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THE EXAMINATION OF INDUSTRIAL DEBRIS FROM ROMAN RURAL SITES ALONG THE ASTLEY TO WORCESTER AQUEDUCT, HEREFORD AND WORCESTER, 1994

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Summary

Excavations by the Hereford and Worcester unit of Roman rural sites along the line of the Astley to Worcester aqueduct recovered a small quantity of redeposited ironworking debris. A number of smithing hearth bottoms, along with hammerscale, were identified; the assemblage is thought to have been the result of iron smithing.

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The examination of industrial debris from Roman rural sites on the line of the Astley to Worcester aqueduct, Hereford and Worcester, 1994.

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Introduction

Excavations were carried out along the line of the Astley to Worcester aqueduct by the Hereford and Worcester unit (HMCM 20854). A small amount of industrial debris was recovered from a number of pits, trackways and hollows on the edge of a Roman rural settlement, damaged by medieval ploughing. In total 9.6 kg of debris was examined, all thought to date from the 3rd to 4th century AD[1].

Examination of industrial debris

The visual examination of metalworking debris allows it to be classified into various categories based on its morphology, density, colour and vesicularity. Of these categories only a small proportion are diagnostic of a particular metal working process. Others can only be assigned to the working of a particular metal, whilst many can be produced by a wide range of high temperature processes.

All the debris from the Astley to Worcester aqueduct was individually weighed, visually examined and classified to type.

Table 1. Interpretation of metalworking debris from Roman rural sites along the line of the Astley to Worcester aqueduct

Context	Weight (g)	Interpretation	Comments
103	166	smithing hearth bottom(s)	
	133	smithing hearth bottom(s)	
	773	undiagnostic ironworking slag	
		flake hammerscale	
106	2367	smithing hearth bottom(s)	
	836	undiagnostic ironworking slag	
	134	vitrified hearth/furnace lining	
		flake hammerscale	
		spheroidial hammerscale	
108	495	smithing hearth bottom(s)	
	368	undiagnostic ironworking slag	knobbly
	533	undiagnostic ironworking slag	
	53	cinder	
	33	iron object	
	19	coal	
		flake hammerscale	
112	89	undiagnostic ironworking slag	
		flake hammerscale	
112	208	undiagnostic ironworking slag	
	< 1	coal	
		flake hammerscale	
112	1535	undiagnostic ironworking slag	
		flake hammerscale	
119	149	undiagnostic ironworking slag	
	19	cinder	
121	629	undiagnostic ironworking slag	
127	30	undiagnostic ironworking slag	
	32	iron object	
129	275	undiagnostic ironworking slag	
	322	dense slag	blocky
	61	iron object	
200	272	undiagnostic ironworking slag	

Explanation of Results

Evidence for iron smithing is present in the form of **smithing hearth bottoms**. These are formed during the smithing (hot working) of iron due to a high temperature reaction between the iron, iron-scale, and silica from either the clay furnace lining or the sand used as a flux. They are plano-convex in form, characteristically having a rough convex base and a smoother vitrified upper surface, which can sometimes be slightly hollowed due to the downwards blast of air from the tuyère.

The smithing hearth bottoms recovered from the Astley to Worcester site were typically not of the 'classic' plano-convex form. Their basic shape is such but they all have slight variations on the morphology, making identification slightly more difficult. Those smithing hearth bottoms marked with a question mark in table 1 are the more irregular and should be seen as possible hearth bottoms. The remaining examples are probable hearth bottoms, their morphology corresponding more closely to the 'classic' form.

Hammerscale is also diagnostic of iron smithing and appears in two different forms. **Flake hammerscale** are small 'fish scale' like fragments dislodged by mechanical or thermal shock when the iron is forged. **Spheroidal hammerscale** forms from small droplets of liquid slag expelled from the iron during hot working, particularly during the fire welding of iron, and also as a result of the primary smithing of an iron bloom. During the examination of the debris, hammerscale was detected in the soil contained in the sample bags using a bar magnet. It was not quantified, and therefore is only recorded as being present.

Undiagnostic ironworking slag is similar in density to smithing hearth bottoms, but has an irregular morphology and could have been produced by smithing or smelting. **Dense slags** are similarly non-diagnostic, but in the presence of other smelting evidence are usually thought to have been produced by this process. In the absence of this evidence however, and in the light of the relatively high density of some of the smithing hearth bottoms, they are considered to be the product of smithing activities.

Vitrified hearth/furnace lining is produced by a high temperature reaction between the clay lining of a hearth or furnace, and the alkali fuel ashes or fayalitic slag. It can be formed by iron smelting, iron smithing, non-ferrous metal working or other pyrotechnical processes. This material may show a compositional gradient from un-modified clay on one side to a glazed surface or irregular cindery material on the other.

Cinder is also produced by fuel ash or slag attack of the clay lining of a hearth or furnace. It resembles the more heavily reacted surface of a hearth/ furnace lining.

Table 2. Quantities of the various types of debris from Roman rural sites on the Astley to Worcester aqueduct	
Slag type	**Total Weight (g)**
smithing hearth bottoms	3161
undiagnostic ironworking debris	5697
dense slag	332
cinder	72
iron object	126
vitrified hearth/ furnace lining	134
coal	19

Discussion

Of the small quantity of debris recovered, the only diagnostic slag is that resulting from the smithing of iron. In the absence of any evidence of iron smelting, smithing is likely to be the origin of the undiagnostic ironworking material.

Elsewhere in the United Kingdom there is growing evidence for the use of coal as a fuel to smith iron in the late Roman period[2]. An association between the coal fragments and iron slags from the same context at the Astley to Worcester site is difficult to prove as the assemblage was not found in situ on an iron working site. It is interesting to note the much smithing slag recovered from other late Roman sites is of a 'spongy', loosely consolidated, nature; a result, it has been suggested, of smithing with a coal fire[3]. The smithing slags from the Astley to Worcester site were, however, quite the opposite being well consolidated so the presence of coal in this assemblege is probably a coincidence.

Conclusions

The debris is the result of smithing of iron. The presence of spheroidal hammerscale suggests that fire welding took place. There is no clear evidence for iron smelting, and no evidence for the use of coal in the iron working process.

Potential for further work

Given the limited size of the industrial debris assemblage from Astley to Worcester aqueduct site, and the nature of its context, further examination and analysis of the debris is not justifiable.

Storage of industrial debris

Ironworking slag, being predominantly fayalitic, is not prone to deterioration and requires no special storage conditions. Vitrified material also does not require special storage treatment. Iron objects must be stored in dessicating condition to inhibit corrosion. It is recommended that the debris is retained.

References

1. Victoria Buteux, pers comm.

2. David Starley, pers comm.

3. David Starley, pers comm.