and ane halfe deepe. The blast was upon the brodsyde and about tuo foottes (above 5 handbroads) above the panne. At the ryght end of the panne and fornace was ane ergasterie¹¹ lyke unto ours, at the which the[y] did watch and pull out the slages. The end of the panne to my conjecture came about a foott and ane half square without the fornace, where the slagges wer drawn out and sturred to make them cleire of the metall with gavelockes¹² and porres¹³ such and as we doe watch our fornaces.

March 9. The slagge that comes fourth (which runnes out¹⁴ in a certaine quantitie when they watche and open the mouth of the fornace, which they doe bot once in ane 1/6 part of ane houre or therby, and thereafter closes it againe by throwing before and upon it such small coall¹⁵ dust as doeth impied the further flux therof* is brickell and blacke like gette,¹⁶ brakeing in sharpe points and

edges lyke flint or glasse. The metall is putt in above at the tope of the fornace layke as the charcoall also by turnes. So soone as the fornace is settled at the tope about foure foottes doune (which they measure with a staffe of that lenth hung at the end of ane uther because they can not come above the fornace to looke in for heatt) then they fill it up with coalle. And as that setles which it does sensiblie and quicklie, they cast and heape one the metall above (which is only a litle knocked small with a fleggell¹⁷ efter it is burnt)¹⁸ bot on the one syde only, leiving alwayes a litle free for vent on the uther syde. They fill her up thus, 15 or 16¹⁹ tymes in the 24 houres. They put 4 baskett of coalles (whereof I judged one to hold about ane halfe of our bolles) to 12 litle troches heaped full of metall; the troch would have been about 1¹/₂ footte long and ³/₄ footte broad. When the panne is full of metall they pearce ane hole at the end of it and letts it so sunne out into the moulds that are reddie by prepared for it.²⁰

March 9. Because they were casteing ordinance heire,²¹ they lett the fornace voyd bot once in the 24 houres. And everie 24 houres they cast a gunne of 2100 weight. I asked what they would take for the 100 of such worke as backes of chymnays²² (intending to have cast some foreplates for my leid fornaces). They demanded 20 ss. bot said they could doe nothing without the maisters ordors, who wes some 10 myles off; his name is Broune.²³ The cheiffe meiter said he had 20 ss. a weeke, the caster²⁴ als much; the under workemen to the number of 8, some 8 some 10 ss. They said the load of coalles conteining 11 or 12 quarters did cost them threttie ss; that the charges of that one milne would stand in some 2000 lib. a yeire; that ther fornace had burnt (above gone) these fourtie fyve weekes and never blowne doune, bot lyklie would be within these 10 day because they lacked coall; that when shee wer blowne doune they would make her yeeld metal againe efter 24 houres workeing, bot that shee would not come to her ryght temper in lesse then a mounthe.

Of all the aforesaid sorts of stones I tooke a litle with me to Tunbridge to be sent to Langlie. The foresaid fornace is built all of free stone and is some 3 foottes thicke at the mouth.

March 9. The bellies have no tewyron bot ther pype-ends came not within ¹/₂ foot of the innersyde of the fornace. Efter that we came from the fornace, we went to see the pittes out of the which the yron metall is digged, which wer a litle on our right hand about midle way in our returne to Tunbridge. Bot ther had been none workeing ther of a long tyme, and all the holles wer runne together; only I could conjecture so much, that they had never been above 12 or 16 footes deepe, and that the vaine (for I was informed that it lyes orderlie in a vaine)

lyes flatte in some kynd, for I could see no appeirance of any leider, wherein I was confermed by the many holes together lyeing to the bradth.

March 9. The thickest of the vaine that I did see ther lyeing was not above halfe a footte thicke, all of it much lyke into a rid and yellow brittle brattie²⁵ rotten rocke, which dissolved by lyeing in the weather into a clayie substance lyke marle.

I understood by the discourse of the workemen (for praesentlie understanding us to be Scottish men they wer (sic. Read ? [and that] there wer) some works goeing to be sett up there) that both the cheeffe founder and moulder would have been content to have taken on with me; which they offerred to my brother; bot they wer most part drunke and I would not enter into discourse with them.

That night we returned againe to Tunbridge about 6 a clocke.

March 9. By the way on our returne we did see of the gunnes lyeing by the way. They are caried upon a cariage with foure wheelles lyke unto ther ordinarie chariots. Sex horses drawes tuo gunes upon one of them at a tyme and as I ame informed will go 16 mylles a day in winter and 24 in summer; bad winter way.

[.....]

March 11. From a man of Sir Umphray Stylls' s I informed myselfe of the forme of makeing of charcoall²⁶ which is thus.

First they sett 3 stickes in triangle flatt upon the ground with halfe a foott of voyde in the midle, then to bigge²⁷ them about ane ell this high just as we euse to stacke dailles. Then they sett wood (all cutt of ane equall lenth about 3 foottes long) upon end about these so close as they can stand untill it be round about 10 foottrs over or therby; then they putt a peece of wood in the midle hole of the lenth of the rest straight up, which they call the pinner, and about it they place uther wood of the same lenth close together, first somewhat inclyning, and then straight upon end as before, untill ther be as many placed as will convenientlie stand above the former. Thus being pyled up tuo storie high, they cover it first with braickes²⁸ or fairnes or strae some 3 or foure inches thicke. Then they putt in some fyre at the midle hole (haveing pulled out the pinner) and when the fyre is once taken with, presentlie putt in the pinner againe, and when the fyre beginnes to crakle and er the flamme doe brake forth, they throw upon the cheime²⁹ or tope of it some sand or moulding earth, and as it burnes

fast or slow they cast it on the more quicklie, covering her dounewards until shee be all once full covered so that ther be no smocke perceaved to come out. Then immediatly (leist shee should be altogether extinguished) they give her way first at the top by thrusting in a staffe thorow the dust to give her vent, bot so that no flame ishew; and when shee is sufficientlie coaled, that is all become rid at the tope, which will be knowne by the blewness of the smocke, then they give her vent lower about halfe a footte, and when shee is coaled there also, ane uther halfe foott untill shee be coaled to the bottome. Note that these holes to give her way are made just round about the pyrimid, circle wyse, first about 1¹/₂ footte distant, thereafter the further doune the thicker halfeway, thencefourth aequallie to the ground.

March 11. When the smocke is thus broght doune to the ground, then it is all coaled. So immediatlly they pull off all the strae and cover with a raicke, so cleanlie as can bee, that it mix not with the coalle. And immediatlly making the sand so cleane of all the burnt strae or other cover as can be (the heape in the meane tyme being all in a rid fyre) they throw on the sand againe as thicke as can be so that ther be no vent left at all, and within 12 houres thereafter shee will be fullie extinguished and smuthered out. Then they gather off the sand as before barie carefullie and puttes it in litle heapes to be made use of againe, for lyke moulding sand the oftner it be used the better it is. Note that ther must be liewes or skonses³⁰ as we call them to sett betuixt the wynde and the pyle or fyre, for the least wynd will blow all the fyre to one syde and it will not burne aecruallie, bot indanger the losse of all. Note that they measur ther timber (being cutt in peeces of 3 footte long) by cordes of 12 foottes long and 3¹/₂ foottes high. And fyve of thir cords will make a load, that is 60 seckes of charcoall, everie secke conteining 3 bushells. This charcoall is sold for 12d. a secke of that measure; so the load wilbe worth 3 lib. And the timber costs ordinarlie 5 and 6ss. a cord, and the coalyer hes 4ss. for his paines. So the halfe gained.

March 11. The aforesaid way is only for the charking of great coall or of wood half ane inch great and above. Bot for that which they call small coall they doe nothing bot efter that it is coaled (which it will be with the first fyre being confusedlie cast unto any heape) quench it with water.

This day also I gave ane note to Mr Robert Steilles, Sir Umphraes brother, to be sent to Mr Broune, maister of the forsaid yron milnes, to cause make to me tuo yron plaites for to be in place of forestonnes for my leid³¹ fornaces,

each of them tuo inches thicke, 24 inches long and 20 inches broad, which he promised to have in reddiness for me at London against my return.

Notes

1. For background see Ernest Straker, "Wealden Iron" (1931).
2. At Barden Furnace Farm, near Speldhurst, the site of this furnace is still easily identifiable. Cf. Straker, op.cit., p.219.
3. crumbles
4. flakes
5. soft clayey limestone
6. open kiln
7. run together
8. The bellows, in pairs, were depressed alternately by a lug or cam (wypper) on the revolving shaft (exeltrie); on release they were raised by a suord or rod connected to the overhead counterbalance.
9. baulk of timber
10. Figures inserted above to read: In Liege about 1¹/₂ foottes wyde and 5 footts long.
11. work hole, slag vent
12. iron crowbars
13. Cf. porring iron, poker (Warrack).
14. above they draw
15. Throughout, charcoal
16. jet
17. iron sledge
18. Inserted above this parenthesis: In Liege not burnt at all bot only mixed with lyme stonne for a flux.
19. 10, written above 15 or 16, refers to Liège.
20. Inserted above this last sentence: In Liege because they cast small worke, they take out the metall with ane yron ladell clayed.
21. For the production of ordnance in this area, see Straker, op.cit., pp.48-68 and Chaps. xv, xvi; Charles ffoulkes, "The Gunfounders of England" (1937), chap. vi; Victoria County History, Sussex, ii, 246-9. To the gunfoundry sites traced by Straker and listed by ffoulkes, Barden can now be added.
22. Along with iron grave tablets or slabs, a regular branch of the industry. "Wealden Iron", pp.168-176.
23. John Browne of Brenchley; became official gunfounder to the Parliament after 1642, and continued to cast guns for the Commonwealth till his death in 1652. "Wealden Iron", pp.162-4; C. ffoulkes, op.cit., pp.75-76, 113, 118; V.C.H., Kent, iii, 386-7.
24. moulder
25. ragged or scurfy
26. A closely parallel description is quoted in extenso by Straker, op.cit., from Evelyn's "Sylva", edn. 1679.
27. build
28. bracken
29. Cf. Fr. cheminée
30. wattle hurdles, shelter screens; vide lews, Eng. Dialect Dict.
31. lead

Shorter Notes

Marinus and Wealden Iron

Marinus was a master potter whose working life can be dated somewhere between AD 70 and 110, a period of great expansion of trade and communications following the completion of the Roman conquest of Britain. As the new metalled roads began to spread all over the country, great opportunities arose for merchants and manufacturers to sell goods to distant market. This encouraged the mass production of household goods, such as pottery, by enterprising manufacturers.

Marinus appears to have been one of such manufacturers who seems to have specialized in the making of pottery mortars (mortaria). Together with a few others in his trade he adopted the practice of impressing his name, in an abbreviated form, as a stamp on the rim of his vessels, a practice not adopted by Roman potters producing the ordinary run of household pottery.

Marinus is known to have used six different stamps, and about 70 examples of his stamped wares have been recorded in Britain; five of these were found as far north as Newstead (Notts) and nine at Brockley Hill (Middx), where it is likely that he worked, at least for a time. Until this year, only two examples of his work had been found in Sussex (none of these at Fishbourne).

In the spring of this year, our Treasurer, Mrs D. Meades, picked up a small mortarium rim sherd at the Roman ironworking site at Great Cansiron (TQ 448 382), which was found to have impressed on it part of a potter's stamp. This was sent to Mrs K. Hartley of Leeds, the leading expert on mortarium stamps, who identified it as the stamp of Marinus. To her I am also indebted for the facts about Marinus given above.

You will by now be impatient to ask me what Marinus has to tell us about Wealden iron, to justify the title of this note. First I must remind you that the London-Lewes Road, which we can safely assume as contemporary and complementary to the Cansiron iron works, passed only a mile to the east of them. Therefore it seems likely that London was the market for Cansiron iron, and that the returning convoys of carts would bring back other goods from the London markets and manufacturers. The mortars of Marinus were undoubtedly sold in these markets and so found their way to Cansiron. The finding of this sherd supports the presumption that the north Weald then looked north to London for at least some of its imported goods and not, as did perhaps the rest of Sussex, to

coastal trade. Other types of pottery recently found at Cansiron support this view. They include examples of Nene Valley (or Castor) ware from near Peterborough and "rusticated" ware, probably from Lincolnshire, all rare in other parts of Sussex. What a pity we do not know more about Marinus!

C.F. Tebbutt

A Simple Pantograph

A pantograph is an instrument used for reproducing line drawings from one diagram to another. In the more complex pantograph, a change of scale, either larger or smaller, as well as reproduction at the same scale, can be accommodated. However a simple pantograph which can be made easily and is very simple to use, is outlined below.

This pantograph is being used to transfer geological information from the 1 in. geological map to the 2¹/₂ in. O.S. map. The resulting map is proving to be very useful when hunting for bloomeries, which are usually situated at the junction of the Wadhurst Clay and the Ashdown Beds.

Although it is not well known, the so-called 2¹/₂ in. to the mile map is in fact 2.5344 in. to the mile.

In the diagram, lengths A and B should be as accurate as possible and the pivots free to move, but not sloppy. The actual increase in size of the copy may be calculated from

$$\frac{A + B}{A}$$

which for this particular pantograph is

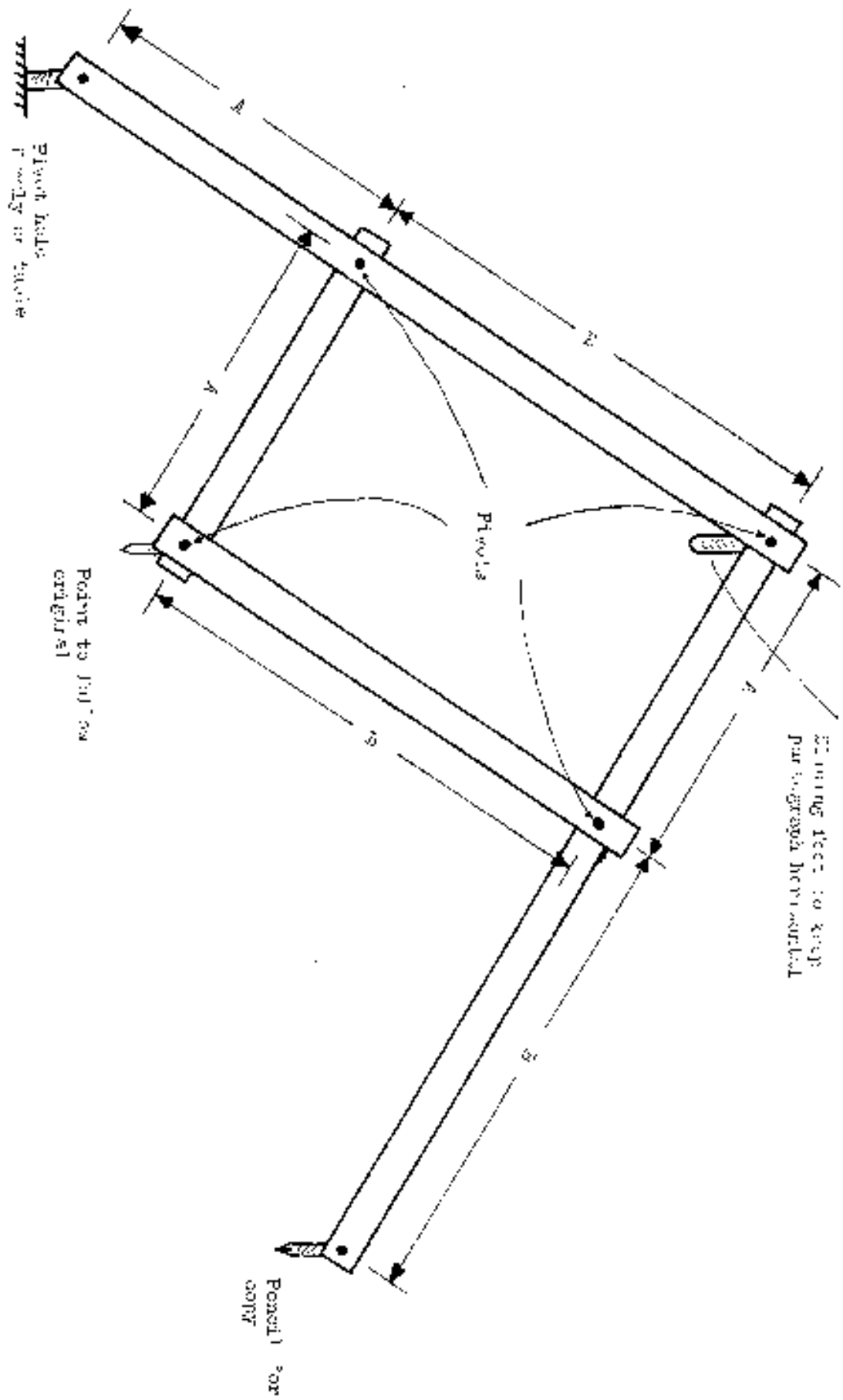
$$\frac{A + B}{A} = 2.5344$$

therefore $\frac{B}{A} = 1.5344$

In the actual instrument made, A = 5.5 in. and B = 8.44 in.

If the pencil and pointer are changed over, the copy is 2.5344 times smaller than the original. The limitations of this type of pantograph are when copies of equal or near-equal size are required, when it becomes impossible to make length B become non-existent.

Brian K. Herbert



Local Team Reports

Buxted

Since Bulletin No. 3 (pp.10-12), the Buxted group's activities have been largely confined to a start on a survey of the Uckfield river basin; this extends from west Mayfield and south Rotherfield to Isfield.

Increasingly, we try to understand the geological structure of the area and, in particular, to visualize where the ironstone horizons come to the surface. These horizons are found not only in the base of the Wadhurst Clay but also somewhere in the Ashdown Sand and in the Grinstead Clay. We have reached the stage where, with the help of field-names, we can predict bloomeries, or at least minepits. We try to imitate our ancestral prospectors who worked up the gills in the Ashdown Beds until they reached the ironstone in the Wadhurst Clay revealed by the work of the running water.

Field-names continue to stimulate and to disappoint: 'Oven's Mouth' has not yielded bloomeries in two cases, though in one case minepits were found and in both cases bloomeries were nearby. We are testing the validity of 'Smith', having already found one bloomery in 'Smith Shaw' in one case but failed in another. We hope to establish whether 'Grub' and in some cases 'Grove' indicated digging for ore and, in the case of primitive smelting, will yield bloomeries nearby.

The team convener has to retract his claim to have found a blast furnace site below Broke's Wood Pond in the Kentish parish of Southborough (see Bulletin No, 3, p.10). A second visit to the site (591 426) yielded only scatters of slag over a wide area and what looked like a spoil bank was clean loam with one slag fragment.

Supplementary List of Investigations

Hartfield

4465 3470		All yielded bloomery slag;
4458 3472	All on Lines Farm	first yielded a little
4460 3480		medieval (13th century)
4450 3445		pottery

Buxted

4765 3060	King's Standing Farm	Small concentration of bloomery slag
513 260	Sleeches Farm	<u>Lt Forge</u> : spoil bank in E stream; furnace bottom in W. Also blast- furnace slag (Straker, p.388)
507 256	The Homestead	Morphew's Bloomery: heavy concentration of slag; ?Roman pottery (S., p.389)

4905 2655	Shadwell Farm	Two patches of bloomery slag (see Bulletin No. 3 - one only).
4820 2615		Small quantity of slag in stream.
5040 2285	Above Tanyards	Concentration of bloomery slag; high bank of black earth
Framfield		
4995 1940		Quantity of soft cinder
486 200		Small quantity of bloomery slag in stream, none in bank
490 196		Two concentrations of blast-furnace slag in stream bank
Hadlow Down		
Stocklands Farm		
529 251	I.a Oven Mouth Wood	'Bell-pits' only
	b Stockland Wood	Opencast and 'bell-pits' but no bloomery slag except between a and b in lane. Supplied ore for Huggett's Furnace?
529 255	II. Squarefield Shaw	Scatter of bloomery slag and one massive piece either side of gill

Crawley

John Gibson-Hill

The rescue excavation at Broadfields

Excavations continued at Broadfields in Crawley, Sussex (TQ 258 353) throughout the winter months, with the following results.

Phase I

This area, first explored in the spring of 1971, was considerably extended (see H. Cleere, Bulletin No. 3). Here we found the remains of a further twelve furnaces of the Holbeanwood type, bringing the furnace count for Phase I to a total of sixteen. Some of these were ranged along both sides of a slag-filled Roman ditch, which, when traced, terminated in a pit, some 18 ft in diameter. It seems likely that it was used as some form of water reservoir for the iron working in the immediate area. Nearby we found the remains of a small rectangular timber-framed building, measuring 8 ft by 6 ft. This was orientated north-south, with three of its sides open to the elements.

Phase II

Several weeks ago we started to excavate a low mound that forms one of the banks of a small stream, located some 500 yards due north of Phase I. A test trench had already confirmed our thoughts that the mound represented the remains of a slag dump. What we had not counted upon was the discovery of a further two furnaces constructed on top of the slag dump. One of these is in

a reasonable state of preservation, and we are now looking into methods of lifting the whole unit, so that it will be available for further study at a later date.

The various trials sections that were made over a wider area were confined to features of interest that were threatened by the building development. Possibly the most rewarding of these was trial section XIIIIA, which led to the discovery of two furnaces of the Holbeanwood type and the remains of a much larger smelting furnace. The evidence provided by these sections and constant field walking give the impression that the excavations carried out at Southgate West (TQ 265 355) and Goffs Park (TQ 263 353) during 1970 and our more recent discovery at Broadfields are not three separate Romano-British settlements, but all form part of one large site, covering some 15 to 20 acres.

The slight variations in dates derived from a preliminary study of the pottery from these three areas is not inconsistent with this view. As there are indications of a horizontal stratigraphy at both Broadfields and Southgate West, which is normally taken as an indication of a settlement being gradually enlarged over a period of years, this variation is not unexpected.

This short summary has been confined to the archaeological discoveries made during the 1971 season, the geography and geology of the site having been adequately dealt with by Mr B.C. Worssam in his recent paper (*Proc. Geol. Ass.* vol, 83, part I, pp.37-55). Although he is too modest to admit it, all the credit for the Broadfield discovery is due to Mr Worssam.

Excavations will be continuing at Broadfields, every weekend from 22 July to 20 August. If you would like to lend a hand, please get in touch with me at 48 Paddockhurst Road, Gossops Green, Crawley (telephone Crawley 36018).

East Grinstead

Brian K. Herbert

The East Grinstead group of the W.I.R.G. has been in existence since about Christmas 1971 and consists of two families, the Thorogoods and the Herberts, and one young lady, Miss Beeken.

Our programme at the moment is to cover the Medway catchment area, which includes the two local Roman roads. However, owing to our inability to get the Geological Map No. 302 (2nd Series), it is not possible to determine the ore outcrops (If anyone has a copy of this map and can lend it to us, it would be most helpful.)

Notes on visits to known sites are given below:

- 1. Gravetye Blast furnace** **TQ 3665 3420**
Very little slag left, and the site of the furnace appears to have been well over 100 ft. from the bay, which is still intact, and is the original as an old tree has been cut down from the top. Gravetye House was built by Henry Faulconer, a local ironmaster.
- 2. Mill Place** **Blast furnace** **TQ 3745 3490**
Very little left of the bay; just a bridge over the Medway. Quite a lot of green slag in the river. The owner of the farm now, Mr Leggat, has found a bear in the river downstream of the bay. Unfortunately, he carried it on his tractor (with great difficulty) to Gravetye Manor, where it now lies near the garden wall close to the stocks. The present upper part of the bear is metallic (cast iron). It is interesting to note that Straker (p.237) mentions that "a large lump was at Mill Place, but has now gone".
- 3. Ridge Hill** **Roman bloomery** **TQ 3695 3555**
Plenty of tap slag over a wide area, as Straker says.
- 4. Walesbeech** **Roman bloomery** **TQ 3955 3450**
Plenty of tap slag on the highwater line of Weir Wood Reservoir.
- 5. Bough Beech** **Blast furnace (not on Medway)** **TQ 4815 4760**
The bay is very well defined, although breached. The slag is yellow-green and there are some pits close by, but the nearest place that ore from the Wadhurst Clay - Ashdown Beds would be expected is 2-3 miles away.
- 6. Blacklands** **Roman bloomery** **TQ 4480 3830**
A very large bloomery site with plenty of tap slag with large wrinkles, but very little bloomery cinder visible. A large quantity of Roman pottery has been found and one coin. The site has been dated as 1st and 2nd century AD.
- 7. Cansiron** **Forge** **TQ 4530 3820**
Breached bay still standing with forge cinder in it. The tilt hammer was found several years ago when a pylon was put in near the site. The hammer pond reached back almost as far as the Blacklands bloomery.
- 8. Stone** **Blast furnace** **TQ 382 342**
This is situated at the upper end of Weir Wood Reservoir. The bay can be seen during periods of drought.

9. Thunderfield Castle

Medieval bloomery

TQ 300 426

This site was excavated in 1936 by Hart and Winbolt and reported in *Surrey Arch. Coll.*, VLV, p.147. It is not mentioned by Straker, although it appears to have been known to him and Colonel Macleod. The pottery found by Hart and Winbolt was dated to the 13th to 15th centuries, and they stated that the ore used was puddingstone. (If anyone has a sample of this geological material, I should be most interested to see it.)

The actual bloomery site is located in the centrally moated area towards the southern end, and may be visited with permission from the owner of Thunderfield Moat Farm. The 9 ft diameter circle of red earth, thought to be the bloomery furnace site mentioned in the report, is still intact. It would appear more likely that this was an ore-roasting furnace or the base of a charcoal heap, but one may assume that there was a bloomery on the site as well. It might be interesting to re-excavate the site, in view of the greater knowledge of the process acquired since 1936.

One new bloomery find has been made by the group. On the invitation of Mr Gray of the Surrey Archaeological Society, a visit was paid to Upper Stonehurst Farm, Lingfield (TQ 425 411). The farmer, Mr Higgins, had reported that there was a lot of stone in one of his fields, making it almost impossible to plough.

Before the visit, the geological information about the area was transferred from the 1 in. geological map to the 2¹/₂ in. OS map and this revealed the junction of the Wadhurst Clay and the Ashdown Beds. The length of the orefield in this region is over 1 mile long and in one place follows the stream.

The hillside was covered with slag at TQ 4230 4105, although it is grassed over. The slag extended for about 100 ft. along the hillside, 100 ft. up the hillside and about 60 ft. from the stream. It is extended down to the river in one place, by the bridge at TQ 4230 4105; here the cinder was different from normal, and this may represent the forging area. The tap slag is in small pieces with only fine cooling wrinkles.

Also nearby, but not seeming to join the first site, another bank of slag about 4 ft. high and possibly 30 ft. long was found, at TQ 4230 4115, very close to the river. The 2¹/₂ in. OS map shows a track at this point, which has now grown over, so that slag may have been moved there at some time, to prevent the stream from flooding. The field name for this site is "The Grove", i.e. a clearing in the forest. The first bloomery will be known as Upper Stonehurst and the second, if proved, as The Grove.

Hastings

Alan Scott

The Hastings Archaeological Research Group has only been in existence for a few months; anyone in the Hastings-St Leonards-Bexhill area interested in joining should contact me at 36 Clinton Crescent, St Leonards-on-Sea.

Members are helping Gerald Brodribb and Henry Cleere on the excavation of the Beauport Park bath-house for much of their spare time; however, we have made several visits to other sites, including Footlands. The following sites were visited before the HARG was set up.

Wicks Coppice Bloomery

TQ 765 133

This site was discovered by the late Barry H. Lucas on 24th November 1936. When I visited the site in January 1972 I could find only a few pieces of slag in the bed of the stream and one piece of medieval pottery some distance downstream at the south end of the coppice.

Burnt House Wood, Ludlay Farm, Beckley Bloomery

TQ 848 206

Gordon Stainbridge and Wally Botting have been investigating this site with the permission of the owner. The site was discovered by Gordon Stainbridge earlier this year, and so far has yielded bloomery slag and coarse ware identified by Henry Cleere as Roman. I visited the site on 5 May 1972 with Gordon and Wally. The pottery and slag was found at a depth of about 0.45m. in a black deposit. The site itself is about 80 m. east of a small silted stream which joins the river Tillingham to the south. The ground slopes from the site towards the stream and there is a scatter of slag on this slope. Towards the north-east higher up the slope, is a large excavation, but further investigation will be needed to ascertain whether this could have been the source of the ore.

The following local place-names may be associated with the site:

Blacklands Wood (to the north)	TQ 852 214
Cinderhill Wood (to the north-east)	TQ 857 213
Quarries or earthworks	TQ 855 220
	TQ 857 219

West Sussex

Peter Ovenden

The majority of the known sites in the Fernhurst areas have been surveyed and large-scale maps have been prepared. The past season has been devoted to a

careful search along the sandstone escarpment for early bloomery sites following receipt of information from Mr G.H. Kenyon of a possible site at Coombeswell.

A reassessment of the methods of field work has now placed more emphasis on mining and technology, and we now hope that more information will be gained from a close study of the geology, as already revealed by Bernard Worssam's surveys of the Weald Clay.

Slag road in Surrey

Brian K. Herbert

In the last issue of the Bulletin, it was mentioned as a Stop Press item that a rescue dig was taking place on the proposed route of the M23, near Smallfield, Surrey (TQ 312 460 to TQ 309 443). Small excavations on the line of the slagged road showed a monolayer of tap slag and bloomery cinder here and there, deeply rutted in places. A geological formation known as Chert was also used, but there were areas where no road metalling was present. In general the metalling was 6-12in. below ground level.

It is interesting to know that bloomery tap slag has been used, since at Holtye the Roman road appeared to have been metalled with bloomery cinder. This could be tamped down to form a good interlocking surface, unlike tap slag. At the Blacklands Roman bloomery, there is a great deal of tap slag and little cinder.

It is not clear which way the slagged road continues at TQ 309 442, but the indications point to the west, although this is still under investigation.

Around the T-junction at TQ 310 449, no road metalling could be found, and this was considered by Brain Kirsop, who is in charge of the dig, to be important, since he has found blast-furnace slag on this path at approximately TQ 314 499, at a similar distance below ground level. The nearest known blast furnace, Warren Furnace, is about 6 miles away.

(One gets the impression that this may represent the activities of another Mr Byner - see Gerald Brodribb in the last Bulletin - who was getting his road metalling from Roman and later ironworking sites indiscriminately. Another point is that bloomery cinder tends to be rare on Roman sites, such as Bardown and Beauport Park; its presence may be an indication of later working - Ed.)