Material Economies of South Yorkshire.
The Organisation of Metal Production in Roman South Yorkshire.

By:

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Abstract

This thesis aims to develop a model for the social organisation and production of ferrous and non-ferrous metals in South Yorkshire during the Roman period. This characterisation of the organisation of metallurgical activities is achieved through a combined methodology that will gather data from grey literature, published literature, as well as chemical, visual and microstructural analysis of metallurgical debris. Thirty-one archaeological sites were associated with the production or working of metals in Roman South Yorkshire. The metallurgical practices in the study area are primarily rural in nature. These results are looked at through the lenses of Agency, Habitus, and the social construction of craft production. The movement of materials and people within the study area and local specialist practices are central in the interpretation of regional metalworking practices. Furthermore, models of craft production are critiqued, and an alternative modelisation process is suggested to characterise and understand the organisation of metal production in Roman South Yorkshire.

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J’ai fait comme tu m’as dit: Plante-toi.
Pour toi Papa

Introduction

This study seeks to understand the relationships among craft communities, material resources and economy in South Yorkshire between the 50s AD and the fourth century AD. For several years, it was said that South Yorkshire exhibits a unique social trajectory during both the Iron Age and the Roman period, typified by a distinct regional pattern of economy and settlement that contrasts with areas long considered the Roman heartland in Britain (Chadwick 2008: 55; 2009: 1-2; Roberts, Berg and Deegan 2010). This seemingly unique trajectory, which did not conform with the typical patterns of "Romanisation" (Chadwick 2008: 55; Ottaway 2013: 3-4), was often seen as being indicative of insignificant economic activity, in turn giving rise to narratives that cast South Yorkshire as a peripheral and even uninteresting region (Chadwick 2008: 26-27; Ottaway 2013: 3-4). However, recent investigations in the rural landscape of Roman Britain fundamentally changed that narrative. By reviewing local resources and revaluating regional and cross-regional evidence, the Rural Settlement of Roman Britain project brought to light marginalised regions and built upon Taylor (2007) to change our understanding of Roman Britain (Smith 2016) (see chapter 3).

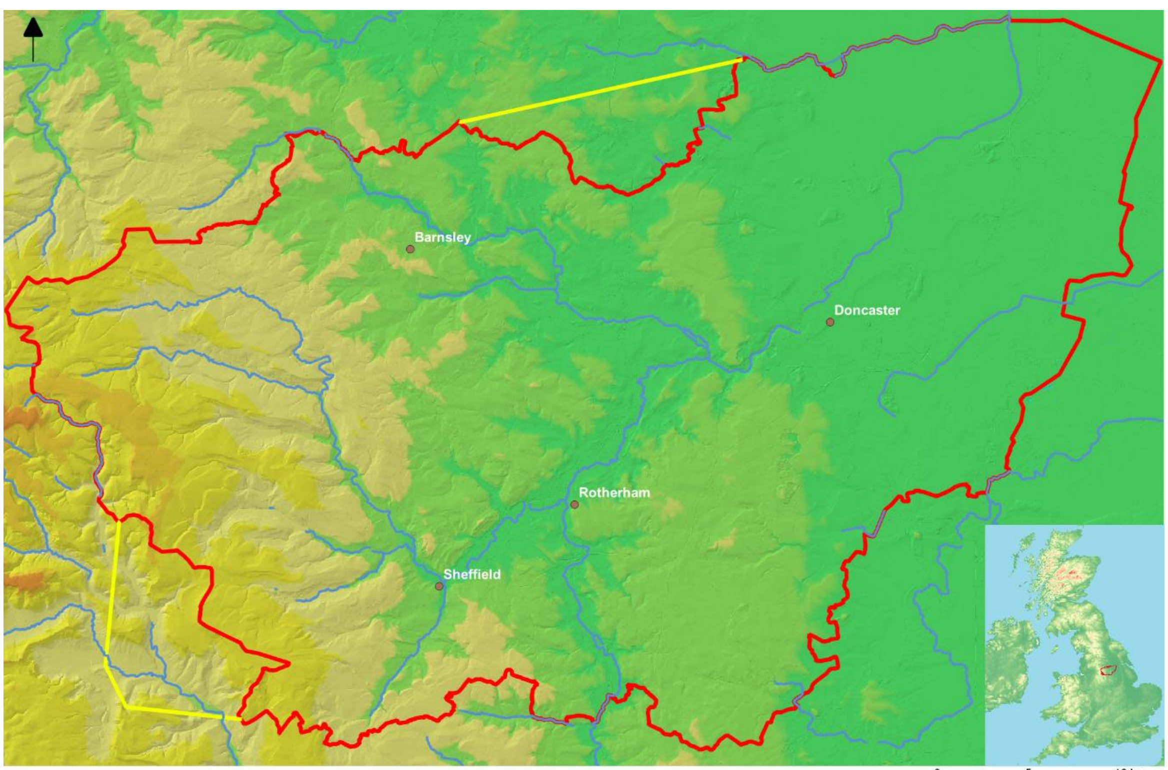

Figure 1.1: Extent of the Study Area

With this in mind, this thesis intends to develop a fresh characterisation of the region through the lens of resource perception, control, and craft production, expressly by establishing the varied strategies that were in place for the organisation of the production of metal goods. Although the term South Yorkshire is used throughout the thesis as a shorthand, this region, to be studied, does not refer strictly to the modern confines of the county (Figure 1.1). Indeed, the region's focus is not the current extent of the administrative region of South Yorkshire, but rather an area that mainly comprises the latter and extends into the peripheral regions that were connected to the former through roads.

Metals and metallurgical practices are an ideal line of evidence to address this matter as both their primary and secondary production (see chapter 2) were organised at a local and regional level, and to varied extents may rely on either local resources or imported materials. While such practices and associated procurement strategies are invariably rooted in earlier traditions, they are also embedded in extensive networks of exchange and interaction (Chadwick 2008; Crew 1991; Halkon 1997, 1999; Halkon and Millett 1999; Schrüfer-Kolb 2004). In short, metals and metallurgical practices offer the researcher a perspective that integrates diverse scales of analysis (local, regional, supra-regional) while allowing varied contexts to be scrutinised in terms of similar and related practices (i.e., centralised/elite commissioned/state-sanctioned production versus decentralised household or small settlement-based production, ferrous versus non-ferrous metals)

When considering the role of metals in society, one has to recognise their intrinsic material value compared to other material classes, namely ceramics and glass, and seek to establish a comparable framework of value within and beyond the region (Chadwick 2008: 330 and 332). Although all of those material categories can have many different values such as an intrinsic material value, craft value, symbolic value (i.e., memory, tradition, identity), metal is unique. The economic value of the material itself can be broadly consistent over extensive areas. While glass was recycled extensively in the Roman period, it was often only re-melted at regional centres. In contrast, the recyclability of metal, especially ferrous, meant that such objects were immediately recyclable at a very local level providing the opportunity for such goods to carry an immediate value beyond the prime artefactual expression. It is then this intrinsic material value that can be observed throughout contexts and across, as well as between culturally coherent regions, that makes metals potentially helpful in addressing both broad and local issues of economy and change.

Aims and Objectives.

The thesis will aim to develop a model for the social organisation and production of ferrous and non-ferrous metals in South Yorkshire during the Roman period. Through the assessment and characterisation of existing material, strategies of metal production on local and regional levels will be established and used to support the proposed model.

This aim will be addressed through the characterisation of both primary and secondary production evidence alongside a study of the distribution of metallurgical debris in South Yorkshire.

The following objectives will create a specific dataset that will be used to address the aim:

- The production of a desk-based assessment of geological data to establish the distribution of viable and utilised geological resources.

- The creation of a desk-based assessment to establish the character, distribution and, where possible, chronology for metal production in Roman South Yorkshire.

- The detailed study of a number of assemblages from key sites, which will then be fed back into a GIS.

- The development of a GIS database populated with evidence gained from the desk-based assessment and primary material research.

- The development of a model for the organisation of metal production, its place in the economy of Roman South Yorkshire and its wider regional relations.

Overview of the Thesis.

This thesis will be composed of eight chapters. The first will comprise the introduction and an overview of important iron production centres in operation during the Roman period. South Yorkshire will then be looked upon in term of mineral resources and compared briefly to these other regions on that specific aspect.

Chapter two will present the archaeological theory that will form the framework used to reflect on the results yielded by the fulfilment of the objectives presented in the introduction. These will include concepts such as Agency, Habitus and Socio-Technical Systems, which will be of paramount importance in interpreting the results. Furthermore, a description of trends in the use of networks in archaeology will be presented and then critically assessed. Then, different models of Romanisation will be described and then be critiqued. This chapter will close with a presentation of technical sequences of metal production to inform the reader on metallurgical practices and gestures.

Chapter three will be concerned with the historical and archaeological background of the study area. This part of the thesis will begin with an overview of the existing body of work on the study area when it comes to history and archaeology, starting from the Graeco-Roman literature all the way to the modern research and reporting methods. This chapter will then look into the pre-Roman Iron Age context as it would have been experienced by people living in the area prior to the arrival of the Roman military. This part will explore the historical and political context of that period and the socioeconomic aspects of the society living within the study area. This latter point will be looked upon through the lens of settlement patterns, and selected material remains in the Roman period that are significant for this research.

Chapter four will focus on the methodology used in the project for the collection of relevant data. This will cover the desk-based assessment, the creation of the GIS for the study area, the steps taken for the analysis of artefacts assemblages, along with the protocol used for the microscopic and chemical analysis of the artefacts deemed helpful for our understanding of the specific site practices. The methodology used for the field walking analyses will then be described. Finally, the categories and structure used to build the site gazetteer will be explained.

Chapters five and six will present the results of the data collection conducted for this research. Chapter five will present the GIS created for the thesis and explore site distribution in the study area. Chapter six, on the other hand, will focus solely on the sites with analyses performed by the author that were both interesting for the understanding of the organisation of metal production in Roman South Yorkshire and accessible in museums or archaeological services stores to the author.

Chapters seven and eight will form the main discussion of the thesis and will present the interpretation of the results presented in the previous chapters. This discussion will be divided into two parts, and both will present a different level of interpretation. Chapter seven will focus on the regional interpretations of the metalworkers of Roman South Yorkshire. On the other hand, chapter eight will be looking at models and modelisation and reflecting on the iron production present in South Yorkshire at that time. Finally, chapter eight will end with reflections on potential research questions raised by the findings of this thesis and will suggest a possible future research agenda for Roman South Yorkshire.

Chapter 1: Romano-British Iron Production Centres.

For ancient authors, Britain was a land of rich mineral potential. In fact, Britain, and along with Spain, were the two most important provinces when it came to mineral extraction and metal production (Jones and Mattingly 2007: 179). Britain's resources were known far and wide in Europe and since prehistory. For example, Pytheas describes at length the extraction and trade of tin out of what was called by him "Belerion", known today as Cornwall (Cunliffe 2002: 76). The ore was extracted from the veins and smelted to remove the impurities. This metal was then worked into knuckle-bone sized pieces to be shipped to the isle of Ictis, which could be the *Mont Saint-Michel*, and then moved to the continent (Cunliffe 2002: 86). For the Roman authors, Pliny the Elder is notable in that respect due to his Natural History. As a spiritual ancestor of the modern encyclopaedia, Natural History is concerned with all-natural subjects of the Roman world and the Romans' lives. For Britain's mineral resources, Pliny notes the importance of the lead sources present on the island, where the ore is present "in the upper stratum of the earth" in great quantity (Pliny. *HN*: XXXIV, 49), in the Mendips, Somerset, and in the Peak District, which will be explored in further detail in Chapter 7. However pertinent Pliny's comment may be, it seems important to explore the perception of mineral resources by the Roman imperial administration. According to Hirt (2010: 1), "the control over marble or metal resources was undoubtedly of high significance to Rome, […] uninhibited access to metal was vital for the economic and political survival of the Roman empire". With the exception of precious metals such as gold, silver and cinnabar in certain provinces, the interest of the imperial authorities was not to acquire the resources as such, but rather to profit indirectly from them by contracting leases on the mines or through taxation of the products during their exchanges and movements (Hirt 2010: 281, 368). Commenting on the organisation of mineral extraction in the Roman empire, Hirt (2010) noted that it is impossible to perceive a singular organisation throughout. Significant differences exist between mines and mineral sources that cannot be solely imputable to geographical constraints and therefore appear to reflect, to a certain level, the autonomy enjoyed by the people operating the mines locally and transporting the goods (Hirt 2010: 331). Regional imperial authority was mainly concerned with imperial mines and quarries to which they provided supplies, logistics and troops, as seen in imperial quarries in Egypt (Hirt 2010: 351). This state of affairs is not substantiated in all imperial quarries and mines, but Hirt (2010: 351) offered circumstantial evidence in Egypt and Spain, among others, that hint at governors and procurators having some hand in the local workings of imperial mines (Hirt 2010: 351). The localisation of military establishments suggests that near many of these mineral sources or in strategic points in the flow of materials, armed forces were employed for the protection and security of these extracting operations, even when mines and quarries were not directly under imperial authority (Hirt 2010: 358). It seems that, regardless of these examples, there were not any overarching organisational principles set by the administration for the production of metals and that these matters were left to the local operators (Allen *et al.* 2017: 179; Hirt 2010: 368). This autonomy means people did not have to conform to rules or directives but instead could negotiate the organisation of metal production in their own ways and embed it in their lives. This brings into focus a number of theoretical concepts developed for prehistory, but which may be applied to inform our understanding of the lives of people in South Yorkshire in the Roman period (see Chapters 2 and 7). In Britain, this picture of autonomy also seems to characterise the organisation of the production of metals. However, it appears that initially, all major metal productions were under the control of the imperial administration or at least the product was owned by this administration. These mineral ventures were then moved to private contractors or at least maintained a less direct imperial involvement at different times and in different places. Centralisation of specific industries is uncommon in Roman Britain and is mainly found in the "central, southern and eastern" parts of the province (Allen *et al.* 2017: 235).

For the purpose of this thesis, iron production is of paramount importance and will be discussed in more detail since it is the primary metal produced in the study area (see chapter 5 and 6). In order to set this production into context and provide scale, it seems suitable to describe other iron production complexes in Roman Britain (see below in Chapter 1 and figure 1.2). Furthermore, the production of non-ferrous metal is also within the scope of the thesis, specifically lead production and non-ferrous working (lead and copper alloys). However, the actual production of lead is still mostly misunderstood, and its sources are set slightly outside of the geographical extent of this research. The discussion of this production will not be centred around the production but rather on the material dynamics at play in its production (See chapter 7-8).

Jurassic Ridge

The research of Irene Schüfer-Kolb (2004) highlighted the significance of the iron production complex of the ridge of Jurassic geology located between Lincolnshire and Nottinghamshire (Figure 1.3). The large-scale iron production complex is the first of four such entities and is the most recently acknowledged in the Romano British scholarship. Significant deposits of iron-bearing minerals are located within this area. These occur in the form of carbonate siderite ore found in limonite and nodular forms (Schrüfer-Kolb 2004: 13-14). This ore is of good quality, meaning here that it is rich in iron content without a deleterious amount of other minerals such as phosphorus and could easily be smelted after roasting (Schrüfer-Kolb 2004: 13-15, 19-21).

Figure 1.2: Location of the Iron Production Regions.

Chronology.

Although this industry is more significant for the national context during the Roman period, its roots can be found during the Iron Age, when iron was already produced regionally. With the conquest of the region by the Roman legions, this existing iron production tradition was used as a building block for the subsequent production complex (Schrüfer-Kolb 2004: 132). With the arrival of the Roman military, along with urbanisation and the development of the civil landscape, it is probable that there was also a significant increase in the demand for iron products (Schrüfer-Kolb 2004: 132*)*. This increase led to the rapid growth of production during the first century AD (Schrüfer-Kolb 2004: 132*)*, growing steadily during the second and third centuries AD (Schrüfer-Kolb 2004: 132*)*. After that date, it would appear that no significant decrease in the number of sites can be identified until the fifth century AD (Schrüfer-Kolb 2004: 132*)*.

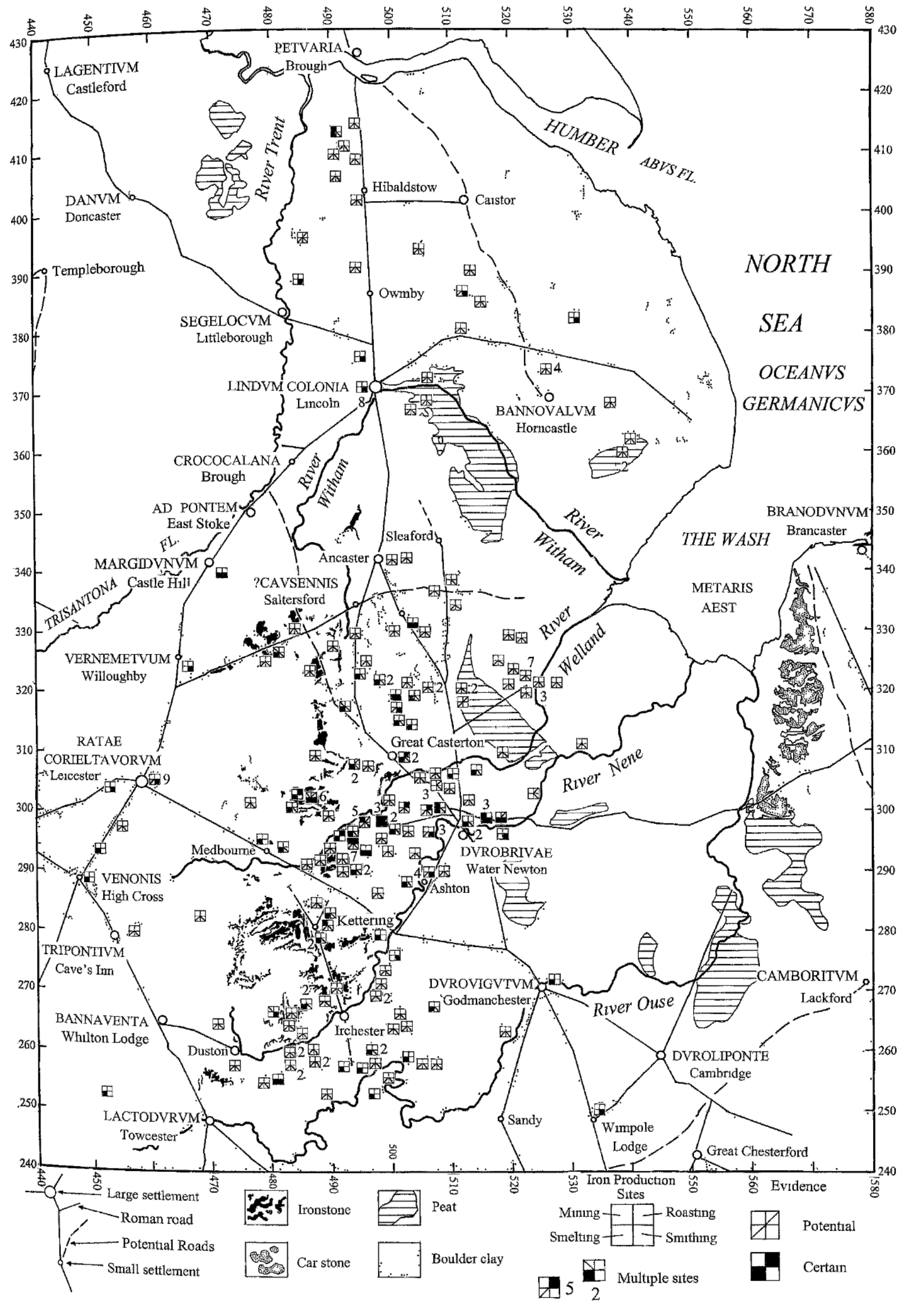

Figure 1.3: Site Distribution on the Jurassic Ridge (Schrüfer-Kolb 2004: 39).

The Organisation of the Production.

This presentation of the organisation of the iron production in the East Midlands is based on the account by Schrüfer-Kolb (2004: 37-47; 99-120), who provided the most comprehensive review of the metallurgical evidence in this area. All the mining sites and the sites where the ore was roasted are found in close proximity to the crucial local ore sources. Smelting sites were distributed in a similar way but were often located close to smaller deposits of iron ore. The majority of this primary production was carried out in rural sites rather than urban or suburban ones. This metallurgical activity was conducted using three types of furnaces: the high shaft tapping furnace, the low shaft tapping furnace and finally, the non-tapping furnace type. The latter has been attributed to the late pre-Roman Iron Age, which, although still significant for the purposes of this thesis, does not fall within its chronological constraint. Iron working, on the other hand, was located in a large variety of archaeological site types. Domestic forging, or the production of simple iron objects on site for immediate consumption along with the maintenance of existing objects, was conducted on rural sites. More complex smithing activities, on the other hand, were seemingly carried out in larger settlements such as small towns, large towns, and military establishments. Surprisingly, villa sites do not seem to have played a significant role in the production of iron and its subsequent organised working. When excluding Pre-Roman Iron Age sites and accounting for both the certain and potential sites linked with metallurgy, the East Midlands iron production centre comprised around 228 archaeological sites. These sites where iron was worked and produced are numerous and widely distributed in the area. Furthermore, it would appear that the products made in the region were often destined to go on to the market and be traded, as can be seen through the localisation of larger production centres in close proximity to navigable waterways and important roads. This distribution and its civilian nature seem to indicate the major economic importance of this industrial landscape of production, within which local populations administered the production of iron and its goods rather independently from central authority, sponsors or organisations.

Forest of Dean.

Due to a lack of publications of the production centres discussed here, the Forest of Dean is less understood than its counterparts. Regardless of that, the research done in that part of the country has identified it as a significant area for the production of iron, on a par with what is happening during the same time period in the Weald and on the Jurassic Ridge (Figure 1.4). Local deposits of iron ore can be found in considerable numbers in the Forest of Dean. These are mostly located within carboniferous rocks with notable outcrops of limonite and hematite (Fulford and Allen 1992: 186-188; Schrüfer-Klob 2004: 121). The ore is rather pure in composition, containing few elements which could have been detrimental to the quality of the iron smelted (Fulford and Allen

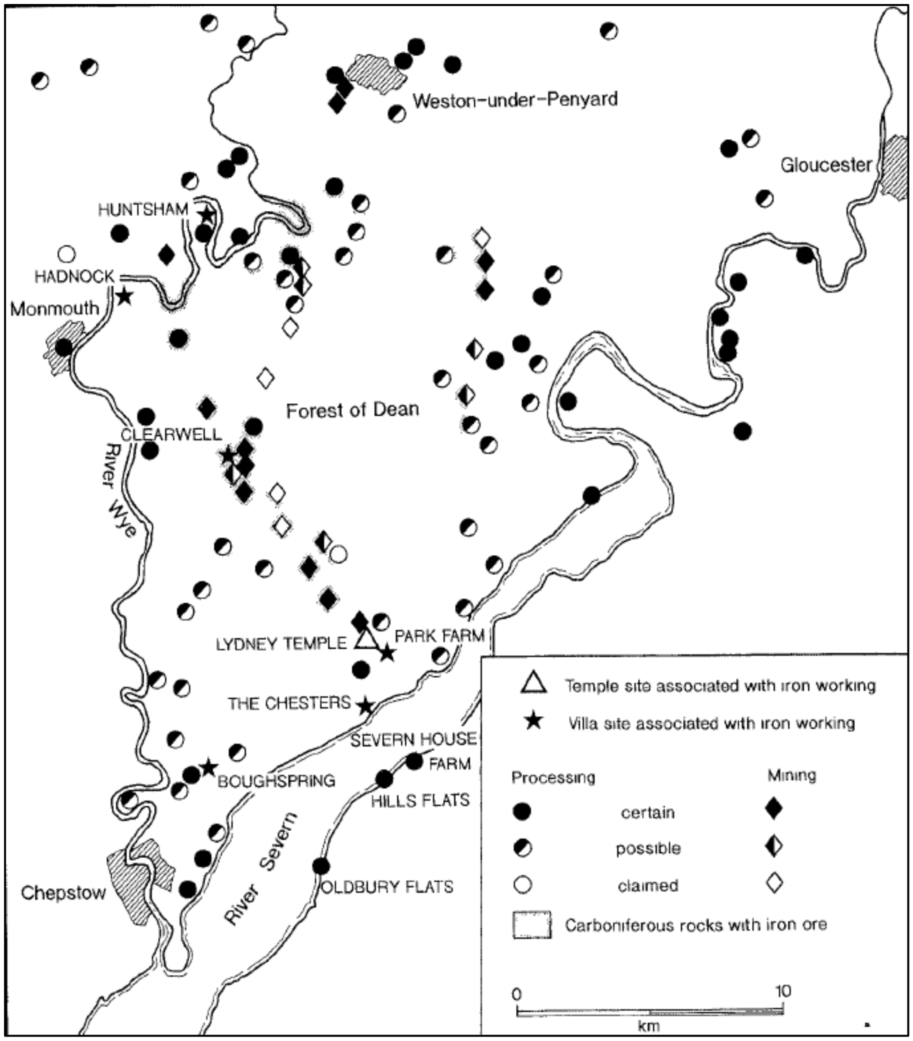

Figure 1.4: Site Distribution in the Forest of Dean (Fulford and Allen 1992: 203).

1992: 186-188; Schrüfer-Klob 2004: 122). Similarly to what has been observed archaeologically with the Jurassic Ridge complex, a significant scale of production was present there, perhaps built on an existing Iron Age tradition of a small scale iron primary production.

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This production increased dramatically in scope with the arrival of the Roman military and its substantial demand for iron products during the first century AD (Schrüfer-Klob 2004: 121-122; Walter 1992: 150-153). Again, there was an increase in production to some degree during the second century AD, which stabilised in the third century AD and then steadily declined from the fourth century onwards (Schrüfer-Klob 2004: 121-122; Walter 1992: 150-153).

The Organisation of Production.

With the quality of the ore available to the smelters working in the area, ore benefaction by roasting was possibly not necessary, but it is important to note that these ancient metalworkers might not have evaluated and valued ore in the same way as we do. In any case, evidence for ore roasting is yet to be recovered in the Forest of Dean (Schrüfer-Kolb 2004: 122). Contrary to what has been noted in the East Midlands, ore was not smelted close to the mineral deposits, but some distance away, possibly to preserve the woodland area present there at that time (Schrüfer-Kolb 2004: 121). The lack of a published synthesis on the Forest of Dean restricts our understanding of the details of production there, but it would seem that the smelters used tapping furnaces and that evidence of other types of furnaces remains scarce. Secondary production suffers the most from this lack of published work at the moment and is again poorly understood (Schrüfer-Kolb 2004: 122). The whole iron production industrial complex of the Forest of Dean is at the moment represented by around 95 archaeological sites where material evidence of these metallurgical activities has been recovered (Shrüfer-Kolb 2004: 121; Walters 1992: 37).

Again, similarly to the East Midlands complex, iron production was mostly settlement-based and represented an important aspect of the regional economy, as it was possible that some part of the production was intended for the market as seen through the location of important smelting and working sites along major waterways and roads (Condron 1997: 6-7, 10; Schrüfer-Kolb 2004: 123; Walters 1992: 1-28). The production here was again probably organised on a locally independent model and was possibly centred around a small number of family units or around one larger specialist group.

The Weald.

Another important iron production centre present in the province of *Britannia* during the Roman period is located in the southeast tip of the island in and around the Weald forest (Figure 1.5). This region has long been considered the most important centre for iron metallurgy in Britain at that time, and indeed one of the most important empire-wide with the production areas of *Noricum* and *Hiberia* (Cleere and Crossley 1995: 56). The Weald is known archaeologically today for the staggering volumes of metal produced there with huge slag scatters. One such example is found at the site of Clipsham, where the scatter is estimated to be over one hectare in extent and around 1.2m deep (Schrüfer-Kolb 2004: 126). This was estimated to represent a volume of slag of about 12000m^3. Furthermore, this is not an isolated example in the Weald, with the site of Laxton where a scatter of two-thirds the size of the one at Clipsham was discovered (Schrüfer-Kolb 2004: 126). Overall, three sites produced more than 10000m^3 of slag, thirteen up to 1000m^3, 26 up to 1000m^3 and 39 less than 100m^3 (Hodgkinson 1999: 69-71). These substantial volumes of material were produced using the large deposits of iron ore available locally. The Wealden beds contain layers of sandstone, clay, limestone and, more importantly, siderite (Cleere and Crossley 1995: 2;

Schrüfer-Kolb 2004: 124). These siderites outcrops come to the surface through geological movements. Furthermore, additional deposits come in the form of iron-rich concretion and localised deposits (Cleere and Crossley 1995: 2; Schrüfer-Kolb 2004: 124).

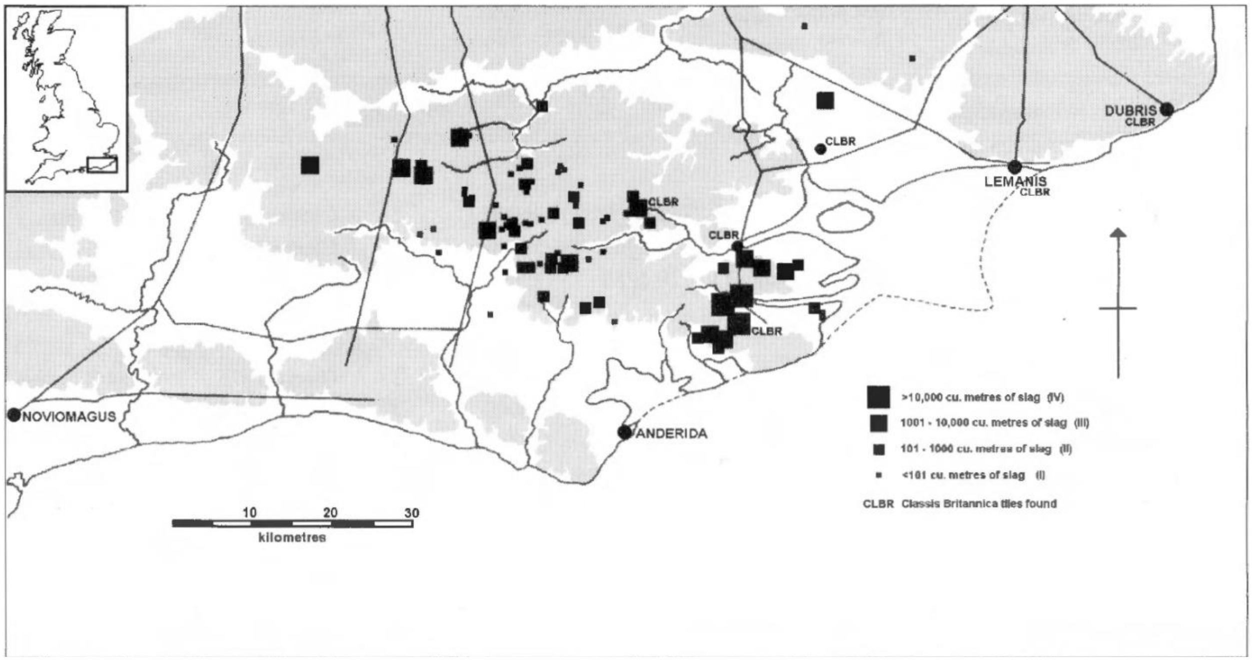

Figure 1.5: Site Distribution in the Weald (Hodgkinson 1999: 69)

Chronology.

Similar to the other production areas mentioned in this chapter, the metallurgy of iron had a pre-Roman tradition which in this case could date back to the second or first century BC (Cleere and Crossley 1995: 56). Iron production at that time was known across tes4he channel as it was mentioned by ancient sources (Schrüfer-Kolb 2004: 125). As with elsewhere, the increase in the need for iron products brought by the conquest of the region and the arrival of the Roman garrison, as well as its civil and economic infrastructure, brought about a dramatic increase in the exploitation of the local resources (Schrüfer-Kolb 2004: 125). Later, local mining and metallurgical activities experienced a sharp decline from the middle of the third century AD onwards (Schrüfer-Kolb 2004: 126).

The Organisation of Production.

In the Weald, as in the East Midlands, the composition of the ore led ancient smelters to roast their minerals (Cleere and Crossley 1995: 35-36; Schrüfer-Kolb 2004: 124). Furnaces used in the area were also, as on the Jurassic Ridge, of three types: high-shaft tapping furnaces, low-shaft tapping furnaces and non-tapping furnaces (Cleere and Crossley 1995: Schrüfer-Kolb 2004: 124-125). The landscape of production in the Weald is very similar to that of the East Midlands, with small to medium size iron production sites alongside a few larger ones where large scatters have been identified (Schrüfer-Kolb 2004: 127). Furthermore, it is important to note that the metallurgical activities that took place in the western half of the area can be closely associated with the presence of the *Classis Britannica*, the Roman fleet present in the channel and operating along the surrounding water bodies around the island (Schrüfer-Kolb 2004: 127; Cleere 1974). This military association is problematic, however, when it comes to larger manufacturing sites, as these were already in use before the arrival of the fleet (Schrüfer-Kolb 2004: 127). As for the eastern part of the Weald, this military supervision seems to be absent, perhaps indicating that the metal production in this part of the region would have been under the control of some civilian entities, perhaps groups such as *conductors, collegia or societates*, independent from the military administration (Cleere and Crossley 1995: 61, 68-69; Schrüfer-Kolb 2004: 127). The resulting metal products of these archaeological sites were again possibly meant for the market rather than purely local production, although these seem to be rather located to gain easy access to resources (Schrüfer-Kolb 2004: 127). This possible destination could be seen through the strong spatial relationships between those sites and roads leading north towards *Londinium*, and for sites located close to the coast, this relationship would move from the roads to concentrate around important harbours (Cleere and Crossley 1995: 57-61). In the Weald, around 81 production sites could be confidently dated to the Roman period (Hodgkingson 1999: 69-71). However, more than 400 other sites linked to metallurgical activities remain undated (Schrüfer-Kolb 2004: 126). This has to be considered when evaluating the scale of production at play here as while 81 sites would make it the smallest of the iron production centres, the addition to this number of only a fraction of the 400 undated sites would change that picture dramatically (Schrüfer-Kolb 2004: 126).

Lowland East Yorkshire

Lastly, the compilation of evidence from Holme-on-Spalding Moor indicated that a sustained iron production complex was present in the lowlands of East Yorkshire (Figure 1.6). It was estimated from the quantification of slags that one of the sites, Welham Bridge, saw the production of over 2000 kilograms of iron over the whole production period which could not be dated with precision (Clogg 1999: 94-95; Halkon and Starley 2011). Moreover, it appears that a total of 19 sites in the area were also producing iron (Clogg 1999: 95; Halkon and Starley 2011). This means this iron production centre saw the smelting of a large quantity of metal, and in the case of Welham Bridge, this manufacture took place over a long period of time on a seasonal basis (Clogg 1999: 94). However, that claim is problematic since the length of the production is unknown. As mentioned by Clogg (1999: 90-91), although it is possible that ore from the Frondingham ironstone beds south of the Humber was in use in Welham Bridge, it is more probable that these smelters extensively used bog iron ore which was easily accessible locally due to the presence of marshes nearby.

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Sadly, as mentioned by Clogg (1999: 94; see also Halkon and Starley 2011), dating evidence remains limited on the iron production sites. However, due to the absence of Roman material, it was presumed that production took place during the Iron Age, which was further confirmed by radiocarbon dating on Welham Bridge and North Cave. However, in at least two instances, Hasholme Hall and Bursea House, it appears that production did start during the Iron Age but continued into the Roman period, even though at that point the production had passed its peak (Clogg 1999: 94; Halkon and Starley 2011: 161).

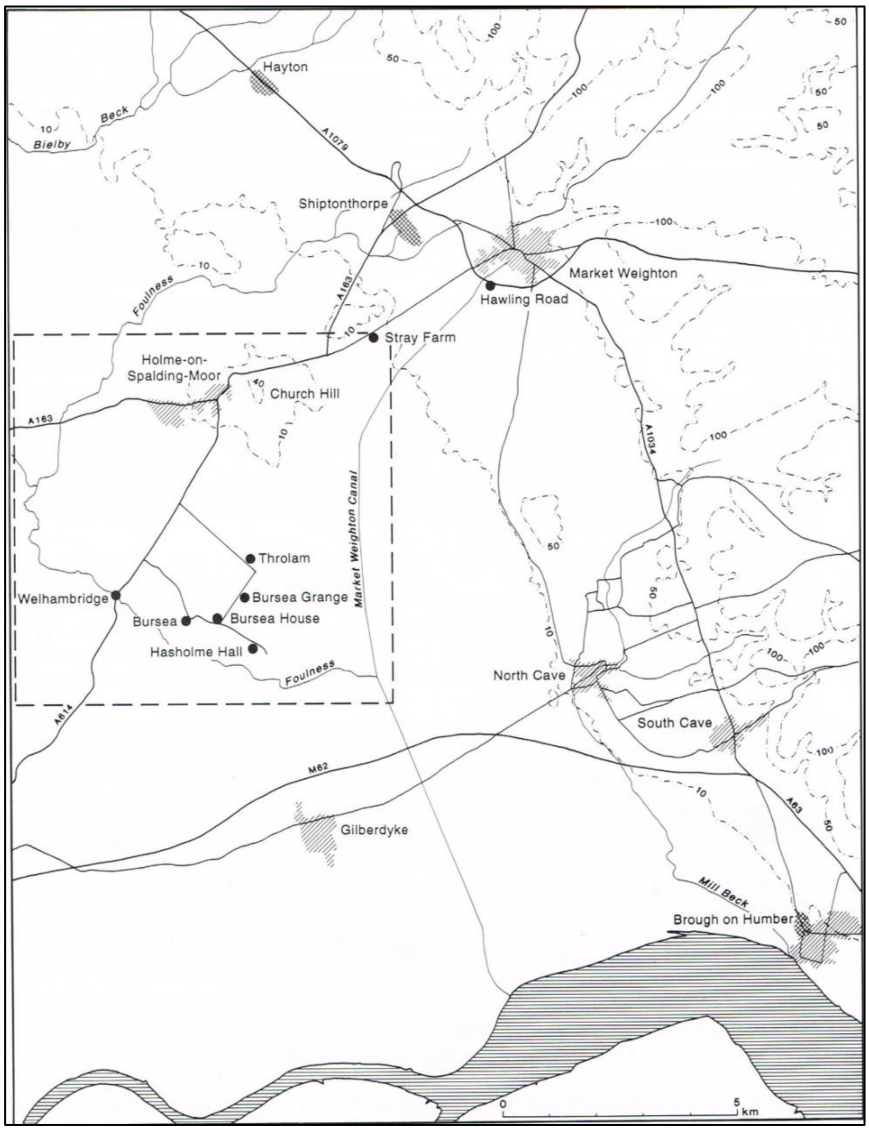


Figure 1.6: Site Distribution around Holme-on-Spalding Moor (Halkon and Millett 1999: 2).

The Organisation of Production

A lack of excavated furnaces at Welham bridge renders the identification of furnace type difficult. However, it appears that from the presence of large vesicular blocks of slags, non-tapping furnace technology was used (Clogg 1999: 89-90). In this iron production complex, the majority of sites seem to have been located in marginal areas away from settlements (Clogg 1999: 95). This is not invariably the case, however, since the site of Welham Bridge was most likely located close to a settlement (Clogg 1999: 95). Furthermore, a large number of sites were situated on creek systems edges which brought a proximity to bog ore sources and access to waterways for transportation of materials (Clogg 1999: 94). It has been suggested that the production and its related acquisition of resources were conducted seasonally (Millett 1999: 222-223). The extraction of bog ore would have been undertaken in the summer and would require a considerable investment of local workforce as observed in the case of charcoal production (Millett 1999: 222-223). As for the actual production of metal, Millett provides two different scenarios to explain the evidence provided. First, iron production would have been conducted on a significant scale with the successive exhaustion of bog ore sources in the area (Millett 1999: 223). This scenario suggests the presence of specialists and that the production sites were occupied in succession following the exhaustion of local resources (Millett 1999: 223). On the other hand, an opposite scenario suggests that the production sites were occupied contemporaneously, and these productions were conducted on a smaller scale over a long period of time (Millett 1999: 224). The latter hypothesis suggests iron production would have been integrated into the settlements' daily life alongside farming, woodland management, and other activities (Millett 1999: 224). From these two, Millett (1999: 224) suggests that the latter of the two scenarios is the most likely because the "balance of evidence tends to favour the idea of long-term small scale production integrated into a mixed economic strategy. Such a niche economy would be consistent with Iron Age settlement evidence which implies the evolution of the enclosed settlements" (Millett 1999: 224). Although this production is linked to evidence from the Iron Age, there is evidence in the region that metal was also produced in the early Roman period, although in a state of decline, potentially because of the exhaustion of local resources (Millett 1999: 226). It has been suggested that the knowledge and skills of iron producers in the manipulation of clay to create heat resistant ceramics was transferred into the pottery industry that was established in the Roman period in that area (Millett 1999: 226; Halkon 2013: 251). Tap slag was recovered which could show a technological change from non-tapping to tapping furnaces (Halkon 2013: 251). This hypothesis is certainly tantalising and would present these two industries as different "cash crops" sustained to pay taxes in lieu of agricultural resources, which have been limited considering the nature of the terrain (Millett 1999: 226).

To sum up the issue of the major iron production centre of the island, sites found in the East Midlands and in the Weald showed comparable output levels when comparing slag scatters. The Forest of Dean is, at the moment, less thoroughly understood when compared to the other areas, but it is important to emphasise that significant slag heaps were discovered, which indicate the importance of the production there as these are rather uncommon in regions where iron was produced at a smaller scale. Finally, the iron production in the lowlands of East Yorkshire presents a potentially interesting comparative region with a long-term seasonal production centred on local resources.

Roman South Yorkshire's Place.

Although Roman South Yorkshire is absent from the narrative of iron production centres, neither the area nor the sites therein should be seen in a vacuum. These iron-producing regions produced large amounts of material that travelled all around the country to be sold or moved to the continent for further exchanges and uses. They most certainly had a major socio-economic impact as people and material moved around the landscape, as the inhabitants performed their business and got on with their lives (see Chapters 2 and 3).

Somewhat surprisingly, Roman South Yorkshire is not noted for any substantial ferrous metallurgy, even if the post-medieval history of the region is strongly associated with the large-scale production of iron and steel. Iron mineralisation is present to a considerable extent in South Yorkshire. Sideritic ironstone is present either in nodules or in thin beds within the Coal Measures, the geological formation underlying the area between the Peak District to the west and the Magnesian Limestone ridge to the east (Aitkenhead 2002: 151). These nodules and beds were central to the development of the steel industry of the South Yorkshire economy during the early modern period when they were extracted alongside the coal present in the coal measures (Aitkenhead 2002: 151). These were extensively mined and are estimated to have been used to produce 617 000 tonnes of steel in 1868 when taking into account the whole industrial complex present in Yorkshire, Derbyshire and Nottinghamshire (Aitkenhead 2002: 151). Furthermore, iron ore is present in smaller deposits cropping out in other geological formations, such as the Namurian Shales on the edge of the Peak District to the West of the Coal measures (Aitkenhead 2002: 151).

Other Mineral Sources Linked to the Study Area.

Moreover, iron is not the only metal present in the form of ore to be present in significant quantities within the study area. It is to be noted that, as mentioned previously in this chapter, other lead production areas, such as the Mendips, will not be covered like the iron production regions because lead production is still misunderstood in the Peak District and will not feature as prominently as iron in the dataset and in this thesis (see chapter 7-8). Lead sulphide mineralisation, or Galena (PbS), is also present in large amounts on the eastern edge of the Peak District, where it outcrops out of the Dinatian Limestone (Aitkenhead 2002: 151). These outcrops are known as rakes when they are sizable and scrins when they are smaller (Aitkenhead 2002: 149). This orefield is quite large and is dotted with numerous rakes and scrins over its surface, rather than being present in beds. The northern edge of this orefield is located in Castleton, where sizable rakes are located and are known to have been quarried in the past. These deposits have been sometimes extensively worked in the Roman period (Bradwell 2014; Tylecote 1986: 61). Modern exploitation renders, in some cases, the extraction activities difficult or even impossible to date with any certainty. Furthermore, these rakes have sometimes been so intensively exploited that it makes the modern exploitation of the deposits impossible (Aitkenhead 2002: 149). One such example is the Riber Mine which is not in use nowadays because of its large-scale exploitation in the past (Aitkenhead 2002: 149).

Finally, it is important to note that bog iron ore could have been present in the marshes that were located to the east of Doncaster and in the surrounding area (Peter Robinson, pers. comm.). The ancient Humberhead Levels, at the time a wet, low-lying area, were subject to frequent flooding and generally marshy (Mather 1991: 3). These are now dry due to the extensive drainage that took place in the late medieval and the early modern periods. This type of ore would have been easily extractable to an expert eye as it is created through the “precipitation of iron compounds in lakes, bogs and other poorly drained locations, and could simply be dug out” (Dungworth, Bailey, and Paynter 2015: 18). This mineralisation of iron would have been readily available to local smelters.

Chapter 2: Production, theory, and socio-cultural self-creation.

Introduction

The production and consumption of various kinds of objects is not a simple and mechanical endeavour. In the past as well as in the present, material culture has been significant in the constitution and display of gender, class, kinship, and various other types of social and cultural relationships. The study of the material representations of past human relations and cultures that is archaeology (Barrett 2000: 62-63) has to consider these immaterial aspects of objects and materials to understand past societies and groups fully and deeply. These social production theories are rooted in the upsurge of thoughts and literature concerning these aspects of human groups, working to counteract the traditional study of technology and material culture in the 19th and 20th centuries (Dobres 2000; Pfaffenberger 1992). The following chapter will be concerned with the reasons that a transformation of material studies is required and the conceptualisation of this enriched understanding as applied to ancient crafts. Finally, to conclude this chapter, the technical sequences of metallurgical processes that are relevant to this thesis will be presented. This latter part intends to provide a background to metal smelting and metal working in preparation for the material, which will be presented in the subsequent chapters.

The Problem

The root of the problem regarding past studies concerning craft and ancient technologies is that material culture was not considered to be cultural (Pfaffenberger 1992: 492). Social anthropologists of the 20th century disregarded craft studies as being “scientifically sterile” (Malinowski 1935: 460), or even that culture was completely absent from the objects and that “[...] culture is the *idea* behind the artefact” (Kroeber 1948: 65). Following these thoughts, material culture studies were relegated, in the western world, to museums, where scholars were outside of developments in social anthropology at this time (Pfaffenberger 1992: 492). This isolation led anthropologists to ignore technology and craft since these were non-social facts and turned technological research into internal histories of materials. Although these are especially useful when interpreting the technical knowledge behind different technological practices, they are often presented in a linear way that rarely considers the social and cultural implications of technological facts (Pfaffenberger 1992: 491). This non-social understanding of technology has been conceptualised by Bryan Pfaffenberger (1992) as the "Standard View of Technology" (SVT).

This concept was considered as being "a master narrative of modern culture" (Pfaffenberger 1992: 493). It is based on three structuring principles: "Necessity is the mother of invention, the meaning of an artefact is a surface matter of style, and the history of technology progresses in an unilinear way" (Pfaffenberger 1992: 514).

- "Necessity is the mother of invention" (Pfaffenberger 1992*:* 495).
    - Lewis Binford stated that culture is an "extrasomatic means of adaptation" (1962: 218). Therefore, in accordance with this understanding of technology and of New Archaeology, "technology and material culture form the primary means by which people establish their viability, given the constraints imposed upon them by their environment and the demands of social integration (Pfaffenberger 1992: 495-496).
- "The meaning of an artefact is a surface matter of style" (Pfaffenberger 1992: 502).
    - By using this argument, the SVT desocialised artefacts by reducing them to their alleged function, leaving the secondary, alternative, and residual roles out as insignificant (Pfaffenberger 1992: 502-503)
- "Unilinear progression, from simple tools to complex machines" (Pfaffenberger 1992: 507)
    - From the SVT standpoint, technology builds upon itself in a simple fashion. Each technological advance brings out new possibilities and potential advancement upon which people can build (Pfaffenberger 1992: 507). This linear evolution saw humans move from flint tools to the edge of space travel. Nevertheless, this would not seem to be the case. Although it is clear and undeniable that men and women of the past knew less about natural processes that acted in their world, it cannot be denied that a great deal of knowledge has been lost to us today (Pfaffenberger 1992: 508).

Although Bryan Pfaffenberger wrote what is probably the complete criticism of the SVT, he is by no means its only critic. Among them, Karl Marx pointed in his *Thesis on FeuerBach*: "The chief defect of all hitherto existing materialism [...] is that the thing, reality, sensuousness, is conceived only in the form of the object or of contemplation, but not as sensuous human activity, practice, not subjectively" (1845: 1). Furthermore, these issues were recognised by other researchers who suggested similar methodological approaches to solve the problem, which all have one thing in common: Technology must be studied and only can be understood within its social and cultural contexts (Lechtman 1977; Schiffer 2004, 2011).

Against the "Standard View of Technology"

In reaction to this linear and simple view of technology, Pfaffenberger puts forward his idea of sociotechnical systems, which states that technology is cultural in itself. This concept is in many ways similar to the behaviourally relevant performance characteristics put forwards by Schiffer (2004: 579). These performance characteristics are "defined contextually in relational, activity- or interaction-specific terms" (Schiffer 2004: 580). As for Lechtman's technological styles, these "involve normative cultural behaviour and the rules behind that behaviour" (1977: 12). Meaning that techniques "arise from cultural actions because technology is part of the larger integration of cultural subsystems" (Lechtman 1977: 6-7, 10-12). Objects are the embodiment of cultures and agents. This idea originates from the work of Thomas Hughes, who explored the rise of modern electrical power systems. In his conceptualisation, one who aims at developing new technologies must account for the social, economic, legal, scientific, and political contexts as much as the techniques and artefacts that concerns that new technology (Hughes 1983: 112; Law 1987: 123; Pfaffenberger 1992:498). Law (1987: 124-125) and Latour (1987: 57) built on Hughes' work by emphasising the difficulty of creating sociotechnical systems capable of resisting dissociations. Indeed, "a system builder is faced with natural and social adversaries, each of which must be controlled and modified if the system is to work" (Pfaffenberger 1999: 498). Law's (1987) example of the creation and rise of the mixed-rigged vessel demonstrates the implications of change within sociotechnical systems (1987: 124-125). Indeed, the benefits of creating this type of ship are not only found in the superior design of these vessels but also the importance to its rise of the use of the magnetic compass, the simplification of the astrolabe. Using these tools, explorations were conducted that produced data that was used for positioning and the understanding of the Atlantic winds (Pfaffenberger 1992.: 498). The large-scale adoption of the mixed-rigged vessel had to incorporate all these different elements to work in a system.

Sociotechnical systems are the specific technological activities that result from the relationships between material culture, the techniques used in their production, and the "social organisation of labour" (Pfaffenberger 1992: 497). Techniques in this definition "refer to the system of material resources, tools, operational sequences and skills, verbal and nonverbal knowledge and specific modes of work coordination that come into play in the fabrication of material artefacts" (Pfaffenberger 1992: 497).

When it comes to changes in societies, "any sociotechnical system shows the imprint of the context from which it arose, since system builders must draw on existing social and cultural resources" (Pfaffenberger 1992: 500) while at the same time creating new elements to make the new system work, as "system builders draw from existing resources but modify them to make them function within the system" (Pfaffenberger 1992: 500). Through this, we can see that sociotechnical systems are amongst the primary ways through which past and present people created and transformed their social world. Nevertheless, one should not underestimate the degree of latitude and choices that innovators can use to solve problems linked to new technologies, nor should the success or failure be attributed to the choice of the "correct" or "incorrect" techniques or "social-coordination method" (Pfaffenberger 1992: 498-499).

To summarise this vital conception of crafts and technologies, sociotechnical systems "put forward a universal conception of human technological activity, in which complex social structures, nonverbal activity systems, advanced linguistic communications, the ritual coordination of labour, advanced artefact manufacture, the linkage of phenomenally diverse social and non-social actors, and the social use of diverse artefacts are all recognized as parts of a single complex that is simultaneously adaptive and expressive" (Pfaffenberger 1992: 513).

Agents and Activities in Space-Time.

To be truly meaningful in understanding and characterising past societies, sociotechnical systems have to be integrated with other current theoretical concepts. When combined, these situate the systems in the world on and in which they act, as well as emphasising the important role of the agents in the creation, acceptance, and survival of these systems.

Temporality of the Landscape

Sociotechnical systems exist within a landscape on which they act in different ways and in varied locales through time. This way of understanding the landscape stems primarily from the work of Tim Ingold (2000). His *Temporality of the Landscape* is based on two structuring principles: "human life is a process that involves the passage of time" and "this life-process is also the process of formation of the landscapes in which people have lived" (Ingold 2000: 189). His aim is to put forward a new conceptualisation of the landscape, the dwelling perspective, which would move the discipline past the opposition between the naturalistic and the culturalistic views of the landscape. Indeed, the latter is not only the world in which present humans live and act but also where "the lives and times of predecessors who, over the generations, have moved around in it and played their part in its formation. To perceive the landscape is, therefore, to carry out an act of remembrance, and remembering is not so much a matter of calling up an internal image, stored in the mind, as of engaging perceptually with an environment that is itself pregnant with the past" (Ingold 2000: 189).

This understanding of the relationship between people and landscape needs new definitions. Firstly, landscape is not just the backdrop of human activities but should be considered as "the world as it is known to those who dwell therein, who inhabits its places and journey along the paths connecting them." (Ingold 2000: 193). Secondly, temporality is not solely the passage of time. It is a concept that is intractably linked to the concept of taskscape, which considers the chain of actions and activities made by actors that go on through time (Ingold 2000: 194-196). The taskscape that goes on through time is also social. Indeed, people do not solely execute an action but also attend to one another and live their life as part of these actions (Ingold 2000: 197). Therefore, these taskscapes are not only linked to sociotechnical systems but could even be considered as being the sociotechnical systems themselves. Therefore, the "temporality of the landscape" should be seen as the embodiment of the taskscape on and in the landscape.

Culture as repetitive human actions.

Sociotechnical systems also tie in with two intricate theoretical concepts that are indispensable for the comprehension of past crafts: Agency and *Habitus*. Agency was first presented by Georg Simmel (1903) and then conceptualized by a number of sociologists such as Giddens (1979, 1981 and 1984) and Bourdieu (1972), but also with important contributions to its application to archaeology by various archaeological theorisers such as John Barrett (1988; 2000) and Ian Hodder (1984), and to technology by John Robb (2000) and Marcia-Ann Dobres (1994; 1999; 2000), among others.

Agency considers the human individuals or agents to be at the centre of socio-technical decisions (Barrett 1988; 2000; Giddens 1984; Hodder 1984). In order to properly present this concept, it is vital to deconstruct the elements forming it. Firstly, Agency is seen by and acted through the agents. These agents not only act on their world and on others through material and immaterial culture along with cultural and social interactions but also know their place in the world they are building (Barrett 2000: 61-62). Secondly, agents, and therefore Agency, operate through time. This indicates that not only do they act on the present, but also, as time passes, they remember the past and look to the future (Barrett 2000: 61). Agents also live in a place in which and on which they act; "a place occupied over the period [during which agents acts], a place to which resources are drawn and from which the consequence of that action reach out" (Barrett 2000:61). Therefore, agents are operating in a temporal landscape, a landscape that is the embodiment of the taskscape (Ingold 2000). Finally, agents act onto the world. These actions, in Barrett's words, are "the doing, the mobilisation of resources to have an effect" (Barrett 2000: 61). These actions do not only encompass the material and immaterial culture but also the actions that led to their creation.

Considering these concepts as structuring principles to our study of past crafts, an important tool to consider is the *chaîne opératoire*. This tool stems from the work of André Leroi-Gourhan. *Chaînes opératoires*, which are the complete operational sequences of material acts, and aim at showcasing the sociality of technology; the fact that technological acts are total social acts (Darvill 2002: 84; Leroi-Gourhan 1965: 26). "These *chaînes opératoires* are empirical, grounded in a collective tradition which passes from one generation to the other. Their principal characteristic, regardless of the unity in their great lines and their repartition on large polyethnic territories, is their strong locality and individuality. Everything that is done, tools, gestures, and products, is impregnated by the aesthetics of the group, has an ethnic personality [...]. In the traditional setting, the individual inscribes his personal variations and draws in the margin at his disposal to act his existential feeling as individual, in the security that his integration in the group gives him."[1] (Leroi-Gourhan 1965: 59). Technology, according to this concept, is entirely a social fact because it is not solely built on individual experiences, which is constituted by the craftsman by trial and error, but also through education that is given to him by his group through the use of language (Leroi-Gourhan 1965: 22 and 26). In our case, the production of complete, localised chaînes opératoires is impossible at this point in time due to a lack of defining details on parts of the *chaînes opératoires*. These details are unavailable because of either a lack of research or the destruction of data by more recent industrial works (furnace fabric, specific ore sources in the region, metal

[1] Translated from original French edition by the author.

artefact consumption patterns, partial reporting of sites, among others). These unknowns prevent the formation of localised and detailed *chaînes opératoires*. However, components of these will be detailed later in this chapter for contextualisation and used throughout the thesis as part of the analyses and interpretations (see Chapter 5-6-7-8). These will still acknowledge the deep sociality of technical practices but will not provide the localised detailed traditions iconic to *chaînes opératoires*. In order to eschew confusion on the nature of these partial *chaînes opératoires*, the term technical sequence will be used instead to refer to these components of *chaînes opératoires*.

These technical sequences, when considered as part of the daily life of people, have significant implications in the social lives of groups. These day-to-day repetitions and micromanagement of *chaînes opératoires* are what should be conceptualised as *Habitus.* The latter "is a system of predispositions that generate structures of practice and representation which 'regulate' actions, without simply being obedience to rules; that is oriented toward a goal, without doing so consciously; and that collectively orchestrate activities, without being the product of an organisational force"[2] (Bourdieu 1972: 256). In this definition, practice should be understood not only as actions but also as "the relation between [a] given situation and the *Habitus*, the latter acting as a matrix of perceptions and actions based on predispositions defined by social factors and past experiences"[3] (Bourdieu 1972: 261). In other words, the habitus sets "the way people go about with their lives"; the way the agents react to, adapt and perceive their own life (Bourdieu 1972: 261, 272, 284-285; Dobres 2000: 137) it would also be through *Habitus* that sociotechnical systems are cohesively reconstructed and adapted by agents. Finally, although the *Habitus* can be seen as rule-bound and normative, which could be seen as being paradoxical with the idea of Agency, one should not come to think of *Habitus* as a "mechanical reaction, directly determined by preceding conditions and entirely reducible to mechanical workings of pre-established montage" (Bourdieu 1972: 261) in which agents would have no input or control. On the contrary, agents are the "nexus[es] of *Habitus*" (Gosden 1994, in Dobres 2000: 137), since "it serves as both source and medium for expressing (and contesting) everyday routines of social and physical action" (Dobres 2000: 137).

[2] Translation from Proulx 2014.
[3] Translation from Proulx 2014.

It seems important at this point of the thesis to state that these ideas were not originally created with the Roman World in mind. However, these intertwined theoretical concepts are what articulate human lives and the social fabric of societies. This is true not only in prehistory, for which these were often originally thought out and from which the relevant evidence was gathered but also throughout history and even today. These ideas are perhaps even more significant for Roman Britain, where different cultures, societies, and, therefore, socio-technical systems came into direct contact. The issue of these contacts and interactions between Romans and native populations has been renamed Romanisation in older scholarship and still remains today when referencing and characterising these contacts. This evolving concept will be discussed at the end of chapter 3, along with descriptions of settlement patterns and material of the inhabitant of Roman South Yorkshire. When it comes to metal production, these concepts are paramount as most practices in Roman South Yorkshire are metal working in settlements to maintain and produce needed objects for other activities (see Chapter 6-7). Smithies located in towns, villages and forts might face some restrictions, but it is unlikely that these would come in stricter form than army requisitions and *corvées,* leaving a lot of space and time for individuals to produce and maintain pieces to sustain their lives and businesses. In more structured practices, such as organised smelting activities and quarrying, as explored in chapter 1 (see also chapter 6-7), the Roman administration endeavoured, in most instances, to keep the involvement of imperial administration and officials to a minimum level while also keeping control over resources and riches created through these practices (Hirt 2010: 368). This let private entrepreneurs organise production in their own way, in terms of techniques, technologies, and manpower uses, as long as they paid their due either as fixed payment or in kind (Hirt 2010: 368; see chapter 1-3-7-8). This loose control is perfect for individual choices and practices to take place and how these moulded the lives of the craftspeople. In this setting, concepts such as Agency and Habitus, which were developed studying different contexts, often prehistoric, still apply and are meaningful. As for the relation of metalworkers to the landscape within which they dwell, it is a rather simple one. While settlements and enclosures might be founded in relation to more than necessity, metal practices rarely are. Secondary production will more often than not be practised where the people needing the result of these crafts are located, as in our case (see chapters 5-6-7). As for primary production, craftspeople will more often than not establish their practice in proximity to resources needed (see chapter 6-

7), such as clay, charcoal or ore, to ease production since these resources would require extensive transportation through a complex network of people, places, and resources.

Within a Network.

From an analytical standpoint, these concepts, of Agency, Habitus and Socio-technical Systems, can be populated with data because the properties of the materials from which objects are created are not simple and attributed from the start, but rather these properties emerge through the object creation process and use-life, like a history (Ingold 2007: 15). To fully understand this history, though, objects and agents must be considered not only on their own but as part of a network (Knappett 2007: 22-23).

Underlining the network analysis in this research are two basic principles. First, networks are emergent and dynamic. Second, they have a temporal as well as a spatial occurrence. As Knappett (2007: 22) noted in his comment on an article written by Tim Ingold, "network thinking" would cause materials to be looked upon not simply as individual entities, but rather through the connections between multiple iterations of the latter, it should enable a relational perspective wherein the properties of materials can be seen to emerge rather than simply be. During the Roman period, some of these features are now set-in-stone, literally. The formation of the Roman road system crystallised parts of the transportation network and established it permanently in the network. However, it is important to note that the majority of the rural population would still regard droveways and ancient routes as significant and possibly consider the creation of these roads as detrimental to their livelihoods and their traditional way of life, as exemplified by the instances of roads cutting through existing boundaries and paths (see chapter 3; Chadwick 1999: 164; 2008: 44-53). Also, considering these droveways and paths, although the stoned road network provides a much more structured and durable network of transportation, these were not the only roads used to move goods around, only the most obvious in the archaeological record. Indeed, many rural sites needed to use non-paved roads and paths to simply use these stoned roads or generally to move around to other settlements or enclosures. Therefore, the more structured Roman network would still exhibit emergent and dynamic properties where new settlements founded away from the roads would subsequently be linked between them and to the paved roads and join these new links of transportation. Perhaps the most important impact of the Roman administration is the ease brought by the usage of facilities and structure along the network, such as protection from raiders by the presence of military outfits roaming around and the benefit to transportation brought by the road network for the use of carts and animal power (see chapter 7-8). In this context of Roman South Yorkshire metal production, it appears that networks do exhibit the principles stated above. They are emergent, dynamic, set in space and in time. To investigate these links between places and people, network theories had to be investigated, and one selected to frame the analysis of the elements forming the network.

One network approach that is in vogue in archaeology in recent years is Actor-Network-Theory. It is, in many ways, a reflection of the recent surge in interest regarding material agency in the discipline. Actor-Network Theory put the emphasis on categories of things (objects, people, landscape, nature, all things that form the world), which are meant to be treated equally in a network (Van Oyen 2015: 64). By flattening the anthropocentric hierarchy structuring archaeological research as an attempt to break the artificial nature-culture divide, this new ontology considers objects as impactful on the world as human beings (DeLanda 2004: 58). This puts objects as active nodes in networks (DeLanda 2004: 58) where they interact with other nodes made of human and non-human things in a flat ontology similar to what was advocated by Latour in his *Nous n'avons jamais été moderne* (1991) and by Gell in *Art and Agency: An Anthropological Theory* (1998). However, objects and materials are not alive and therefore are not active agents. Neither can we, as Ingold argues (2007: 12), simply add a sprinkle of Agency. Things should instead be included within the flow of materials that make up life (Ingold 2007: 12). Furthermore, physical properties of materials, as well as stylistic and technical choices put into their creation, should not be construed as Agency (*contra* Whitmore 2014: 211). Rather, these are respectively physical reactions between external stress on the material put on by the environment and decisions by human agents that gave meaning, purpose, and form to a piece of material. Therefore, because of its underlining theoretical suppositions, Actor-Network Theory was not selected as an analytical framework for this thesis. In its place, another framework of network analysis has been considered to look at the data presented in this thesis: Social Network Analysis.

Social Network Analysis has been described by Orengo and Livarda (2016) as a type of network analysis "mainly [used] to study the structure of relationships (represented as links) between individual actors (or nodes) by allowing the generation of hypotheses about sites' hierarchy or the expansion of human groups or ideas" (Orengo and Livarda 2016: 24). Recently, the use of this analytical tool has been criticised due to the subjectivity in the establishment of links within the analysis. To mitigate this, Orengo and Livarda organised their spatial network to reflect past transport routes that were found in the landscape (2016: 24). This last point has been duly recognized in the delimitation of the study area (see introduction) and has affected the analysis of the dataset (see Chapter 5, 6, 7 and 8). However, it is important to note that the work presented here is not a landscape-based project, although, as clearly presented previously in this chapter, landscape is a central feature of any ancient and modern activity. Therefore, the analysis of a potential network of sites in this work will not use a formal network analysis approach, but rather a loose analysis informed by Social Network Analysis, where Orengo's and Livarda's mitigation of the subjectivity of the latter technique will be in the forefront.

Technical Sequences of Metallurgical Processes.

Here, the technical steps of the production of metals that were researched within the scope of this thesis are described. These will aim to inform the reader on the processes of metal production and of metal working and aid an understanding of the uses of sites where metallurgical activities were conducted and the potentially intricate relationships of different metallurgical practices. The goal here is not to bring new insight into the techniques and practices of ancient craftspeople but rather to inform the reader on the metallurgical processes that created the artefact categories studied in this thesis. These should not be construed as *chaînes opératoires* since they do not dwell deeply into the localised metallurgical practices (see above in chapter 2) but rather establishes a general sequence of metal production to inform the reader on metallurgical practices and debris that were looked at in this body of work. However, this does not mean that this thesis is not concerned with the sociality of crafts, quite to the contrary, in fact. This solely reflects the fact that at this point in time, it is not really feasible to produce a *chaîne opératoire* of metallurgical practices in Roman South Yorkshire due to the early stage of the understanding of these crafts and organisation of metallurgy in the research area. Firstly, the mining and ore extraction steps will be described. Secondly, the primary production or the smelting of metals from ore, of iron, copper, and lead will be discussed. Thirdly, the secondary production or the production of objects from smelted metal and the formation of alloys of non-ferrous metals. (Figure 2.1)

Mining

The first step in the production of metals is the mining of ores. As described in chapter 1 (see chapters 1 and 7), known deposits of iron, copper and lead ore are located within the study area. Mining techniques used during the Roman period were diverse. During the Roman period, most deposits of metal-bearing ores would have been exploited by opening a cast or a large ditch, and metal was extracted from the deposits near the surface (Tylecote 1986: 155). In one known instance during the Roman period, some iron deposits were exploited using deep mining in the Forest of Dean (Tylecote 1986: 155). Fire setting was probably still in use in some specific areas where the ore was located in suitable rock surfaces (Dungworth, Bailey and Paynter 2015: 41). The fire setting technique uses an open fire set against the rock surface to weaken it. The thermal shock created by quickly cooling a heated surface of rock would make the rock brittle and make the extraction of ore-bearing rocks easier. Bog ores could be collected by hand in old swamps and then treated as ores coming from other sources as seen in the East Yorkshire Iron Age iron production (see chapter 1) (Halkon and Millett 1999: 221-222).

In the case of copper and iron minerals, sulfidic ores needed to be roasted in order to drive as much sulphur out as it is deleterious to the smelting process (Tylecote 1986: 19). On the other hand, copper and iron oxidic ores could be used straight away in the smelting process, but iron ores specifically were often roasted, as it makes them easier to smelt (Tylecote 1986: 128). Lead is rather different as the most usual compound is galena, a lead sulphide, but its low melting point means that no further treatment of the ore is necessary. Evidence of mining activities includes the presence of non-roasted ores, pickaxes, partially roasted ores, crushing stones, and hammerstones. Furthermore, roasting platforms are sometimes found on archaeological sites, along with open cast mines and deep mines.

It is likely that Late Iron Age and Roman smelters would not know the difference between these ores chemically as we understand it today. Rather, it is probable that they had a deep understanding of ores and techniques based on experience and that they would use the sensual, especially visual, differences between different minerals. As highlighted by Pliny (HN.: XXXIV. 47), black lead (lead) and white lead (tin) were differentiated through physical characteristics, and although the characteristics used are problematic (Paparazzo 2008: 43-44), they are still differentiated. They would not know the ores as sulfidic or oxidic but rather as ore types that needed that or this step to be suitable for smelting. For example, the processing of bog iron, which is a type of iron oxide, would be identified through environmental indicators such as the colour of water and the vegetation (Thelemann *et al.* 2017: 479) that would inform them on the specific location and type of ore.

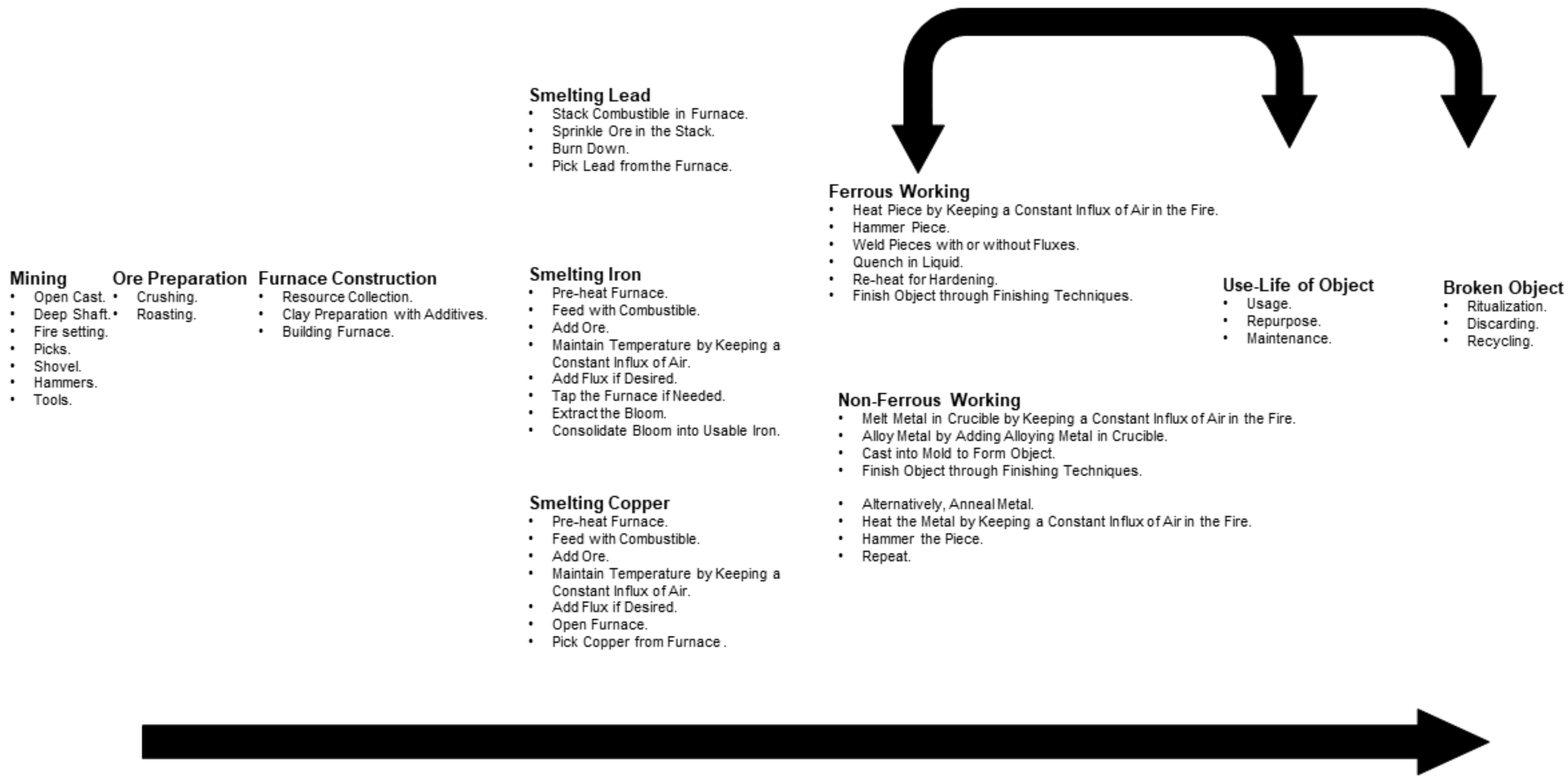


Figure 2.1 : Diagram of the Technical Sequences of Relevant Metals.

Primary Production or Smelting of Iron, Copper, and Lead.

The transformation from metal-bearing ore to metal required a great amount of heat produced in a controlled, reducing environment. Charcoal was added directly into a furnace made out of refractory clay, with added tempers (sand and straw). Furnaces could either consist of a shaft of varying heights or even a bowl furnace (Tylecote 1986: 155-156). The shape of the furnace is difficult to ascertain in most cases because of the poor survivability of these standing structures archaeologically (Paynter 2007a: 202), and it has recently been suggested that iron can be produced in a small bowl-shaped furnace rather than solely in a furnace built with a shaft (Dungworth 2015; Girbal 2014: 9), complicating the issue of design even more. Furnaces such as these were found in Ashwicken, Pickworth, Minepit Wood, Wakerley, Cow Park (Tylecote 1986: 156-159), among others. Furnace forms would vary greatly between traditions and between the metal worked or produced. The furnace would have been powered by a constant influx of air (wind-power, bellows, blowing tubes, etc.) in order to achieve the needed temperature. Copper smelting evidence was not identified within this research and, therefore, will not be discussed.

As for iron smelting, it is important to note that two types of iron were produced during the Roman period: Steel (an alloy of iron and carbon, with carbon content less than 1.7%) and wrought iron (a mixture of iron and slag prills with a carbon content between 0.02% and 0.15%) (Sims 1998: 2). Wrought iron was produced through the bloomery process was the most common of the two in the Roman world (Sims 1998: 2). This metallurgical process will be now described. First, the ore again was often roasted to oxidise the material and help the separation of metal and gangue (Tylecote 1986: 131; Sims 1998: 9-10). Then, the ore was fed into a furnace with charcoal. This created a reducing atmosphere within the clay furnace and an excess of carbon. The furnace was then heated to a temperature of about 1200°C through a sustained stream of air fed into the furnace. These conditions were required to transform the iron ore into wrought iron. It is important to note that ancient furnaces could not sustain the required temperature (around 1550°C) to melt iron consistently along with a controlled, reducing atmosphere (Tylecote 1986: 128-130; Sims 1998: 9-10). Therefore, instead of getting molten iron, the iron agglomerates to become a sponge-like mass, a bloom (Tylecote 1986: 129-130; Sims 1998: 2-3). The bloom must then be hammered, using a hammer or a rock, in order to remove the remaining impurities from the heated metal (Tylecote 1986: 129-130 and 163; Sims 1998: 2-3). It is this worked bloom of wrought iron that will be shaped into ingots, bars or objects. As demonstrated by Paynter (2007a), the late Iron Age and Roman Period were marked by changes in the practice of metallurgical crafts. Originally, non-tapping furnaces were used to produce iron. These would be shaft furnaces with a cavity underneath where the molten slags could drip and accumulate. This block would be removed afterwards. Then, in some regions within Britain, by the late Iron Age, these furnace types were replaced by tapping furnaces where slags were allowed to flow out of the furnace periodically through a hole at the base of the furnace (Paynter 2007a: 209). Indeed, in some regions of England, Kent and the Weald, for example, this change has been linked to an intensification of production (Paynter 2007a: 202). It is also meaningful that most characteristics of smelts, such as temperature, raw materials and ore, rarely change between non-tapping furnaces and tapping furnaces (Paynter 2007a: 202, 209). The composition of slags was identified by Paynter (2006) to be reflective of the provenance of the ore used in the metallurgical processes that created them.

Lead metallurgy is significantly different because of lead's low melting temperature (Tylecote 1986: 54-56). Galena, a lead ore, can be melted in an open fire using charcoal or even dry wood. For galena to be transformed into lead, it requires roasting in the top part of the fire to oxidise the material, and then it would be melted into the bottom part of the furnace (Tylecote 1986: 54-56). It could then be cast into ingots or other pieces using moulds or poured directly into a hole in the ground. Slags produced during the primary production of lead are tap slags, slag runs, furnace bottoms, furnace lining, furnace slag and non-diagnostic slags. Other evidence can include fired ceramics, charcoal, ore, tuyeres, and rarely structures.

Metallurgical debris would have been created by these processes. Pyrotechnical ceramics would be abundant in the form of vitrified furnace lining, as well as unreacted ores and cinder, in ferrous and non-ferrous metallurgy alike. Also, slags would be created in relative abundance within the furnace. Non-ferrous metallurgy does not produce particularly diagnostic slags in shape or in colour. Copper metallurgy can sometimes produce corrosion with shades of green, but this is not always the case. However, along with non-diagnostic pieces, some diagnostic ones are also created as part of the iron smelting process, namely furnace slags, tap slags, slag runs, and slag cakes or block, and with small quantities of waste produced by the consolidation of the iron bloom. Furnace slags are "lumps of slags with fractured edges and occasional protruding flows, incorporating abundant fuel fragments" (Paynter 2007b: 17). Slag cakes are the by-product of non-tapping furnaces and are large masses of slags of varying shapes, which often show one or more than one side with impressions of the cut feature in which they solidified under the bloom (Paynter 2007a:

204-205). Tap slags, on the other hand, are “dense slag with a rough lower surface and a flowed upper surface” (Paynter 2007b: 17). Slag runs are similar to tap slags in texture but are long and slim pieces of slag that could flow from larger lumps, such as the tap slags. However, furnace slags would often be produced. Slags are, in many ways, the reflection of metallurgical processes (see chapter 2 on slags as liquid stones). Their form is reflective of manipulations and movement of slags inside the furnace (Dungworth 2011: 224), while their microstructures are reflective to some extent of conditions within (Dungworth 2011: 224-225; Paynter 2007a: 207), and chemical composition is altered by the ore selection and raw material used (Paynter 2006: 285). These characteristics of slags allow us to gain information on the individual practices of metal smelters and workers. As mentioned previously in this chapter, the smelters' practices and techniques would be constituted by the craftsmen by trial and error, but also through education by their peers (Leroi-Gourhan 1965: 22 and 26).

Secondary Production or Metal Working.

There are a great variety of copper alloys. Bronzes were probably melted from smelted copper with which metalworkers mixed tin. Brass is found from the Roman period onward and was made of copper and zinc. These materials are heated either in a closed crucible or under a cover of charcoal to seal the zinc vapour inside during the melt to produce the alloy (Tylecote 1986: 22-26). Lead and arsenic were often added to alloys to affect their properties. Mixed alloys, which cannot be assigned to either composition, were often made by mixing recycled scraps of metal (Dungworth, Bailey and Paynter 2015: 43). These alloys were melted in refractory clay crucibles and then poured into moulds. Iron Age (IA) crucibles were often triangular in shape and these types were found not only in IA contexts but also throughout the Roman period (Tylecote 1986: 97-100). Roman period crucibles were sometimes wheel-thrown when circular or shaped by hand in other forms such as the triangular examples referred to and could have a second layer of clay added to them to help them withstand the heat, and also to protect the crucible and prevent it from cracking (König and Serneels 2012: 9-10). Furnaces used for melting, alloying, and annealing would be bowl-shaped or furnaces without shafts in which crucibles and materials could be easily manipulated. Due to its similar properties, lead can be worked in a similar way to copper alloys and can be alloyed with tin to produce pewter. Copper and lead working and melting would require the use of tongs for manipulation of the crucibles, hammers in the case of annealing, ceramic moulds which could be open or closed, sand or even directly poured into the ground. These moulded or annealed pieces could then be polished using sand or cloth. Metallurgical debris specific to non-ferrous secondary production is similar in many ways to ferrous secondary production, such as forms of slags and cinder, but differ markedly by the use of crucibles and of casting moulds, which are often found in fragments and occasionally whole. The presence of copper in the slags and residues on vitrified ceramics can sometimes corrode in shades of green, which would link these slags with copper alloy working, but this is not always the case, as seen in this thesis (see chapter 6-8). Furthermore, spills and trimming of metals are common in non-ferrous secondary metallurgy, where molten metals are poured into shape.

As for iron, as mentioned above, once the majority of impurities present in the bloom were hammered out, either directly after the production of the bloom during the smelting process or after by reheating the bloom, it could be heated and then hammered to create objects (Tylecote 1986: 162-163). Smithing hearths are more often than not holes in the ground, but bowl furnaces are also used for that purpose (Tylecote 1986: 162-163). If heated properly, it would also be possible to weld two pieces together to create a larger piece (Sims 1998: 12). Evidence for this process is numerous and includes smithing hearth bottoms, non-diagnostic slags, crucibles, crucible slags, furnace lining, tuyère, and possible *in situ* structures. Although relatively simple in theory, the working of metals is far more difficult to control than it seems (Sims 1998: 12). The inclusion of slag found within the piece could create weak points which, when hit, could create faults and even cause the metal to fracture. Furthermore, although the bloom exits the furnace at a high temperature, once it is cooled, it is difficult to reheat to a workable temperature because of the heterogeneity of the piece. Also, the welding of iron or steel pieces requires a specific temperature point and skillset to control (Sims 1998: 12-13). The hammering of a piece in itself is no easy task and requires strength but also finesse and intimate knowledge of the material. Hammers of different sizes, tongs, anvils, punches, scissors, along with unique tools built for specific purposes by the smiths, were all tools that were necessary for the working of iron into objects. As with smelting, various metallurgical debris would be created by these processes, along with vitrified ceramics. As for slags, in addition to non-diagnostic examples, plano-convex smithing hearth bottoms are commonly found and are created by the agglomeration of impurities coming out of the iron pieces while they are hammered (Dungworth 2011: 225). These present a rounded bottom moulded by the furnace and a flatter top, which sometimes present a hole caused by the air induction from the tuyere. They are spongy and heterogeneous (Paynter 2007b: 17).

Scrap metal is also commonly associated with the secondary production of iron with pieces such as turnings, offcuts, rods, bars, and wires.

Slags as Liquid Stones.

This study is mainly based on the study of archaeologically recovered metallurgical slags. Slags, unlike many other artefact categories, are not finished products. Slags are not even archaeologically recovered in the same substantial state in which they are useful to ancient craftspeople. While in a liquid state, slags have critical utility in the smelting process. They assist in temperature distribution and act as process indicators. Good fluidity of slags in the furnace will create a slag bath which will assist in temperature distribution and prevent reoxidation of the forming iron bloom. Secondly, the consistency of liquid slag is a good indicator of the furnace atmosphere and how well a smelt is proceeding. Together, these indicators give a crucial awareness to the craftsperson or craftspeople. Smelting is, in essence, a remote operation conducted without direct manipulation of the material within the furnace but mediated by the skilful use of bellows, furnace additions (charcoal, flux and mineral) and, sometimes, the use of the tap hole by the craftsperson or craftspeople. Slags are found in an archaeologically recoverable state that is a cold, hard, black fossil of its former incandescent nature where it was a luminous flow generated by the crafting decisions and material conditions under which metal is formed. To address this nature of slags and, more generally of metallurgical debris, it could be meaningful to switch from a perspective of "the endless shuttling back and forth from image to object and from object to image" to something more in line with "the material flows and currents of sensory awareness in which images and objects reciprocally take shape". (Ingold 2013: 20). This switch will facilitate a renewed importance of the process of object creation. Things are not the end product of a process but rather the result of a flow of action and material that is convened through practice.

Conclusion

As a concluding thought on these intricate theoretical concepts, which will act as the foundation of this thesis, it seems clear that "one does not 'possess' a technology," but that agents "enact technologies through socially organised material practices" (Dobres 2000: 128). They create, reproduce, and transform their "social and material conditions" through these various materially and socially entangled practices (Dobres 2000: 128). These agent-specific practices, which are regulated through the *Habitus*, are "dynamic strategies [of] identity and self-differentiation" (Dobres and Hoffman 1994: 219). These agents do not act on their own or in a vacuum. They are part of an intricate network of agents, entities and things that are all situated within a landscape that is negotiated and inhabited by the agents. In our specific context, Roman power can be intimidating and disruptive, with newly built roads breaking traditions of rural movements (see Chapter 3-7) and military establishments created in the area. However, it appears that the new administration did not care for direct control in a number of cases and let local craftspeople and entrepreneurs act on their own as long as they received their due (Allen *et al.* 2017: 178; Hirt 2010: 368). This theoretical standpoint will be the backdrop for this thesis and will inform how it looks at the lives and activities of people in the past. This research was constructed with the technical sequences of the relevant material categories in mind. These helped direct the investigation and open the discussion to techniques and practices of ancient craftspeople. Metallurgical debris is the prime evidence for the investigation of metallurgical practices. These often-discarded pieces provide an interesting window through which to understand the lives of ancient craftspeople, and this is exactly why this category of evidence was selected for this research. The next chapter will explore the historiographical, historical, and archaeological background of the study region. This background aims to focus on specific aspects of the Iron Age and Roman pasts of South Yorkshire in order to define the people living within the area that this thesis is concerned with.

Chapter 3: The Historical and Archaeological Background of South Yorkshire.

Historiography of South Yorkshire

Introduction

The following chapter will present an overview of the historiography of the study area. Starting with ancient authorship on South Yorkshire and to some degree on Britain as a whole, it is useful to consider how the Romans wrote their own history of the area, as well as to critically analyse and comment on these sources. These ancient accounts of events in Roman Britain offer an interesting insight into the reasons behind the invasions as well as the minutiae of the events, people and locations. This historiography will then explore the antiquarian period where a renewed interest in the ancient history of Yorkshire began. This will be followed by a discussion of the early archaeological work conducted in the region, a time when the first organisation concerned with this specific part of heritage was established. The post-war and rescue archaeology period will then be explored, setting the scene for the current paradigms within which research archaeology is evolving in South Yorkshire. We will then move onto the specific archaeological and historical background of this project regarding the organisation of metal production in Roman South Yorkshire.

Ancient Authors

Ancient authors have passed on a limited, but nevertheless fascinating, number of texts that highlight their interests in this far away land. “Their weather is more rainy than snowy; and on the days of clear sky, fog prevails so long a time that throughout a whole day the sun is to be seen for only three of four hours […]” (Strab.: 4, 5). It is in these words that the ancient Greek historian Strabo described the skies of Britannia, a land shrouded in fog with wild inhabitants tall and strong in war (Strab.: 4, 5). Britain was a peculiar province for the Empire, a faraway land, the end of the world, a large island (the largest known to them) stuck between Gaul, Germany, Spain and “[the] immensity of an open ocean” (Tac., *Agr.:* X, 3-4). The oldest surviving reference known to us comes from Pytheas of *Massalía*, an ancient *Marseillais* who may or may not have visited *Belerium* or Belerion or Cornwall and visited tin mines in the fourth century BC (Cunliffe 2002: 75-76). His writings on the matter were used by other ancient writers, notably Strabo and Timaeus of Taromenium, who not only used the texts for parts of his own description (Cunliffe 2002: 24

and 75-76). Other authors who recorded information on Britain include Julius Caesar, who, in the mid-first century BC, campaigned twice on the island to further his prestige (Caes. *BGall*.: 4, 20-35 and 5, 1). The next part of the ancient narrative of relations between Rome and Britain was during the Claudian invasion of the island. Although the evidence for the reasons behind this attack is not clear in ancient texts, some historians (Creighton 2000: 78; Suet. *Claud:* 5, 17) argued that he invaded not simply to add resources and land to the Empire but also to enhance his prestige at the start of his reign over the Roman empire. Suetonius wrote in his "Life of Twelve Emperors" that Claudius remained in Britain for the beginning of the campaign to defeat the local chieftains and kings in a series of pitched battles before he left the island, leaving the forces he had led across the Channel to finish the job (Suet. *Claud*.: 17, 1).

This initial invasion is traditionally thought to have stopped at a line between the Severn estuary and the Humber (Higham 1987: 1; May 1922: 5), but these imaginary lines should not be thought of as a *limes* or frontier similar to what was constructed on the northern British frontier later in the second century A.D. The conquest changed Britain dramatically. Indeed, the past frontiers and socio-political entities and relations that once existed in the land were replaced or modified to some extent, either by direct Roman control or indirectly through client or friendly kingdoms. This was the political and military state of affairs for a generation. Tacitus' *Agricola* is a rare source on this time in Britain (Tac. *Agr*.). Written to enhance the prestige of his father-in-law, Gnaeus Iulius Agricola, later governor of Gallia Aquitania and Britannia, this book has a mixed value as a historical source. In his book, after having described the province and the events prior to his father-in-law's accomplishments, he notes that Petilius Cerialis took charge of the conquest of the "kingdom of the Brigantes", located north of the territory conquered during the first campaigns during the previous governors' time, pacifying this new land for the Empire (Tac. *Agr*.: 8). The classical accounts of the modern county of South Yorkshire broadly stop at that point, with the exception of the two itineraries which briefly mention sites in the area.

Antiquarianism

A renewed interest in the Roman antiquity of Yorkshire started during the 18th century, when most antiquarians were especially concerned with small finds of various kinds, such as pottery, metalwork, and glass, alongside the more visible architectural remains. This is not to say that these early scholars were solely interested in material culture or that architectural remains were neglected. However, "visible" architectural remains, such as columns, large masonry buildings, burials, etc., are rarer than "invisible" architectural remains, such as ditches and post holes, and were not as present in antiquarian scholarships.

The first significant antiquarian contribution can be attributed to Robert Thoroton in 1677 with his *Antiquities of Nottinghamshire*, with the second edition of this copied verbatim by Thorsby in 1790. This document consists of a settlement-to-settlement description based on documentary evidence. Although mostly concerned with Nottinghamshire, as expected, Thoroton does mention the southern part of the region in this study in a rare reference to pre-Norman antiquity through the Roman fort at Bawtry. The earthworks were still visible in his day, and a fragmentary spear and some pottery were found in a cut of the earthworks (Thoroton 1790: III, 323).

The next notable antiquarian text concerned with the region is the *History and antiquities of Doncaster and its vicinity* by Edward Miller (1804). This antiquarian description is concerned with the pre-Norman history of an area between Rotherham, Thorne, Pontefract and Bawtry.

A few years later, in 1813, William Peck's *Topographical History and Description of Bawtry and Thorne with villages adjacent* was published. This antiquarian source is again a settlement-by-settlement history of the region. His later contribution, *A Topographical Account of the Isle of Axeholme,* is also relevant to archaeology with an account of the general lie of the land, local geology, and soils (Cockrell 2016: 52). In this book, he also gives a detailed history of the drainage of the Humberhead levels (Figure 3.1) from the medieval period onwards (Peck 1815). This is significant for the history of the region because the drastic modification of soil conditions in the region, from anaerobic to aerobic, greatly affected the survivability of artefacts (Buckland 1976: 158-61; Cockrell 2016:52-53). Specifically, the anaerobic conditions preserved organic materials while the aerobic soil did not. Thus, artefacts that were not well suited for the wet soil condition

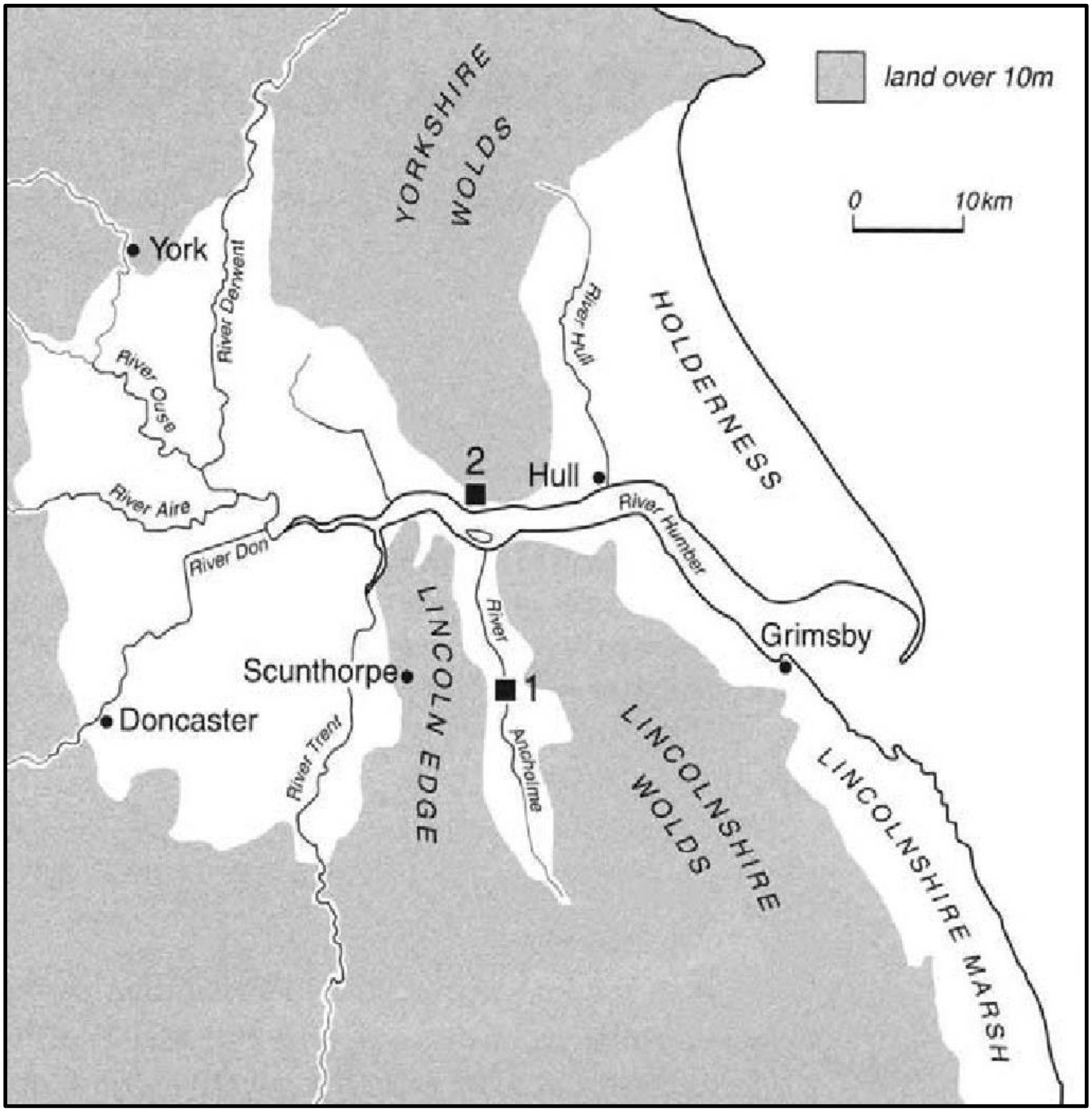


Figure 3.1: Humberhead Levels (Van De Noort 2004 in Chadwick 2008: 5).

did not survive the pre-drainage phase, while those that survived that phase later perished after the changes in soil conditions. Building on this antiquarian tradition, Joseph Hunter, a pastor born in Sheffield who showed a keen interest in the past of his native county, published his *Hallamshire* (1819), in which he described the various parishes forming Hallamshire and wrote a narrative history of Sheffield. Then, he authored his seminal book, in which he coins the term "South Yorkshire" for the first time. In *South Yorkshire* (1828), he described the history of the area in broad terms and then provided a history of towns, villages, and other localities. Much of his work did not use sources predating Edward the Confessor, but he occasionally mentioned older features such as prehistoric remains and, notably, military or sites thought to be Roman and military in nature. Hunter's research area, "South Yorkshire" and "the great valley of the Don", are terms used since then in the exploration of this region.

Following Hunter's contribution, John Holland published in 1837 his *Tour of the Don: a series of extempore sketches made during a pedestrian ramble along the banks of that river, and its principal tributaries*. In it, he detailed the local history of major and minor settlements and then discussed geology and the history of the drainage of the Humberhead levels.

Finally, in 1887 John Tomlinson published his book entitled *Doncaster from the Roman Occupation to the Present Time*. This chronological narrative of Doncaster first discussed the pre-Norman presence in the area and then moved on to a description of the historical events from then to the late nineteenth century.

Early "Archaeology"

At the crossroad in early archaeological scholarships, upon the adoption of typologies and seriations, Ella S. Armitage stands out as one of the earliest scholars to adopt these methods in South Yorkshire. For the first time in the area, heritage research was conducted by a scholar not only with an interest in archaeology but also with a foundation in history to enlighten her work (Counihan 2004). In her *Key to English Antiquities, with Special Reference to the Sheffield and Rotherham distric*t, her scholarship is aligned with previous antiquarian research and, at the same time, presented a detailed seriation of prehistoric features in the region (Armitage 1897).

The establishment in 1912 of the Hunter Archaeological Society provided structure and focus for research in South Yorkshire. This society established itself strongly in the research movement that was emerging with a goal to provide "systematic scientific investigation" (Leader 1914: 109) of archaeological remains that needed it. The society's journal, *The Transactions of the Hunter Archaeological Society*, provided an easy and convenient place to publish regional fieldwork on various scales and enabled meaningful regional interpretations.

Excavators working at the beginning of the 20th century often conducted archaeological excavations of various extent and precision (Chadwick 2008: 23). Although, as previously noted, interest in prehistoric and non-monumental archaeology started to grow from this period, these early excavations were mostly focused on the remains of Roman sites in the British Isles, such as forts villas and fortlets. In South Yorkshire, the Roman fort at Templeborough saw small scale work by Leader at the end of the 19th century, and then a rather detailed and professional rescue excavation (for its time) by Thomas May in 1916-17.

Other sites excavated in the early 20th century include Ilkley in 1925 (Woodward 1925) and the "villa" in Stancil (Whiting 1943).

Post-war Rescue and Research Archaeology

After the second world war, there was a dramatic increase in the number of rescue excavations conducted in the South of England during the late 1940s, 1950s and 1960s, but there was not as much activity in the Midlands and in the North. Indeed, the only major excavations in South Yorkshire were in Doncaster and in some rural areas of the county (Chadwick 2008: 23; see Buckland and Magilton 1986). One notable contribution from that period is Dorothy Greene's research on the Roman remains in South Yorkshire; she can be said to have been the first salaried archaeologist in the region (Cockrell 2016: 59). Although she did work on the Roman Ridge, which runs through the region and is of doubtful Roman origin (Chadwick 2008: 176), her most significant contribution to local scholarship has to be her work on the Roman road network, a full survey of the roads in the area (Greene 1948, 1957a, 1957b; Greene and Smedley 1958). This work highlighted a possible road leading west from the fort to modern Sheffield (Greene and Wakelin 1950). In the peripheral area to this study, the Roman period remains in Castleford, Chesterfield and Ilkley were also now excavated.

From the 1950s and 1960s onward, before the Planning Policy Guidance Note 16 from 1991, rescue excavation was made at the discretion of landowners and developers in charge of the construction work. This led to a rather poorly funded archaeological sector (Cockrell 2016: 62) and highly variable constraints in time and resources being forced onto rescue excavation (Cockrell 2016: 62). Working in this under-funded period of archaeological research, Derrick Riley's contribution to the archaeology of Iron Age and Roman South Yorkshire is incredibly important for our understanding of social and economic dynamics. Along with his reporting of surveys, he conducted in Ramsley Moor (Riley 1960), Riley used his piloting skills to produce extensive aerial surveys, published in two books (Riley 1980, 1987). This increased our understanding of later prehistoric, i.e. the Late Iron Age and Roman, periods exponentially by showing the size of the intricate field systems covering South Yorkshire, although there is a certain bias in this work, as cropmarks on the Magnesian Limestone Belt are more visible than on other geological formations and, therefore, figure more heavily in his books (Cockrell 2016: 61; see Riley 1977). This resource is still valuable for research planning and surveys in the area. From the 1970s, rescue work has been led increasingly by professional archaeological units that were often attached to a larger organisation, such as a university, city or county council (Cockrell 2016: 63). For South Yorkshire, the South Yorkshire Archaeological Unit, attached to the Sheffield City Council, took charge of many rescue excavations in the region from this time. The main difficulty faced by these organisations at that time was to secure funding for these excavations, the shortage of time and resources leading to a loss of meaningful data (Cockrell 2016: 64).

The appointment of Paul Buckland as Archaeological Field Officer, along with John Magilton, at the Doncaster Museum was an important step for the archaeology of the region (Cockrell 2016: 65-66). The in-depth excavation and analysis of the pottery kilns found south of Doncaster highlighted one of the most important centres of pottery production for the whole of Roman Britain. These products were exported to most northern military establishments on the island and were one of the most recognisable and numerous examples of coarse pottery on these sites. Furthermore, the excavation of large parts of the Roman fort under Doncaster revealed that this site was of tremendous importance for the area and that a relatively large *vicus* was also present. The publication of *The Doncaster Region in Roman Times* in 1971 (revised in 1975) (Barwick, Buckland, and Dolby 1975), followed by *Roman South Yorkshire: A Source Book* in 1986 (Buckland 1986), is a seminal moment in South Yorkshire archaeology, as these were the first modern regional syntheses.

Present Day Archaeology

The advent of the Planning Policy Guidance Note 16 in 1991 radically changed the rate at which archaeological rescue excavations are conducted by placing the responsibility of the survival or recording of archaeological deposits on the landowners and the project developers (Hodgson 2012: 38-39). These projects are carried out now by various commercial archaeological units that, more often than not, operate in the region where their offices are located or, in the case of larger companies, open regional offices to take advantage of local manpower and projects. Examples of the former are West Yorkshire Archaeological Services, Archaeological Research Services and the now-defunct Archaeological Research and Consultancy at the University of Sheffield (ARCUS). Larger companies with regional offices include Wessex Archaeology, which established a regional office in Sheffield, and ArcHeritage, a subsidiary of York Archaeological Trust.

Summary

Throughout this short history of the archaeology of South Yorkshire and Britain in general, two aspects stand out for further consideration. Firstly, the impact of the arrival of Roman forces on indigenous rural life is still relatively poorly understood, because of past lack of interest in developer-funded and academic research in the region, and, more importantly, because much of the work has been unpublished or is accessible only in the so-called grey literature (Chadwick 2008, 26). Secondly, South Yorkshire is poorly represented in regional and national narratives. Indeed, although the region has been the subject of a number of regional publications, these are now out of date (Buckland 1986; Chadwick 2008; Roberts, Berg, and Deegan 2010). In cross-regional publications, such as Patrick Ottaway’s (2013) *Roman Yorkshire: People, Culture and Landscape*, South Yorkshire is discussed, but in significantly less detail than the rest of Yorkshire (West, North and East counties). These large-scale narratives tended to not present the great variation and diversity in the way societies express themselves materially. Notably, the recent publication of the Rural Settlement of Roman Britain project hopefully will change that state of affairs. This recent work was built on much of the grey literature produced as a result of PPG 16 and developer-funded archaeological work. Furthermore, this masterful piece of work built upon the work of Taylor (2007), who broke from traditional narratives and argued for definite regionality in the nature of settlement patterns between different zones (eastern/central and northern/western). The Rural Settlement of Roman Britain also recognises important and deep-seated regionality between different regions of Britain. The study area of the present thesis is divided between the North-East region and the Central West region. With this in mind and remembering the theoretical background of this thesis centred on the day-to-day creation of identities and the necessity to consider the entirety of the socio-technical system when exploring technologies and crafts (see chapter 2), the following sections will focus on the archaeological and historical background of the study area.

People of South Yorkshire.

Introduction

The rest of the chapter will explore two cultural narratives concerning the pre-Roman Iron Age followed by a discussion of settlement pattern and material evidence of the Late Iron Age will be discussed. Then, the same will be done with the Roman period evidence in South Yorkshire based on the Rural Settlement of Roman Britain project and older scholarship to discuss specific points relating to material remains. Finally, the concept of Romanisation will be discussed and critiqued while linking this discussion to the theoretical background set in chapter 2.

The Later Pre-Roman Iron Age.

As this study is concerned with the Roman presence in the study area, it may be thought strange to start with a discussion of the Iron Age. However, if one is to reflect on the organisation of society and the impacts of significant changes on it, it is paramount to discuss its organisation previous to these changes. In this case, the discussion of different models of Iron Age organisation as well as descriptions of settlement patterns and materials in the study area will be compared to the same aspects in the Roman period in the study area and then used to reflect on the process of "Romanisation".

Grand Iron Age Narratives.

A number of narratives have been created trying to explain the changes in the society of Late Iron Age Britain. Early examples used cultural histories to explain changes in society. In these, changes were attributed to the arrival of continental Celtic people displacing or invading the existing indigenous groups living in Britain in the Bronze Age (Collis 2003: 9 and 224; James 1999: 26). However, there is no archaeological evidence to support a possible foreign invasion on British soil at that time and, indeed, the Iron Age is typified as a period of great cultural diversity between regions

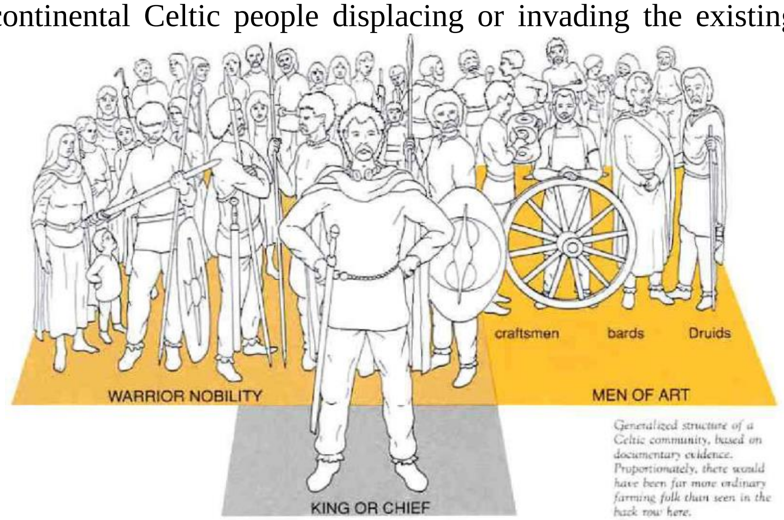


Figure 3.2: The Late Iron Age Warrior Society. (James 1993: 53)

and a clearly insular style in the arts (James 1999: 41-42; Hill 1989: 18). It is interesting to note, however, that these invasion-based narratives appear to be resurgent in recent years.

From the 1970s, efforts were made by a number of scholars to rejuvenate the study of the Late Iron Age (Avery 1974; Bradley 1978; Cunliffe 1984; Creighton 2000; Hill 1989; 1995). Barry Cunliffe, among others, attempted to go past these old accounts of invasions and took a step towards reimagining the Late Iron Age society in Britain (Cunliffe 1984). These authors argued for the existence of a deeply stratified hierarchical society in Britain at that time. Within this society, they identified "tribal kings" or chieftains leading a warrior aristocracy with specialised craftsmen, religious figures, and cultural figures (bards) under them in this hierarchy (Figure 3.2). The farmers and slaves, who would have made up the majority of the populace, found themselves at the bottom of this pyramid (James 1993: 53; see also N. Chadwick 1971; Cunliffe 1984, 1995; Dillon and Chadwick 2000 for similar arguments being made). The scant archaeological evidence relevant to this warrior society is generally in the form of weapons and chariots found in tombs and the rare, fortified settlements showing evidence of prestige metalwork. This organisation of the study of the Late Iron Age is partly based on ideas coming from classical authors such as Livy and Caesar, but also early medieval Irish and Welsh sagas played a significant part in the formation of this theoretical structure in the scholarly literature (Cunliffe 1984: 560-562). Adrian Chadwick rightly pointed out that this transposition of early medieval social structures is not helpful (Chadwick 2008: 32; see also Collis 1997; Dunham 1994; Hill 1989; Merriman 1987 putting forward similar points). Furthermore, these notions of heavily stratified warrior societies, more often than not, are in contradiction with the actual archaeological evidence (Chadwick 2008: 32; Collis 2003: 9-10; James 1997: 42; see also Chapman 1992; Merriman 1987). Such unifying ideas of a single social structure present over the whole island of Britain do not do justice to the myriad of regional variations noted in the region (Chadwick 2008:32).

J.D. Hill has directly criticised these models of Late Iron Age Britain (Hill 1989, 1995). In his opinion, attention had been wrongly focused on hierarchical relations because the archaeological evidence more strongly indicated that it was the household that was the basic unit determining relationships in southern Britain in the Late Iron Age (Chadwick 2008: 33; Hill 1989: 58). To support this, two arguments were put forward. Firstly, hillforts and oppida have been described as being centralised places of power, but Hill's work brought this into question (Chadwick 2008: 33). Indeed, hillforts are not uniform in their chronology, geography or meaning. Some were used in

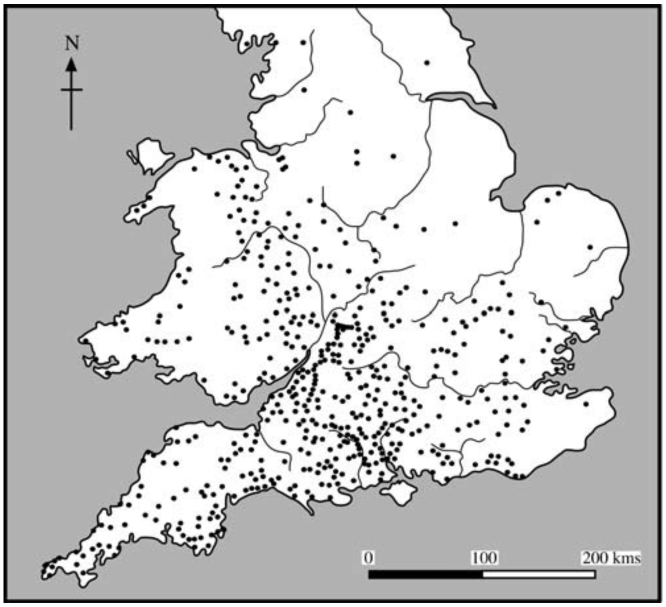


Figure 3.3: Map of the Distribution of Hillforts. (Cunliffe 1991: Figure 14.1).

the Bronze Age, others in the Iron Age, and they were not present in all regions of the British Isles. For example, in Ireland or even in East Yorkshire, there is no evidence of hillforts (Hill 1995: 68) (Figure 3.3). As for their uses and meaning, recent work suggests that these structures might have been communal and ritual spaces rather than a base for power representation (Sharples 1991a: 264; Hill 1995: 68; Hingley 1993: 31-32). Furthermore, "[hillforts] do not tend to occur in the same area or to be used at the same times, as deposits of weaponry and other metal work" (Hill 1995: 69; see also Sharples 1991b). Taken together, these two arguments seem to indicate that such "centralised" settlements were not essential for the cultural reproduction and social life of a percentage of the population of the British Late Iron Age (Hill 1995: 68). In addition, "While it is true that both larger and/or unenclosed settlements existed in some places, the single, architecturally isolated household unit was the dominant settlement form throughout the period" (Hill 1995: 58).

Recent research regarding Iron Age Britain has shied away from the classic narratives of history and, instead, emphasises the diversity and variability of the archaeological record (Chadwick 2008; Ehrenreich 1991; Haselgrove 1989; Hill 1995; Sharples 1991b). "While variations around the household mode of production, with little degree of stratification between households, may be applicable for much of the period, the nature, size, and ways in which the household was symbolized varied considerable" (Hill 1995: 73). What seems to be constant through these interpretations is that a small group of people can be seen as archaeologically distinct in regard to their rites and material culture, which clashes with what was represented in the past (Hill 1995: 83-85). Further developments in the mid-2000s revolved around the idea of heterarchy and a strong critique of hierarchy. Starting from the work of Carole Crumley (2005), heterarchy has been defined as "the relation of elements to one another when they are unranked or when they possess the potential for being ranked in a number of different ways" (Crumley 2005: 39; also in 1995: 3;

1979: 144; 1987: 158). Since then, this concept was taken up by most scholars discussing Iron Age society as the evidence does not tend to suggest a hierarchical organisation of society but rather a heterarchical or at the very least a non-hierarchical one. The suggestion has been made by Chadwick (2008: 461) that settlement pattern, dwelling forms, and material remains in late Iron Age and Roman South Yorkshire indicate that “differences in social status were relatively minor, or certainly not expressed through material expressions of wealth such as larger and more imposing settlements, or richer and more varied material culture” (Chadwick 2008: 461). This concept is considerably more interesting as it allows the consideration of reciprocity and the importance of social reproduction through social relations between agents and daily activities (habitus) in social interpretations (see chapter 2 for theoretical concepts of Agency and Habitus) (Chadwick 2008: 37; Sahlins 1972: 86). Furthermore, the attention to heterarchy brings more focus into localised practices and puts the spotlight on the local people rather than grand narratives and the elite.

South Yorkshire and Iron Age Narratives.

As previously stated, the British Late Iron Age presents great variation and diversity in the way societies expressed themselves materially. South Yorkshire is an example of these variations.

Settlement Patterns

In the early first century AD (pre-Roman), South Yorkshire was populated with farmsteads with rather small surrounding fields enclosed with earth banks, hedges, ditches or walls (Chadwick 2008: 241 and 457-458; Ottaway 2013: 53). Although the dating of these rural enclosures remains problematic, it is thought that they had been in use through most of the Late Iron Age at least and continued to evolve and change throughout the Roman period (Chadwick 2008). The main struggle in understanding settlement patterns in South Yorkshire can be attributed to chronological problems linked to material evidence (Ottaway 2013: 54 and 60). This type of small-scale enclosures closely associated with cropmarks makes up the majority of the settlements identified in the study region (Chadwick 2008: 241); they could be defined, as they were by Chadwick, as “ditched or embanked areas used for some special purpose’, most notably ‘domestic’ occupation” (Chadwick 2008: 242). Riley (1980: 27) created a classification of these and identified six categories, among which are enclosures clusters, rounded clusters, and nuclear field blocks. As noted by Chadwick (2008: 242), however, the usefulness of such a typology might not be as evident as it seems, as it may not be needed at all to understand this phenomenon; furthermore, it might also be the result of our modern focus on typologies rather than reflecting actual meaningful differences in the past (Chadwick 2008: 242).

Nevertheless, different types were identified by Chadwick and will be briefly presented here (Figure 3.7). Firstly, clothes-line enclosures were created alongside existing boundaries, and these usually predate the actual settlement (Figure 3.4; Chadwick 2008: 243). This has been thought to mean that land division might have occurred before the creation of actual settlements (Chadwick 2008: 243). Secondly, irregularly shaped enclosures are often isolated in the landscape of fields or located in small groups and are thought to be linked to the management of herds as corrals (Figure 3.5; Chadwick 2008: 243). Most of these types of enclosures are associated with local field systems, predominantly in the southeast parts of the study area (Chadwick 2008: 252). Thirdly, ladder enclosures, which are known to be a common sight in East Yorkshire during the Late Iron Age and Romano-British periods, were built along roads and important trackways in rectangular segments going from the road toward the fields (Chadwick 2008 252). These are significantly smaller in size, more irregular in form, and quite uncommon in the study region (Chadwick 2008: 252). These were probably linked to animal husbandry on the basis of their frequent location alongside roads and tracks and the common inclusion of fields within the settlements (Chadwick 2008: 252). Fourthly, earthwork sites of subrectangular or subcircular shape were not often directly associated with field systems and trackways and were surrounded by ditches (Chadwick 2008: 240). These characteristics seem to indicate that these enclosures would be predominantly associated with pastoral activities or that these activities would not be visible archaeologically (Chadwick 2008: 240). Finally, the last type of enclosure that is notable within the study region is the D-shaped enclosure (Figure 3.6). As the name suggests, these presented a rounded side opposite a flatter one which could often be the result of the enclosure being built in contact with an existing boundary, be it field or track (Chadwick 2008: 243).

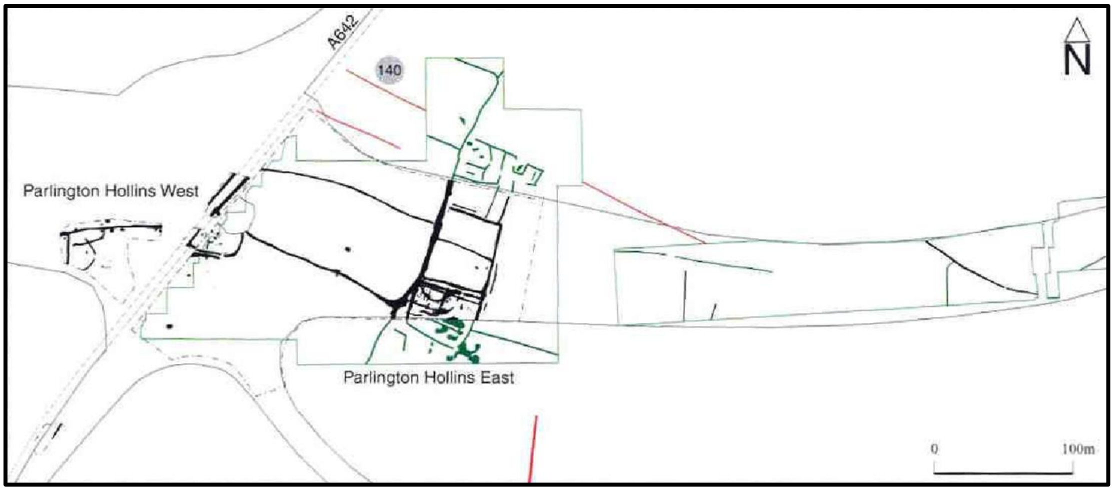


Figure 3.4: Ladder Settlement (Chadwick 2008: 253).

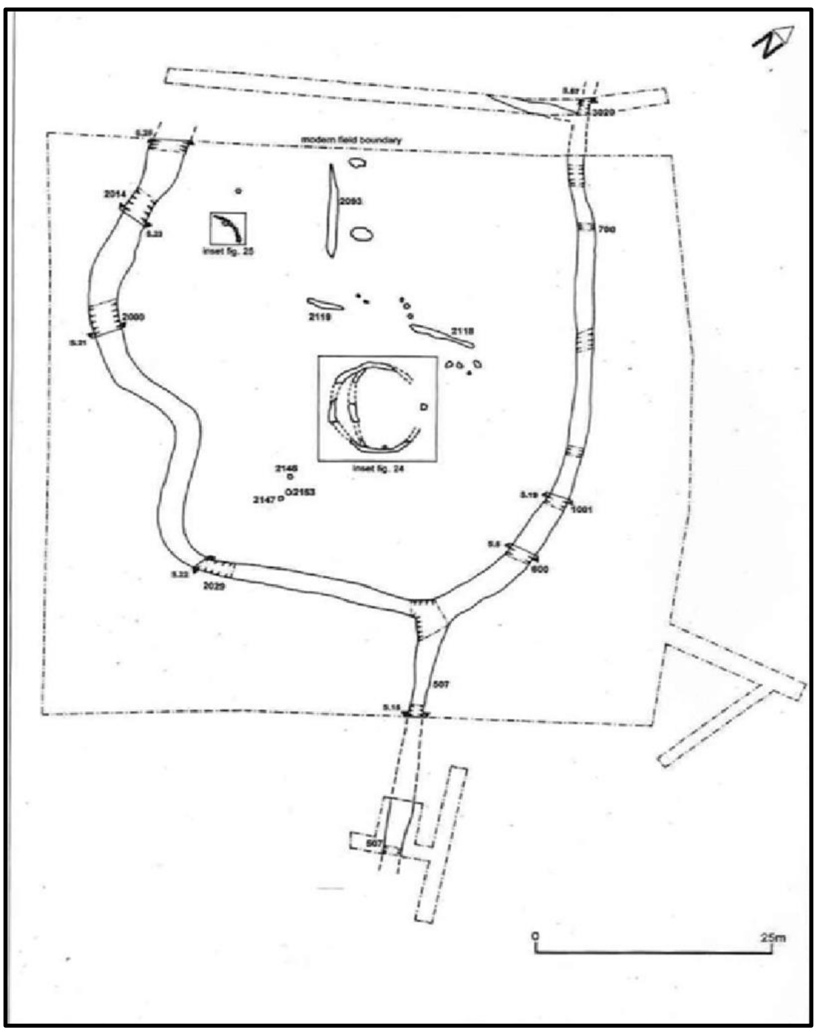


Figure 3.5: Irregular Shaped Enclosure (Chadwick 2008: 245).

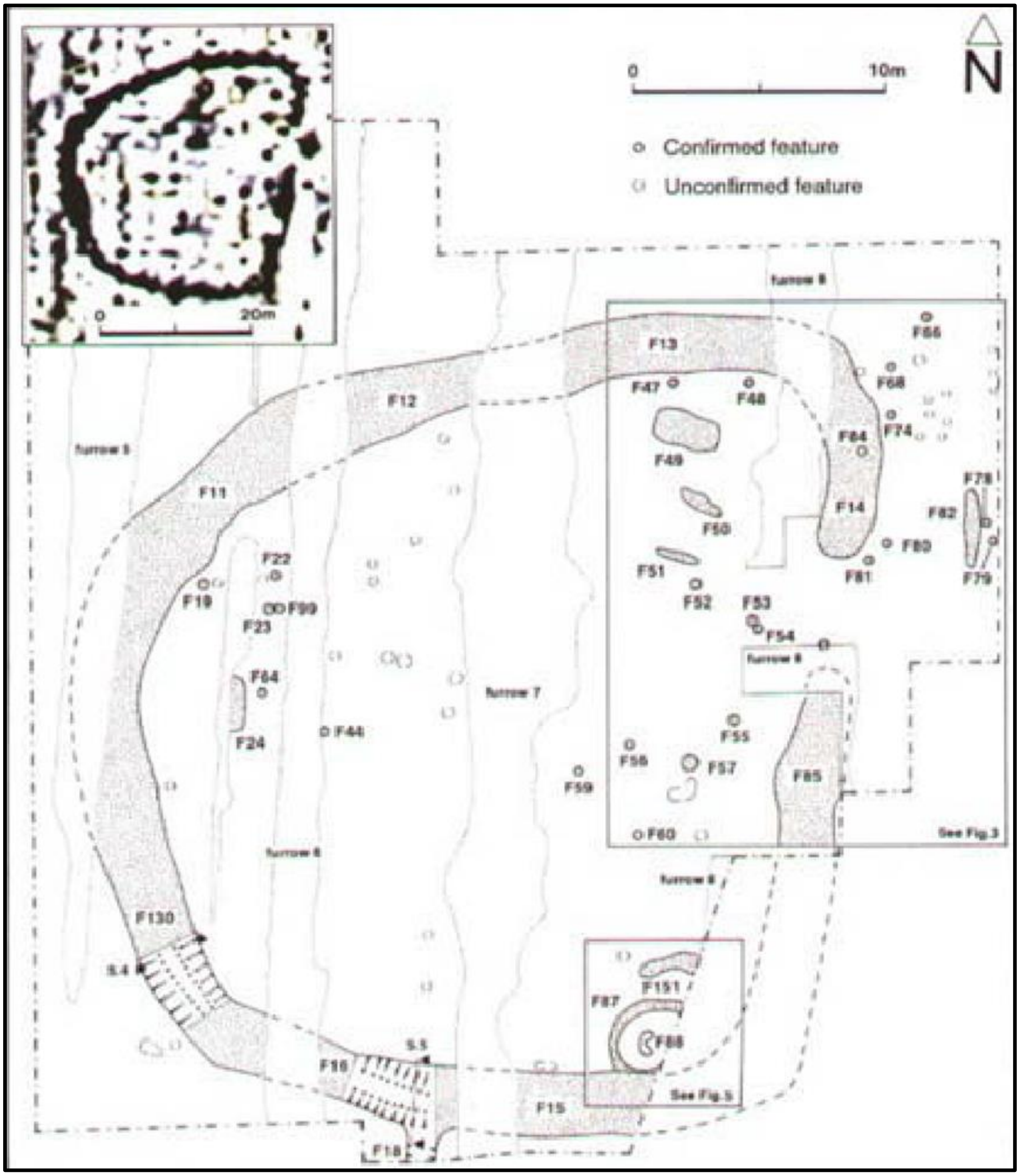


Figure 3.6: D-Shaped Enclosure (Chadwick 2008: 244).

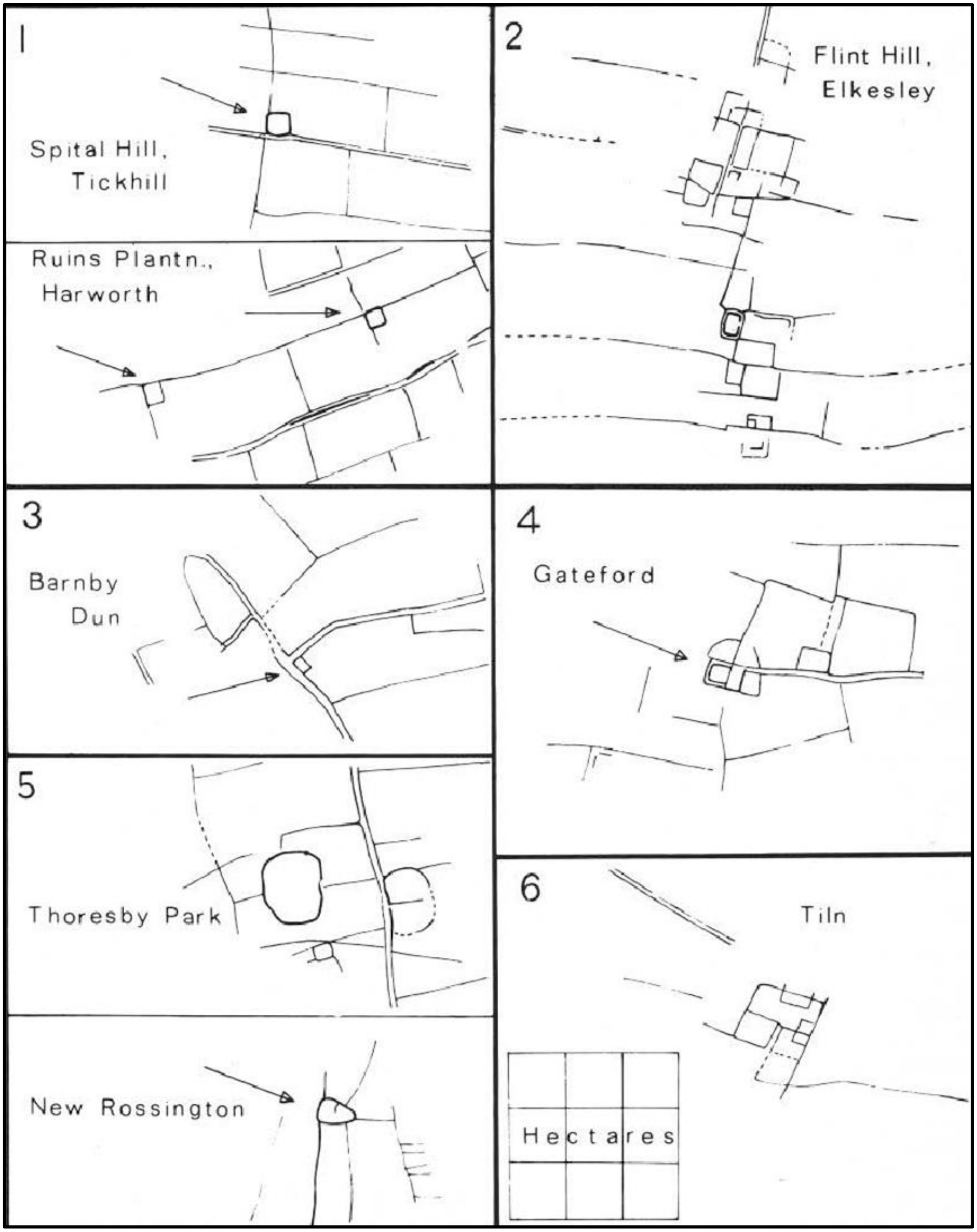


Figure 3.7: Riley's typology as seen in Chadwick (2008: 242). These are particular examples of rectangular, subrectangular, and irregular enclosures in South Yorkshire and north Nottinghamshire.

The common characteristic of all these different types of enclosures is that they were surrounded by a ditch or ditches. These were maintained and recut at regular intervals to maintain their appearance and usefulness (Chadwick 2008: 249). This regular maintenance could mean that archaeologically we only see the final silting-up of the ditches after the abandonment of the site (Chadwick 2008: 250). The re-cutting of the ditches might even be reflective of cultural behaviours of maintenance and remembrance, which could signify that they are far older than expected (Chadwick 2008: 249-250). As Giles (2000: 183) puts it: “reiterative, generational gestures which would have demonstrated respect for the place that had been inherited, and competence in caring for and tending the land”. Furthermore, the fact that some enclosures were single ditched and that others were double ditched could be indicative of chronological differences between the two (Chadwick 2008: 249) or even of cultural differences or a “marker of prestige” (Chadwick 2008: 249).

Also, the hillfort at Wincobank, along with the other possible hillforts in South Yorkshire, are uncommon but are important to note. Unlike most other hillforts in the north of Britain, these do not show signs of extensive domestic occupation, nor is Late Iron Age material preserved, which suggests that they had been abandoned by the later Iron Age (Buckland 1986: 61; Chadwick 1999: 152; Haselgrove 1984: 16).

The preceding description of the settlement patterns present in South Yorkshire during the Late Iron Age suggests a landscape of abandoned hillforts, meaningful in the perception of the local landscape, with small enclosures amidst fields and trackways. These enclosures were sometimes located near existing boundaries, while at other times, they were agglomerated into small groups. This landscape, as observed by most authors writing on the Iron Age past of the study area, does not seem to indicate a strong crystallised hierarchy that would use settlement types or architecture to display their power and prestige. The following part of the chapter aims to examine the material evidence found on these sites to explore the material contingency of the Late Iron Age inhabitants of the area.

Materials of Iron Age South Yorkshire

For more than a decade, the only fragments of ceramics that were identified as being from the Late Iron Age period were found at Pickburn Leys (Chadwick 2008: 333; Sydes 1993: 39-41). However, the increase in excavations since the 1990s has changed our view of the nature of the ceramic remains in South Yorkshire (Figure 3.8). It is fair to say, however, that Iron Age pottery is still relatively scarce in the archaeological record in the study area. Several reasons could be put forward to explain this scarcity. It would seem that most people did not have easy access to ceramic products and that, therefore, their distribution was limited during the Late Iron Age. This could indicate that people used different materials for processing or consumption of food, such as wood, leather or other organic material (Chadwick 2008: 335).

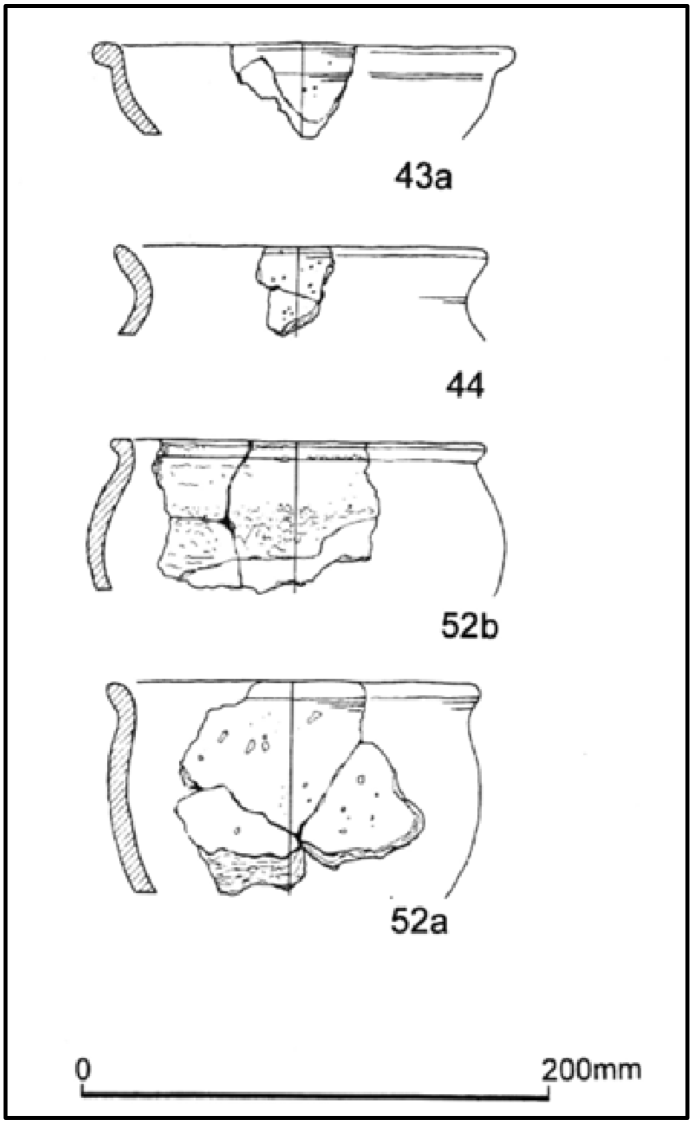


Figure 3.8: Ceramic from Topham Form, Sykehouse. (Cumberpatch, Leary, and Willis 2003: 23; Chadwick 2008: 340)

Also, some pastes that were used to produce local wares were coarse and fired at a low temperature and are, therefore, sensitive to taphonomic processes, possibly having been destroyed in plough-soils and even in stratified contexts (Chadwick 2008: 393; see also Cumberpatch and Webster 1998; Garton, Leary and Naylor 2002). Furthermore, excavation and surveying techniques might not be adequate to notice ceramic remains in Late Iron Age South Yorkshire, where pottery waste might have been deposited consistently in specific places on site (Cumberpatch 1993: 56). These localised deposits may have been missed on sites only partially excavated. The excavation at Sutton Common is a good example here, as only about 10 per cent of the total surface was explored (Chadwick 2008: 237 and 334; Chapman and Van de Noort 2007: 37). Similarly, time and financial constraints put on commercial archaeology may create a situation in which only selected features of a site might be excavated (Chadwick 2008: 465). This situation is improving, however, as local consultancy companies recognise this singular deposition practice. Finally, Late Iron Age pottery might be misidentified as coarse wares from a later period, as some of these forms were still produced well within the first and second centuries AD (Chadwick 2008: 334). Furthermore, the absolute dating of this ambiguous material is not always possible; thus, chronological uncertainty remains.

As for metal products, although artefacts made of metals were used during the Late Iron Age, they are not as numerous as in other nearby regions such as East Yorkshire. Looking at the Portable Antiquity Scheme focusing on metal objects during the Late Iron Age, it appears that 25 objects were recorded. This is only a part of the whole available evidence, but these numbers will be useful when compared to the Portable Antiquity Scheme for the Roman Period. Out of these pieces, most were made out of copper alloys (22 pieces), while the others were made out of silver (1) and gold (2) (Figure 3.9; Portable Antiquity Scheme 2021). Nowadays, commercial work and metal detectorists are recovering more metalwork, for example, in Rossington (O’Connor 2001: 91), at Sutton Common, and Bawtry (Chadwick 2008: 332). Overall, it appears that the people living in South Yorkshire during the pre-Roman Iron Age did not have access to or did not have a desire for the kind of metal artefacts that were sought after in other British regions such as East Anglia, Kent or East Yorkshire (Chadwick 2008: 332).

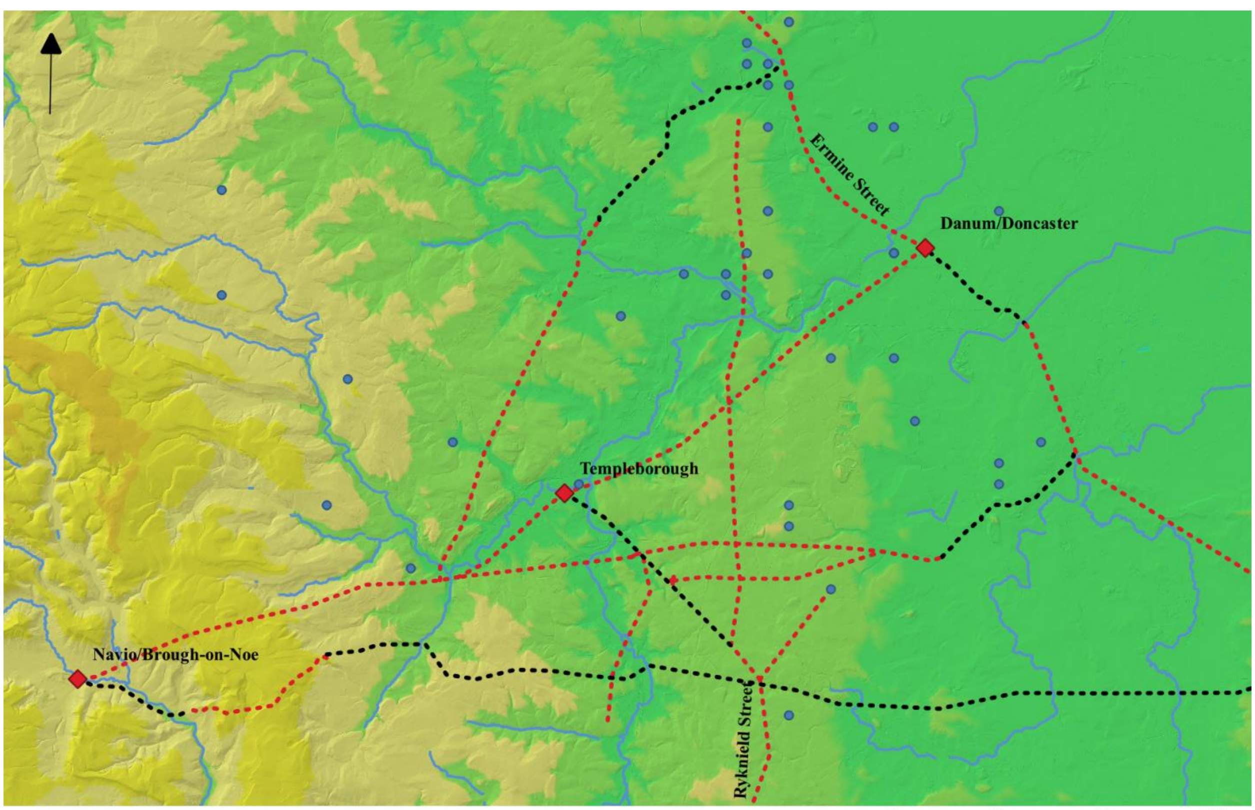


Figure 3.9: Distribution of Findspots Linked to the Iron Age From the Portable Antiquity Scheme. (Potable Antiquity Scheme 2020)

South Yorkshire in the Pre-Roman Iron Age

When considering the settlement patterns and the material contingency of the people living in these parts during the latter part of the Iron Age, it seems that the societies recognised do not fit very well within the older large-scale narratives that have been created in other regions of the island but have a better fit with the idea of heterarchy that is the focus of Iron Age research in the past decade. Indeed, the scarcity of prestige goods, along with the landscape of household or kinship-sized farmsteads, and the relative dearth of the ceramic remains, indicate a rather different society than what could be expected or theorised in the presence of these material aspects. Indeed, it is plausible that the social groups of South Yorkshire were not organised around a hierarchy where richer or more powerful individuals or groups displayed their importance and prestige through differences in material culture or architecture (Chadwick 2008: 36, 480; Ottaway 2013: 76).

> “There can be forms of unequal social relations that need not be explained by ideas of hierarchy, control and exploitation (e.g. McIntosh 1999; Saitta 1994; Stein 1998), as in segmentary societies or those with ‘heterarchies’ of inequality […]. These studies do not deny that social inequalities exist, but power and status are seen as much more informal, local and historically contingent” (Chadwick 2008: 37).

Roman South Yorkshire.

The arrival of the Roman military in the region must have had a profound impact on the existing population. This is not to suggest that this following section will be directed towards ideas of domination over the ‘poor little native population’, but it would be foolish to deny the impact of the arrival of large contingents of foreign people of various status traversing and utilising the landscape in a significantly different way than the local population. In the following, I aim to present certain new features and materials that would have been brought in by the Romans directly or through the inclusion of Britain in the Roman world. Then, I will explore the specific ways that the impact of the arrival of the Romans has been theorised by modern scholars and, further, reflect on the notion of material poverty and its perception for modern archaeologists. Nonetheless, firstly, a simple retelling of the conquest of Britain is discussed, relying on ancient sources and a modern rereading of these by specialists.

Historical Narratives of the Conquest of the Midlands.

It is in that archaeological and historical context of Late Iron Age Britain that the Roman legions arrived on the island led by Caesar in the first century BC and then by Claudius in the 40s AD. These new groups arrived not only with their own material set and their own way of living but also with their own social norms and practices. The direct contact between Britain and the Roman Empire brought the appearance of *Britannia* into the Roman literary world. Authors such as Suetonius and Tacitus wrote about the island for different purposes and with different agendas. When considering these ancient writings, one must consider all the information they provide critically as they are written for a specific purpose, whatever it might be. As a prime example of this, Tacitus, whilst writing his *Agricola*, which is of importance for our knowledge of military actions by Roman Britain in the late first century A.D., sought to elevate his father-in-law, Agricola, and at the same time to criticize Emperor Domitian (Ottaway 2013: 21).

Full-Scale Invasion.

In the 50s AD, under the governorship of Didius Gallus, the area concerned by this study entered the Roman World (Chadwick 2008: 42; Hanson and Campbell 1986: 73; Jones and Mattingly 2007 67-68; May 1922: 4-5). Indeed, forts located along the Don were built during this period, namely Templeborough and possibly the Rossington Bridge vexillation fortress. At this point, it is possible that the Brigantes were a client state of Rome or at least an ally (Hanson and Campbell 1986: 73; Higham 1987: 11). A civil war then apparently started in the territory of the Brigantes, located between Cartimandua, the ruler of the Brigantes and her former consort Venutius due to the former's marital affairs (Hanson and Campbell 1986: 73-74; Higham 1987: 10-11). This regional civil war was contained by Cartimandua with the help of Roman troops, and the queen was kept in power (Hanson and Campbell 1986: 78; Higham 1987: 12), although Venutius retained some power in the region (Higham 1987.: 12). This became problematic when Venutius used outside help to renew his efforts to take over the throne or the leadership position of the Brigantes after Cartimandua apparently married Vellocatus (Hanson and Campbell 1986: 78; Higham 1987: 12). The Roman forces stationed near the Brigantian territories were only able to evacuate Cartimandua (Hanson and Campbell 1986: 78; Higham 1987: 12). The exact chronology of these events is still debated due to some discrepancies in the account of Tacitus in the *Histories* and in Agricola (Hanson and Campbell 1986: 78), but it seems to be reasonable for them to see the second civil war and the evacuation of Cartimandua in 69 AD (Hanson and Campbell 1986: 80; Higham 1987:

12). This created a complex situation for the northern troops since they now had an anti-Roman government at the edge of the territory they controlled (Hanson and Campbell 1986: 83; Higham 1987: 12-13). After the stabilisation of the political situation in Rome with the establishment of the Flavian dynasty, a new governor, Petilius Cerialis, was appointed with the aim of conquering the Brigantian territory (Hanson and Campbell 1986: 84; Higham 1987: 17). The conquest of the area is not well known to this day because Tacitus, sole chronicler reporting these events, is notoriously dismissive of Cerialis' campaigns, as his aim was to celebrate the accomplishment of his father-in-law, Agricola, or through personal dislike (Hanson and Campbell 1986: 84; Higham 1987: 17-18; Ottaway 2013: 21 and 99). It appears, however, that the bulk of the conquest was made under Petilius Cerialis (Hanson and Campbell 1986: 84; Tac. *Agri.*: 17).

*Antonine Peace and Hadrianic Reorganisation***.**

It would appear, from archaeological and epigraphical evidence, that the second and third centuries were mostly a period of peace in Britain (Ottaway 2013: 160). At the end of the reign of Antoninus Pius (circa A.D. 161), the frontier was moved back to the location of Hadrian's Wall (Breeze 2011: 114), consolidating the area that would be the frontier in the next centuries (Ottaway 2013: 160). The construction of the wall (ca. A.D. 122-133) had an important impact on our study region. Indeed, its construction would have necessitated a large workforce which is thought to have been supplied by the Roman army in northern Britain (Ottaway 2013: 160). It is from this time that most of the forts in South Yorkshire and a large number of the military establishments in northern Britain faced a period of abandonment (Ottaway 2013: 160). Some of these forts were recommissioned in the second half of the second century AD, including Navio at Brough-on-Noe, Templeborough and Doncaster (Buckland 1986: 13; Davies 2016: 56-57; Dearne 1990: 103; Ottaway 2013: 161). This has long been attributed to a Brigantian revolt around 150 (May 1922: 9-10; Ottaway 2013: 161), but this proposed rebellion has now generally been debunked due to a lack of direct evidence for and references to a potential revolt in Brigantia (Breeze 2011: 118).

The Third Century and Fourth Centuries

There is a dearth of literary sources pertaining to the study region in these two centuries (Ottaway 2013: 241). What is known for the third century is that *Britannia* was separated administratively somewhere in this period, with South Yorkshire probably part of *Britannia Inferior* (Dearne 1990: 46). Archaeologically, the phasing of the evidence becomes increasingly difficult as quantities of Samian ware (Ottaway 2013: 241-242). Indeed, Samian ware importations plummet around the

230s AD, and none of the other fine wares of the region can be used for securing dates for archaeological structures in the third century AD (Ottaway 2013: 241).

New Patterns?

This section will explore the material and architectural remains associated with the Roman period in South Yorkshire. To do so and to facilitate comparisons with the preceding part of the chapter on the pre-Roman Late Iron Age, this next section broadly will follow the same themes: settlement patterns and material remains in the form of ceramics and metals. The terminology used to discuss settlement patterns is based on the Rural Settlement of Roman Britain by Alexander Smith, Martyn Allen, Tom Brindle, Lisa Lodwick, and Michael Fulford (2016 and 2017), with additions from Adrian Chadwick's Field for Discourse (2008), and selected articles from Breeze and Dobson (Breeze 2011; Dobson 2009). This terminology is used to interpret typological references used in past literature, ensuring clarity of discussion.

Settlements.

First and foremost, it is important to remember that Roman Britain was predominantly an agricultural society and that urban centres were rare in comparison (Fulford and Smith 2016: 419; Allen *et al.* 2017: 234). Also, broadly, rural settlements in the Roman period exhibit a profound diversity in shape, size, and even function within and across regions. With that in mind, the different types of rural settlements described in the Rural Settlement of Roman Britain will be described here. The latter project established eight regions from the analysis of the archaeological datasets and the physical landscape (Smith *et al.* 2016: 15). The study area concerned in this thesis is split on the western edge of the coal measures between the Central West region and the North-East region. The other regions are the North, Upland Wales and the Marches, the Central Belt, the East, the South, and the South-West. The settlement patterns of these two regions will be described after the more general discussion of types of rural settlements. Then, attention will turn to the military establishments, villas and roads, which are often regarded as the settlements most representative of the Roman presence. As mentioned in the introduction and above in chapter 3, older ideas relating to a unique social trajectory are nowadays questioned on the grounds of the extensive evidence reviewed through the Rural Settlement of Roman Britain project. Furthermore, this revaluation of the rural landscape and its focus on localised patterns of settlement fits perfectly within the theoretical background of this thesis focused on Agency and local habitus and practices.

Open Farmsteads

This first type of rural settlement is defined as a settlement where the main domestic area is not surrounded or defined by traceable boundaries (Allen and Smith 2016: 21). They are distributed all across Britain, though they are uncommon and are mostly a late Iron Age phenomenon (Allen and Smith 2016: 21). These open settlements could develop into other types when the site was continually occupied or reoccupied at another time. After the second century AD, it appears that modifications to open farmsteads stopped and those remaining were gradually abandoned (Allen and Smith 2016: 22). This is a prime example of a rural settlement type that progressively disappeared after the Roman presence was well established in the second century AD, perhaps by presenting a better option to enclosure modification with the limited number of nucleated settlements (*Vici* and roadside settlements).

Enclosed Farmstead

The second type of rural settlement is defined by traceable boundaries. These would include domestic activities sometimes in combination with crafts or other kinds of activities within one or two enclosures (Allen and Smith 2016: 23). In this type, the space within enclosures is not sub-divided to a significant degree (Allen and Smith 2016: 23). Enclosed farmsteads have been sub-divided into morphological categories based on the form of the boundary or boundaries surrounding them. These are rectilinear (with straight sides), curvilinear (with a circular or semi-circular shape and no corners), D-shaped (with one straight side on an otherwise circular boundary), and irregular (with boundaries that do not conform to these three other shapes) (Allen and Smith 2016: 24-25). The enclosures that are considered irregular are most often than not somewhere between rectilinear and curvilinear shapes (Allen and Smith 2016: 25). These rural settlement forms were present during the late Iron Age and continued to evolve in the Roman period (Allen and Smith 2016: 28).

Complex Farmstead

This third type of rural settlement is defined by a significant “differentiation of space” (Allen and Smith 2016: 28). This differentiation can take the form of a number of enclosures joined together or as a larger enclosure with substantial sub-divisions of space inside (Allen and Smith 2016: 28). Although the growth and establishment of these enclosures vary greatly regionally, it does appear that this particular form of rural settlement is an early Roman phenomenon (Allen and Smith 2016:

30). Furthermore, the majority of these settlements show no evidence of prior occupation (Allen and Smith 2016: 33). Finally, this settlement type is notably more common in the central belt region and in some parts of the North-East (Allen and Smith 2016: 33). However, these are uncommon in the study area. This has been hypothesised to reflect a potential focus on surplus production (Allen and Smith 2016: 33).

Nucleated Settlement

Lastly, nucleated settlements are sub-divided into three distinct categories: roadside settlements, military *vici*, and villages. All of these are a phenomenon associated with the Roman period specifically. The first two are actually directly linked to the establishment by the Romans of new structures in the landscape: Forts and paved roads. Trackways and roads did exist before the Roman period, but these roadside settlements developed during the Roman period. Roadside settlements and *Vici* are very close to each other, as they both developed along major roads, but these two may have functioned differently because of the proximity to the military (Allen and Smith 2016: 38). These settlements are present all across Britain, but their concentrations vary by type and by regions. Roadside settlements are more common in the East Midlands and East Anglia; villages in parts of Gloucestershire, Wiltshire and Somerset, while *vici* are the most common type of nucleated settlement in the North and West of the province. Villages are defined as agglomerations of farmsteads rather than associated with traditional medieval villages (Allen and Smith 2016: 42).

Villa

Villas were, until recently, a central focus in the study of the rural landscape of Roman Britain thanks to the visibility of their remains in many cases and their inception in the wider Roman world. In the past, villas were defined by their perceived status as Roman dwellings (Allen and Smith 2016: 33). Then, they were primarily described and understood as significant economic units or as settlements that were generating surplus wealth and products to be traded (Allen and Smith 2016: 33). However, recent scholarships set villas in Roman Britain as mediums for the transmission of cultural ideas as well as a place to receive and entertain guests rather than any notion of status or economy (Allen and Smith 2016: 33). Villas often were located within enclosures and took the form of complex enclosures or of enclosed settlements as described above (Allen and Smith 2016: 37). Although there are examples of villas all over Britain (see Mattingly

2006: 379-399), they have a stronger representation in the Central Belt (Allen and Smith 2016: 33). It is notable, however, that these settlements are not the norm and that they are far rarer than other settlement types. Indeed, 326 villas were recorded in the Rural Settlement of Roman Britain project (Allen and Smith 2016: 33). This is considered only a partial number since many sites were identified as having a possible villa character but were dismissed due to a lack of evidence from excavations (Allen and Smith 2016: 33). An estimate of about 2000 villas in Britain provided by Millett (2016, as in Allen and Smith 2016: 33) suggests that they represented less than 1% of all rural settlements (Allen and Smith 2016: 33). Interestingly, the conception of villas as a distinct rural settlement type is potentially artificial. Indeed, approximately half of all villas are new establishments, while the other half can be thought of as a monumentalization of existing dwellings (Allen and Smith 2016: 34). This state of affairs may even be a misrepresentation since few villas were excavated with their surrounding landscape in mind, and further investigation of these characteristics might indicate even more cases where villas trace a pre-Roman foundation (Allen and Smith 2016: 36). Also stemming from this lack of landscape evidence, villas have traditionally been given a high economic importance as a whole, but this is often assumed rather than evidence-based (Allen and Smith 2016: 37). It is also uncertain if the villas were constructed from the wealth of the economic activities located there with a previous dwelling or if they were constructed using revenue from another source (Allen and Smith 2016: 37).

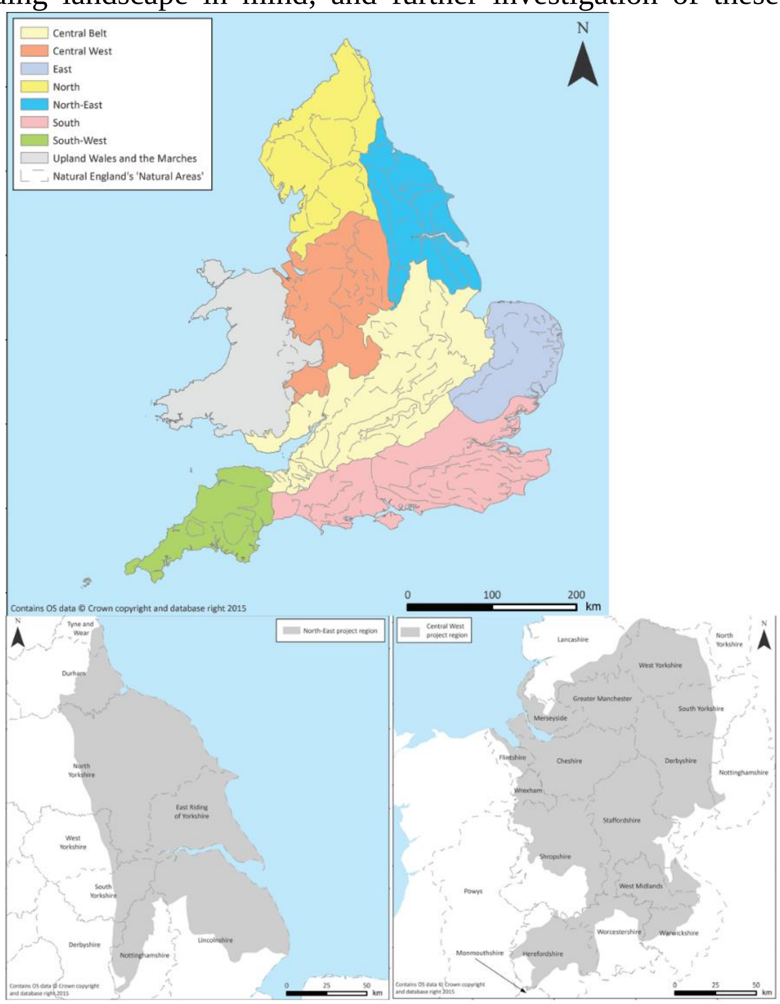


Figure 3.10: Regions of the RSRB project (Allen 2016: 242; Brindle 2016: 282; Fulford and Brindle 2016: 16).

Rural settlement types are varied between each category and even within each one as well. These variations prevent further categorisation. It is important also to acknowledge that an important bias is linked to the size of excavations in Britain (Allen and Smith 2016: 20). The following two sections will cover the rural settlement patterns of the North-East and Central West regions of the Rural Settlement of Roman Britain project (Figure 3.10) each of which contains parts of the broader study area of this project. The relevant sections of these two regions to this thesis are the south-west segment of the North-East region and the eastern part of the Central West region.

North-East region.

The eastern half of the study area is located in the southwestern part of the North-East region. The largest concentration of settlements in this part of the area is located around Doncaster and, more broadly, on the magnesian limestone bed (Figure 3.10) (Allen 2016: 246). The eastern edge of the study area, to the east of Doncaster and Ermine street, shows a light occupation with a notable lack of archaeological records. The large majority of rural settlements found in that area are farmsteads and specifically enclosed farmsteads (Allen 2016: 246). Overall, 17 enclosed farmsteads were found, in addition to 2 complex farmsteads, one open, three villas and one village (Allen 2016: 246). The other farmsteads were not assigned a type in the original publication, but it is noted that there are 43 in total, which represents 16.7% of all rural settlements in the North-East (Allen 2016: 246). Overall, of the 258 settlements recorded in the North-East, 213 are farmsteads, which highlights the rural character of the region (Allen 2016: 246). On the magnesian limestone, it was noted that there was an increase in settlement numbers from the late Iron Age to a peak in the second half of the second century AD and declining numbers in the fourth century AD (Allen 2016: 248). Intra-regional differences in chronology have been recognised by Allen (2016: 248). He also notes that this may have been caused by the southern lands coming under Roman control earlier than the northern part of the North-East region, with only 18% of rural settlements being founded anew (Allen 2016: 248). In addition, it is notable that the construction of new roads and military establishments along the sides of the Humberhead Levels had significant effects on the local settlements (Allen 2016: 248; Roberts, Berg and Deegan 2010: 71-72). These effects were not only disruptive in nature, but it is possible that they also brought new opportunities for trade and exchange of goods along with the increase in settlements in the region (Allen 2016: 249). The establishment of new settlements declined from the third century AD onward (Allen 2016: 249).

Exchanges and trade in the North-East appeared to primarily occur locally during the Roman period (Allen 2016: 274; Ottaway 2013: 146-149). A trade network on a regional and provincial basis did exist and was facilitated by the military and the road network, but it appears that there was "minimal economic integration between the population of the countryside and those in urban and military centres" (Allen 2016: 274) based on the recovery of pottery and of small finds on different types of sites in the North-East region (Allen 2016: 274-275).

Central West region

The whole western part of the study area is located not in the North-East region but in the Central West region defined by the Rural Settlement of Roman Britain project. Specifically, it is located on the eastern edge of the Central West. The Coal Measures are in the Central West with only a small area on the eastern side of the south Pennines. It would appear that in this RSRB region, sites are often focused on the lowlands, while sites in the highlands are poorly represented (Figure 3.10; Brindle 2016: 283). However, this might reflect modern excavation bias to the lowlands rather than an absence of dwellings in the past (Brindle 2016: 283). Taylor (2007: 14) has identified a significant number of undated and unexcavated sites in the South Pennines. This is not to say that this picture is totally an illusion, but that the apparent lack of settlements is potentially less important than we think (Brindle 2016: 283). In terms of rural settlements, as in the North-East, the majority of settlements are farmsteads. In the Coal Measures, 21 farmsteads were identified, along with two *vici* and nine non-categorised sites (Brindle 2016: 287). As for the South Pennines, twelve farmsteads were noted with one villa, one roadside settlement, one *vicus*, one hillfort, and ten other non-categorised settlements (Brindle 2016: 287). Villas are few and are mostly found on the other side of the Pennines. The few villas found in the Central West region might have been official buildings linked to the local administration rather than being rural villas (Brindle 2016: 287). As with the North-East, and indeed some other regions studied in the Rural Settlement of Roman Britain project, the dating of dwellings in the late Iron Age and in the Roman period is often problematic due to the lack of resolution of the pottery (Brindle 2016: 288). Most of the region seems to keep to their aceramic late Iron Age tradition (See above; also see Brindle 2016: 288), or existing ceramic tradition continues at the beginning of the Roman period and beyond (Brindle 2016: 288). However, it appears that the region sees a rise in occupation during the Late Iron Age, which continues all the way into the second half of the second century AD (Brindle 2016: 288). This rise yields to a certain stability in the third century AD and then a gradual decline all the way to the end of the Roman period (Brindle 2016: 288). It appears that, in comparison, the Coal Measures were more extensively settled in the Iron age and in the first century AD (Brindle 2016: 288). Consequently, there is more evidence of prior Iron Age occupation on rural settlements in the Coal Measures where there was a marked increase in dwellings and density during the late Iron Age (Brindle 2016: 288). Overall, the settlement pattern of the Central West is marked by "dispersed, enclosed, farmsteads" (Brindle 2016: 306). Villas were uncommon and nucleated settlements in the Coal Measures, and the South Pennines were mostly *vici* or closely associated with the military presence in the region (Brindle 2016: 306).

Adding to the story of rurality presented by the Rural Settlement of Roman Britain project, other new constructions marked the landscape in a different way and disrupted the way people moved about by cutting across and interrupting traditional routeways and marking the landscape. The first of these new settlement types that has to be recognized is the fort, of which three types have been recognized. Firstly, the legionary fortresses or bases were built to house the main force of a legion, or thousands of legionary soldiers and personnel (Dobson 2009: 28-29). Secondly, the auxiliary fort was a smaller military establishment, generally housing one auxiliary cohort of hundreds of men rather than thousands (Dobson 2009: 28-29). Finally, vexillation fortresses -bases designed to hold partial legionary units-, assumed an intermediate size between the larger bases and the smaller auxiliary forts (Johnson 1983: 244). It is important to note, however, that this hypothesis is still contested as the difference between a vexillation fort and an auxiliary fort is not as obvious as once thought (Dobson 2009: 28).

Traditionally, the role of these camps was described as having a self-evident controlling function over the landscape and the inhabitants. However, the conquest had already assured that level of control before the *en masse* appearance of these military establishments (Dobson 2009: 32). Also, according to ancient sources analysed by Dobson (2009: 28 and 31), the way that the Romans led a war effort was to make battle with the enemy, besiege the enemy strongholds, and gain hostages from the enemy's elite after having led a scorched earth tactic known as *Vastatio* (Caes. *BGall.*: 8, 1-2; Dobson 2009: 25). This strategy would have needed a strong concentration of forces (Dobson 2009: 25). Considering this, forts would have been used mainly as quarters between campaigns or during idle periods (Dobson 2009: 28). As noted by Dobson (2009: 31), this hypothesis seems to be confirmed by the majority of the forts in Britain and the Empire not being under constant attack by hordes of hostile natives, but rather used as living space for the troops once the area had been pacified (Dobson 2009: 31). Therefore, the units occupying the forts would depart during the summer and leave a few men to man the fort, which would not have been to ensure the efficient garrisoning of that emplacement but rather acted as a symbolic force protected through fear of a strong retaliation by the rest of the detachment or legion (Dobson 2009: 32). "[T]hey served the needs of a newly long-serving army, with newly-established auxiliary regiments in large numbers, for better provision for semi-permanent accommodation than the old winter camps. They brought no major contribution to the process of conquest and control as practised by Caesar and those before and after him" (Dobson 2009: 32).

This militaristic role of the fort, however, seems to be unfitting for the study area, as no military activities of any kind were identified south of the Humber after the 70s AD (Breeze 2011: 117). Therefore, the forts may potentially have been used in general across Britain to supervise mining activities important to the administration, to work as a military reserve, or even perhaps simply to be present in the region because of inertia from the bureaucratic administration of the Empire's military (Breeze 2011: 119-120). It is to be noted that there is little indication that Roman forces were kept in higher numbers than necessary to serve as reserves for other regions or reinforcements for the northern forts in Britain (Breeze 2011: 119-120). In the case of the study region, it is Breeze's view that the rather small fort Navio may be linked to the supervision of mining operations (Breeze 2011: 119), and it seems possible that Templeborough and Doncaster could be linked with the supervision of the transportation of these mining products or more generally of goods being transported through the area. As mentioned in chapter 1, there is robust documentation relating to the use of the Roman military to supervise and facilitate mining operations in the Empire. A variety of evidence is used by authors to show this military investment into mineral ventures. Using textual evidence, Hirt (2010: 172) notes that centurions and army engineers (*Librator*) were detached from their units to work on mines and related infrastructures in Mauretania Caesariensis, Egypt and Pontus-Bythinia, among others. These reassignments are examples of the administration's hand in the management of these operations, be it the emperors or the governors (Hirt 2010: 172). Furthermore, it appears that legionary units, as well as auxiliary cohorts and *alae,* sometimes supported similar activities in provinces, such as in Egypt or in Germania Superior (Hirt 2010: 178). However, as mentioned by Hirt (2010: 178-179), the procedures of management and dispatching of experienced people are unknown. These examples should not be construed as usual direct involvement of military personnel in mining and smelting, which was curbed by certain measures put in place by the emperors (Hirt 2010: 197). Considering these points, the primary link between the Roman army and metal extraction and production is one of protection against brigands and assisting in the execution of the decision of the local and provincial administration (Hirt 2010: 198). Furthermore, a majority of the troops stationed near mining regions and imperial quarries were accompanied by cavalry units that could escort the transport of ingots, for example, and to manage and protect regular traffic on the roads to support the flow of materials (Hirt 2010: 198). The Roman military in Britain appears to have been at the very least involved in a number of smelting operations in certain parts of the province, as seen through inscriptions, marks and stamps on ingots produced in the Pennines indicating imperial ownership (RIB II/1 2402. 39-64, Hirt 2010: 101), at least at the earliest date of the extractive operations (Breeze 2011: 119, 131; Hirt 2010: 101, 279). Furthermore, the establishment of forts, and the chronology of occupation of these, along the road system between Navio (Brough-on-Noe) and Doncaster (see chapter 5-6 and 7), as well as the fort founded in Brough-on-Humber (Hirt 2010: 191) seems to suggest that the production of lead in the Peak District did benefit of such protection by the Roman army contingents garrisoning the region (Hirt 2010: 191-192). It is, however, to be noted that the military occupation of the study area was not at all overwhelming. Three military sites are present during the peak of occupation of South Yorkshire during the Roman period, i.e. the second century AD. These are Templeborough/*Morbium*, *Danum* (Doncaster), and *Navio* (Brough-on-Noe). Considering the quartering function of forts as mentioned above in this chapter (Dobson 2009: 29), the size of these military establishments, and the discrediting of the Brigantian revolts (Breeze 2011: 118), it is unlikely that these forts were there to provide a significant military presence in the region but rather should be seen as quarters for patrolling forces in the region ensuring security for merchandise and people along the road network. This seems to be also supported by the location of these military establishments at major crossroads for Templeborough and Doncaster and near lead rakes and a road coming out of the highlands and going to the major north-south axes.

These military establishments would have become an important focus for material and for food consumption since the army would have had greater needs and buying power in general than most long-established settlements (Bidwell 2017: 303). In the case of iron and copper alloys, the evidence suggests that the army and even individual units would have far greater needs for these metals and their products than other settlement types (Hirt 2010: 358). Using the fort of Oberaden on the River Lippe in Germany as an example, several tons of nails were recovered from the buildings, which represent a significant quantity of material (Hirt 2010: 358). This infrastructural need for metal would add to the need for maintenance for the gear and tools of the soldiers and of the followers. Indeed, the establishment of garrisons on the Rhine saw an increased demand for this material category, and it seems likely that this demand was met through importations from other regions such as Gaul (Hirt 2010: 358-359). Hirt suggests that this was potentially happening in other regions of the Roman Empire (Hirt 2010: 359). This resulted, in many cases, in the formation of a settlement attached to the fort which would house people linked to the fort, such as soldiers and families, if these did not also live within the fort (Carroll 2018: 151; see also Allison 2006, 2008, 2011). These settlements also housed others who came to this location to profit from the market opportunity and the security offered by the military establishment (Sommer 2006: 117-118). In the study area, examples of such attached settlements are present in all the excavated forts in usage for more than a generation in the region, meaning Templeborough, Doncaster, and probably Navio.

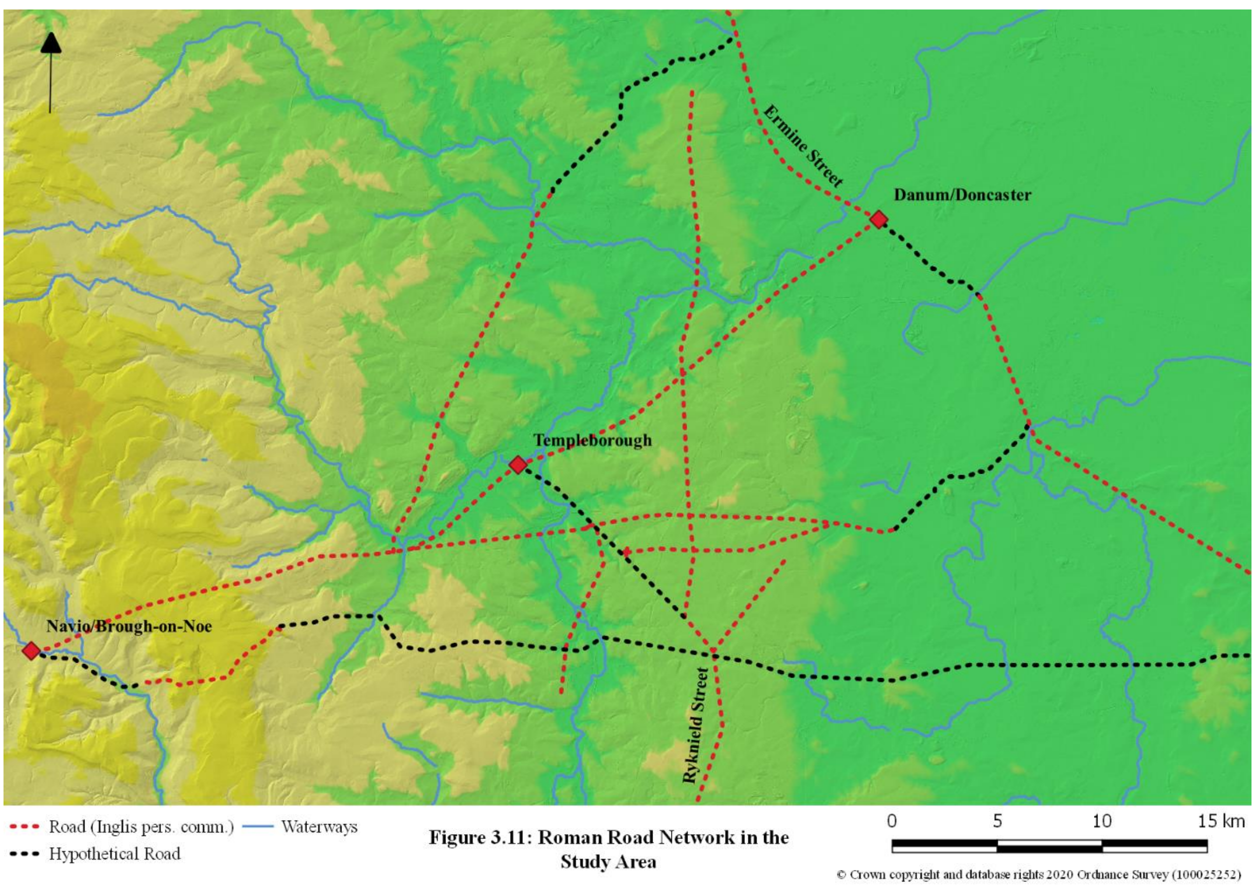


Figure 3.11: Roman Road Network in the Study Area

Finally, the building of roads in the area has to be recognized as the most impactful influence of the Roman conquest on the landscape and on the lives of the local inhabitants (Figure 3.11; Chadwick 2008: 44-53). Roads were constructed linking major Roman sites or important locations within the research area, between Doncaster, Templeborough and probably fort Navio (Chadwick 2008: 44-53.; see also Greene 1957; Greene and Preston 1951; Greene and Wakelin 1950; Margary 1973). The latter segment joining Navio and Templeborough is still contentious, and its exact location through Sheffield is unknown. The recent discovery of a potential road through Sheephill Farm by David Inglis and the University of Sheffield might begin to clarify this specific segment (D. Inglis pers. comm.). Ermine Street and Ryknield Street, two major roads going north-south, are also present in the area and were described by Margary (1973) and numbered 28a and 18e respectively (Chadwick 2008: 44-53.; see also Greene 1957; Greene and Preston 1951; Greene and Wakelin 1950; Margary 1973). The first one passes through Doncaster between Lincoln and Castleford, on its way north towards Hadrian's Wall (Margary 1973: 28a). The second is usually associated with the first advances of Roman troops in the region in the 50s AD; its actual path has long been contentious, with two possible paths listed in Margary (1973). The recent re-examination of the two paths by Inglis (Haken 2021) suggests that the road 18e would "select just about the most awkward and difficult method of traversing the hills, and in total distance is actually slightly further than the less direct route of 18ee" (Haken 2021). This revaluated path for Ryknield street was retained and is presented on all maps rather than the 18e path. Other roads were built in various directions south of that main segment between Doncaster and Navio; these probably linked major settlements together and to the forts and major roadways in the sector (Chadwick 2008: 44-53.; see also Greene 1957; Greene and Preston 1951; Greene and Wakelin 1950; Margary 1973). The red roads in figure 3.11 are ones that have been located archaeologically in past scholarships and compiled by David Inglis (pers. comm.), while the black lines are potential road extents that were hypothesised through the creation of least-cost paths by David Inglis and the author. More detailed descriptions of these latter roads will be given in chapter 5. Furthermore, it is important to note that trackways and drove-ways that were in use during the pre-Roman Iron Age were probably still in use and were perhaps preferred by the natives to move around rather than the newly built Roman roads (Chadwick 2008: 53).

The road network provided economic opportunities and was, therefore, a significant source of economic generation (Fulford 2017: 361). In this mainly rural economy (Allen *et al.* 2017: 235), towns were not that significant as markets but rather depended on and consumed from the countryside for their needs (Fulford 2017: 362). This draws our attention to the importance of the road system and to the movement of goods, livestock and people facilitated by its presence in the landscape (Fulford 2017: 361-362).

As mentioned previously, the significant expansion of the corpus of data through developer-funded projects revised our understanding of rural Roman Britain. The combined evidence provided by these sources in the form of excavated sites, field systems, finds distribution and other features reveal that the province was wholly settled and that there are few truly unoccupied areas. The few instances where areas are sparsely occupied or unoccupied are in poor agricultural regions and uplands (Fulford and Smith 2016: 390). All regions defined in the Rural Settlement of Roman Britain are dominated by farmsteads (65 per cent to 82 per cent of all settlements depending on region) (Fulford and Smith 2016: 390). Other types of settlements vary through regions in importance, with villas only being a significant proportion in the Central Belt, for example (Fulford and Smith 2016: 390). Nucleated settlements are present in all regions, but those in the North and West are almost solely military *vici* (Fulford and Smith 2016: 392). This is significant since military *vici* are fundamentally different to other nucleated settlements such as roadside settlements and villages as they are intrinsically tied to their fort. They are focused inward socially and economically towards the support of soldiers, dependants and associated military infrastructure (Fulford and Smith 2016: 392). This, however, does not mean that *vici* and their inhabitant had no relationships with their landscape, the other settlements in their area or with the large cross-regional networks (Fulford and Smith 2016: 392). Chronologically, it seems that there is a strong emphasis on the second century AD with a decline in rural settlements and “bubbles of wealth” in certain areas of Central and Western *Britannia* in the late third century AD (Fulford and Smith 2016: 408). As mentioned previously, the study area is split between two regions in the Rural Settlement of Roman Britain: The North-East and the Central West. The North-East was “a diverse region with a range of landscapes that fostered quite different patterns of settlements and land use” (Allen 2016: 280). Conquest here was gradual in the second half of the first century AD; settlements were “swept aside” before the establishment of roads and forts (Allen 2016: 280). Even so, the direct impact of the Roman military on the wider landscape and in general on rural settlements is not as obvious as it might be thought (Allen 2016: 280). Field systems remained unchanged in orientation and form and were maintained well into the second century AD (Allen

2016: 280). The North-East, and specifically the study area of this thesis, is in the border zone between the “arable-based communities of the Central Belt [and] the military-controlled, uplands of the north” (Allen 2016: 280). It was full of new opportunities brought by the roads, towns, and military establishments and yet retains a different character (Allen 2016: 280). As for the Central West, it is characterised mostly by dispersed, enclosed farmsteads. There is a notable difference in the Central West between either side of the Pennines (Brindle 2016: 306). This is especially relevant to this thesis as our study area is all located on the eastern side of the Pennines and contains most of the Coal Measures in the Central West. Pre-Roman and first century AD settlements have been identified on both sides, but in the Coal Measures, these are in greater numbers and show a stronger growth overall (Brindle 2016: 307). They continue into the Roman period, and there is a marked pattern of relatively rapid abandonment from the third century AD in the Coal Measures (Brindle 2016: 307). This lies in contrast to other areas in the Central West, where the abandonment pattern was more gradual (Brindle 2016: 307).

The metallurgical sites in our selected study area do not show a marked variation of rural settlement type (Figure 3.12; Table 5.1). All of them, besides the *vici* and Rossington Bridge Pumping Station,

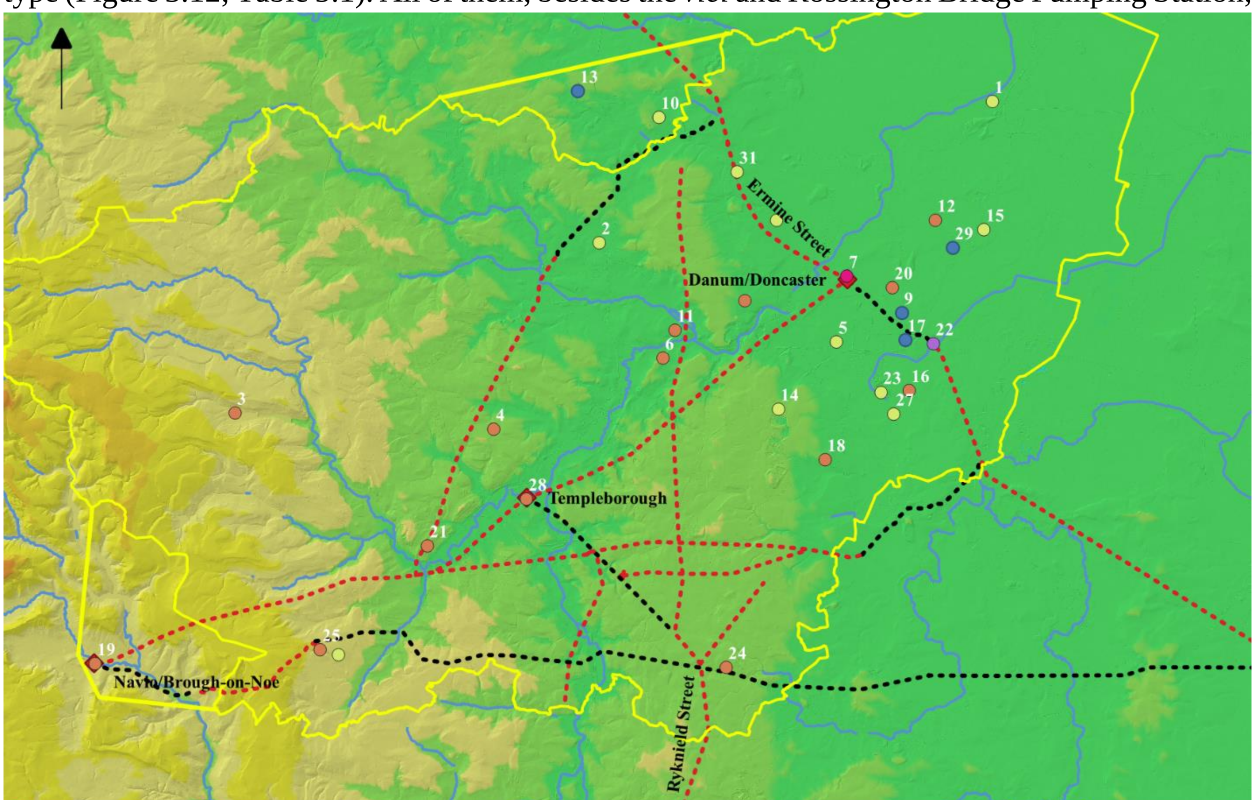


Figure 3.12: Metallurgical Sites Selected Compared to the Rural Settlement of Roman Britain Dataset.

are categorised as rural settlements, with some of them exhibiting an additional industrial character (Doncaster Pottery Production Area, Hemsworth Bypass, West Moor Park and Manor Farm (see chapter 6). Fifteen of the sites identified in the present research through the desk-based assessment were not recorded by the Rural Settlement of Roman Britain project. These are Bradfield, Scholes Coppice, Denaby Wood, Mexborough, Hatfield Lane, the hearth west of Langsett Reservoir, Loversall, Tickhill, Navio *vicus* (although this one is still uncertain), Newmarket Road, Pitsmoor, Smarson Hill, Smelting Farm, Sprotbrough and Templeborough's *vicus*. From the rural settlements that were recorded, three are complex farmsteads (Billingley Drive, Rossington Grange and West Moor Park II) and six are enclosed farmsteads (Doncaster A638 QBC, Hemsworth Bypass, Holme Hall Quarry, Manor Farm, Whirlow Hall and Redhouse Farm (Area 7)). The other sites were unclassified. Notably, the *vicus* in Templeborough was not recorded at all. Also, the Stancil Roman villa was recorded as a rural settlement, which seems suitable based on what is actually known about the site. Moreover, a different categorisation was also used in this thesis based on the size of the site and on the types of activities present (Table 5.1). Findspots (Bradfield, Denaby Wood, Loversall, Tickhill, Newmarket Road, Pitsmoor, Smelting Farm) were recorded as sites where there was no detailed reporting found, no significant evidence of domestic activity or simply no evidence of dwellings. Rural settlements (Ashfield, Billingley Drive, Carr Lodge Farm, Doncaster A638 QBC, Field Lane, Hatfield Lane, Hemsworth Bypass, Holme Hall Quarry, Huggin Lakes, Rossington Grange Farm, South Anston, Sprotbrough, Whirlow Hall Farm, Redhouse) were defined by the presence of significant agricultural and domestic activities on-site or in close proximity. When industrial activities (large craft production areas) were identified, it was selected as the primary category (Doncaster Roman Pottery Production, Manor Farm, Rossington Bridge Pumping Station, West Moor Park). Military establishments and *vici* (Templeborough, Navio and Doncaster) were recorded as military/settlement. These types were also crossed referenced with the SYAS dataset provided graciously by the organisation. When available, dating evidence on these sites indicates that the majority were occupied primarily between the second century AD and the early fourth century AD (Ashfield, Billingley Drive, Doncaster, Doncaster A638, Doncaster Pottery Production Area, Hatfield Lane, Hemsworth Bypass, Holme Hall Quarry, Huggin Lakes, Manor Farm, Navio, Redhouse Farm, Rossington Bridge Pumping Station, Templeborough, West Moor Park, Whirlow Hall Farm). These amount to 51% of the total, and when discounting sites without demonstrated dates, this goes up to 70%. These dates and site types are in line with the evidence gathered from the Rural Settlement of Roman Britain project for the North-east and the Central West.

Finally, an additional source of data that can add insight into these issues of growth, materials, and indeed to our understanding of settlement patterns is the Portable Antiquity Scheme, where metal detecting finds along with other individual material finds not coming from large scale excavations are recorded. The primary interest of using this dataset is its wide geographical distribution. This allows cross-regional comparison as well as potentially identifying new archaeological sites (Brindle 2014: 126). These comparisons have the potential to refine and broaden our understanding of the rural settlement patterns of Roman Britain (Brindle 2014: 129). Brindle's evaluation of the Portable Antiquity Scheme noted that this dataset should be treated with caution, as he himself recognised (Brindle 2014: 126) since his results are extrapolated from a limited number of case studies and that there is a clear and important variation of dataset size and details between regions and even within (Brindle 2014: 126). Indeed, there is a clear bias toward modern arable lands where metal detecting is facing fewer constraints (Brindle 2014: 129). Furthermore, Portable Antiquity Data faces the significant issue of a lack of control over resources and data that goes through a long process before being available (Brindle 2014: 129). The examination of the data presented in the Portable Antiquity Scheme confirms the settlement density shown by the SYAS and the RSRB databases (Figure 3.13). The Portable Antiquity Scheme can be useful for modern archaeological research, but it remains of limited use for this thesis as it does not contain any metallurgical debris or amorphous fragments of metals.

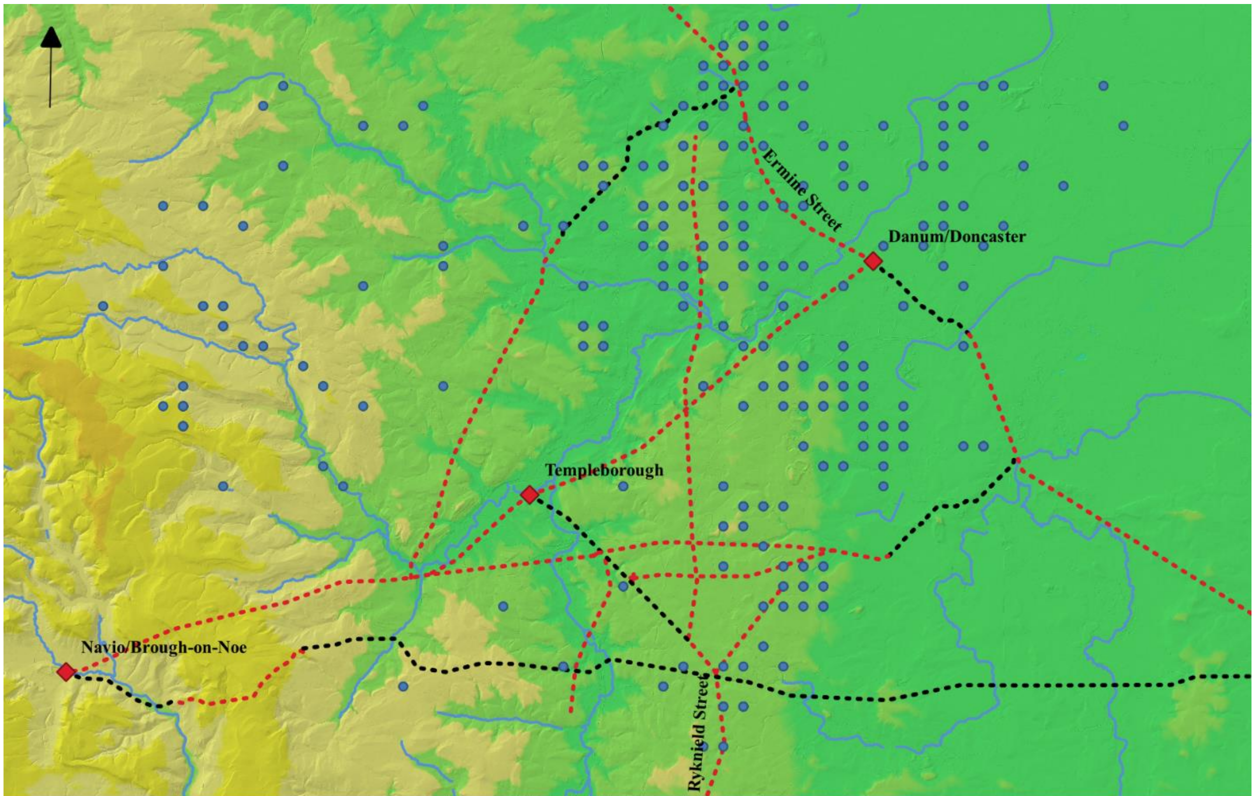


Figure 3.13: Distribution of Findspots Linked to the Roman Period From the Portable Antiquity Scheme. (Potable Antiquity Scheme 2020)

Materials.

When looking at the Romano-British world in terms of materials, a certain economic growth can be recognised. In antiquity, such growth should not be measured in terms of increased monetary circulation or individual growth, as seen in the modern world, but rather in terms of an increase in material production, exchange, and consumption (Hingley 1989: 9). This association has been noted in most regions, and it was accompanied by a certain increase in population numbers, thanks to an intensification in the production of agricultural goods (Hingley 1989: 9). This allowed for an increase in the percentage of the population being involved in activities not linked to the production of food for local consumption, such as the production of material goods and the administration of the local region (Hingley 1989: 9). This idea of economic growth and population growth has recently come under scrutiny. Within the study area, it appears that most artefacts traditionally associated with a Roman lifestyle were brought in with the Roman military and first appeared in Roman-type settlements once these were established (Chadwick 2008: 363). In most cases, "Roman-style" material culture was not recovered in rural enclosures until shortly before the middle of the second century AD, but it was more common on sites during the second half of the second and the third centuries AD (Chadwick 2008: 363). Notable exceptions in South Yorkshire are Scabba Wood and Rossington Bridge, where pre-Claudian Roman artefacts (ceramics and coins) were recovered (Buckland *et al.* 2002: 19; Lloyd Morgan 2001: 16; O'Connor 2001: 91). It is important to note that these types of materials were not found everywhere, but rather at a limited number of settlements (Chadwick 2008: 363). Furthermore, it would seem that in the North and North-East regions (Figure 3.10) of the Rural Settlement of Roman Britain project, this independence from food production might be more complex than it seems. The significant presence of the Roman army in these regions might have impaired local developments (Bidwell 2017: 303). The actual size of the military population within the region is difficult to estimate, but it has been suggested by Bidwell (2017: 304) that it would represent a quarter to a third of the total population in the North and North-East. The military had needs in consumable and resources that were far larger than any potential surpluses produced locally (Bidwell 2017: 303), and these needs would fluctuate suddenly and unexpectedly with relocation, reinforcement, reassignment, and in general, the movement of troops within a between regions (Bidwell 2017: 304). This access to these desired items was provided through what became an "unwritten contract between the soldiers and the state" through importations, purchases, and requisitions (Bidwell 2017: 303). It is hypothesised by Bidwell (2017: 303-304) that the sophistication of this supply system, as well as the potential interest of the people involved in this system, might have precluded or impeded the development of local agriculture infrastructures and of local industrial ventures. Consideration of this system of consumption and supply is critical to understanding the economy and its growth in the North, North-East and indeed in at least the eastern part of our study area (Bidwell 2017: 303-304). Therefore, it seems important to relativise this idea of generalised economic growth and consider deep regional variations.

Ceramics

Even though this thesis is concerned with metal production, crafts rarely operate in isolation (Costin 2001: 312). In the study area, most secondary production happened on sites in association with agricultural activities. However, Roman South Yorkshire saw the establishment of a significant pottery production industry was also often associated with secondary and primary production of iron. During the early period of the Roman presence in South Yorkshire, ceramic production was still small-scale, and potters concentrated on local forms of coarse wares (Chadwick 2008: 345). In addition, ceramic products were made in workshops found in association with newly built forts such as Templeborough (Chadwick 2008: 345; Swan 2002: 35). Interestingly, it appears that these locally produced wares did not make their way onto rural settlements occupied by the native population (Chadwick 2008: 347).

Adding to this, during the first half of the second century AD, pottery kilns were constructed south and east of the fort at Doncaster, in Bessacar, Cantley, Rose Hill, Blaxton, Branton, and Rossington Bridge (Figure 3.14-3.15; Buckland 1976; Buckland and Dolby 1980; Buckland, Hartley and Rigby 2001; Chadwick 2008: 347; Cregeen 1956, 1957; Gilmour 1954, 1955, 1956). The majority of these kilns were in operation from approximately the second quarter of the second century AD until production declined and then ended in the third century AD (Chadwick 2008: 350). Near the end of the life of the kilns in Cantley, potters there reoriented their production towards local forms, perhaps indicating that they aimed at selling their products on the local markets, rather than sending their wares to bigger markets to the north (Chadwick 2008: 350). Interestingly, although there are some exceptions, the majority of the pottery kilns were not discovered at settlement sites but rather in industrial contexts where living quarters could not be recognised (Chadwick 2008: 351). However, it is important to mention that the early excavations were of rather poor quality (Chadwick 2008: 351).

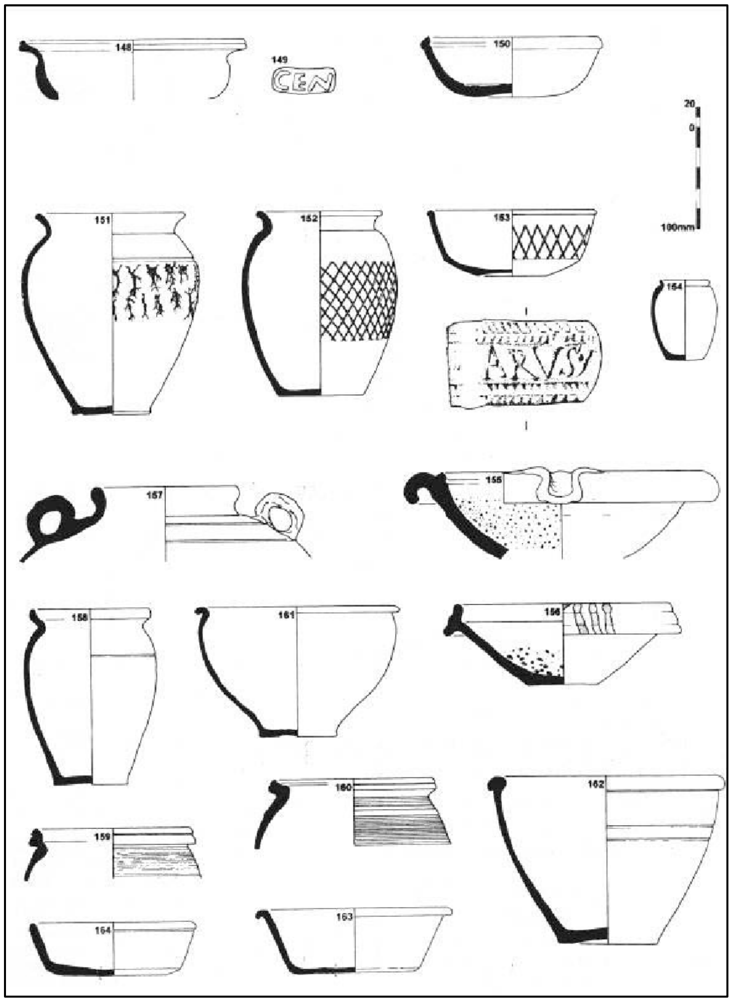


Figure 3.14: Doncaster Area Ceramic Products (Swan 2002: 54).

After the decline of ceramic production in the area, it appears that the products from Crambeck and East Yorkshire might have taken over the markets (Chadwick 2008: 364). This adoption of Roman pottery types in the later stages of the second century and the third century AD could indicate certain changes in the preparation and consumption of food at a local level (Chadwick 2008: 372). This, however, should not be seen simply as an adoption of foreign practices but rather as a complex process that involved the adoption of certain forms for certain purposes and the survival of older practices (Chadwick 2008: 372).

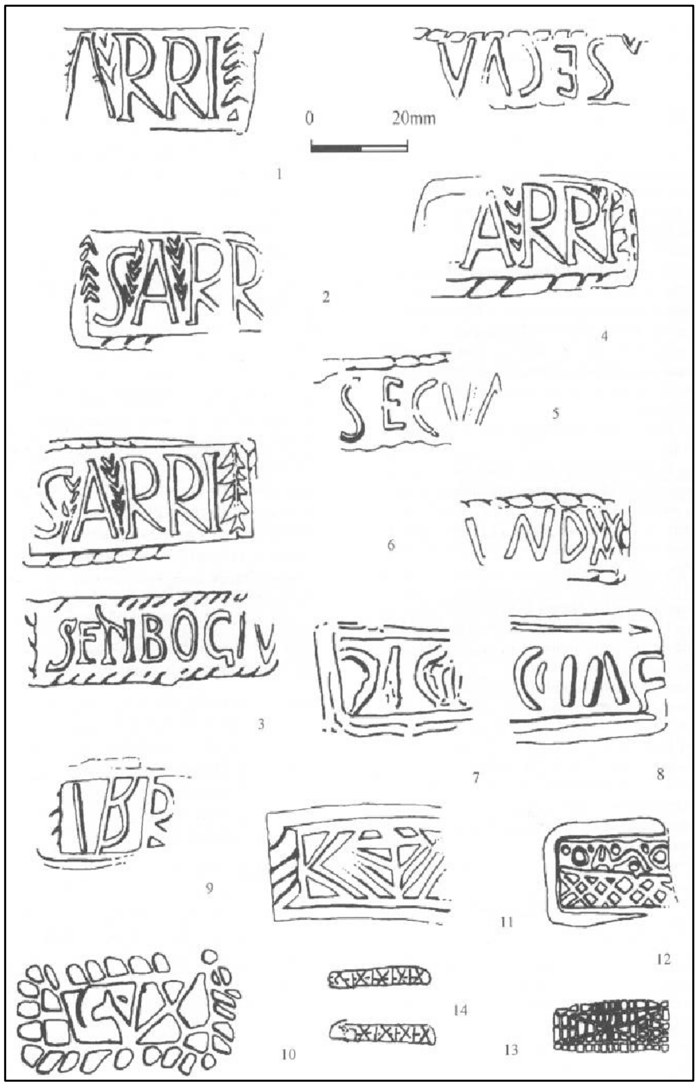


Figure 3.15: Doncaster Potteries Production Stamps (Buckland, Hartley and Rigby 2001: 40)

Metals

The use of metal artefacts also changed to some degree with the arrival of the Roman military. There is a marked augmentation in the number of brooches (Figure 3.16), coins and, generally, of objects made of metal in the region (Chadwick 2008: 373; Portable Antiquity Scheme 2021). It appears that a large proportion of rural enclosures, which are the most common settlement type in the region, showed continuity in form and in material from the Late Iron Age to the Roman period. This is particularly pertinent to this research when considering metal artefacts. The production of the metal needed for these artefacts and the actual formation of the objects is explored later as the central subject of this thesis (see Chapter 2-7-8).

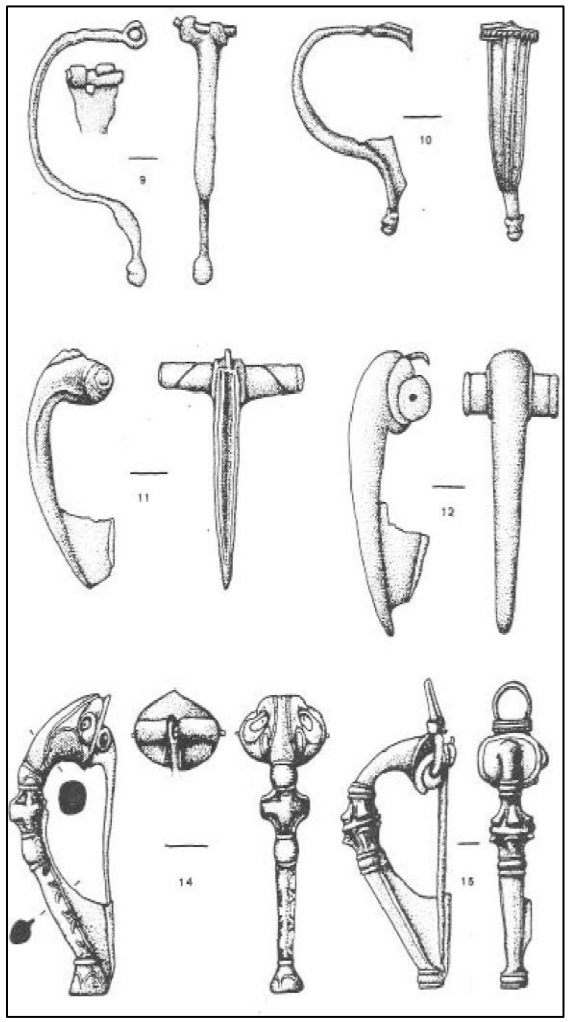


Figure 3.16: Roman Period Brooch Style recovered in South Yorkshire (Dearne and Parsons 1997: 47).

Finally, the Portable Antiquities Scheme (see earlier in this chapter for the strength and limitations of the PAS) was accessed to add to this narrative about Roman period material in the study area. In total, 1292 entries are recorded by PAS within the study area (Figure 3.13); this is quantified to 4996 total pieces. Copper alloy objects and coins are common and strongly concentrated along and between the roads going north-south through the area. Iron pieces have poor survivability and have not been identified in the database. Coins are dominant here in the number of entries and in general quantity (over 15000 individual coins). Brooches are also quite numerous, with 302 pieces. Also, only 30 objects made of lead or lead alloy were recorded in the scheme for the study area. These are mainly lead weights, but some figurines were also found. Ceramic vessels were also recorded within this database, but appear to mainly be vessels to store coin hoards. These statistics do seem to agree with Chadwick (2008: 345, 372-373) that was presented earlier in this part of chapter 3 and also shows a significant augmentation of material being recovered in the study area from the Iron Age, where only a total of 97 pieces for the whole region were recorded (see figure 3.9).

Romans, Non-Romans, Natives?

The process of change in the archaeological material between the pre-Roman Late Iron Age and the Romano-British period is central to gaining an understanding of what it meant to live in that region and in that time. Considering the notions of *habitus*, as well as *agency*, that were explored further in chapter 2, the impact of the newcomers on the way of life of the pre-Roman population is paramount for this analysis.

In British scholarship, the concept of Romanisation has been referred to as the "cultural process by which Britain became assimilated as a Roman Imperial province" (Chadwick 2008: 352). In the next section, I will be exploring the historical concept of Romanisation and its development over time.

Initially, Haverfield (1915), Mommsen (1909), and others presented a romantic vision of the process of acculturation as a "progressive and essentially benign civilising process, 'wrought for the betterment and happiness of the world'" (Haverfield 1915: 10). The adoption of the Roman way of life, which was seen by 19th century historians as being superior, was evidently something wished for and pursued by the inferior natives. They could cite Tacitus' *Agricola* in support of this idea, as the Roman historian said that the Roman administration encouraged the construction of Roman-type buildings and the Roman way of life through education, manners, and dress (Tac. *Agr.*: 21). However, at the end of the day, these early conceptualisations of the process of acculturation by the Roman elite saw this as an imposed process on the natives, who had little to say on the matter (Mattingly 2011: 206).

An alternative view of the process and the second school of thought proposes that the Roman way of life was simply "a "thin veneer" that covered a basically unchanged native society" (Chadwick 2008: 353). This view was especially favoured by scholars studying the north of Britain and many peripheral rural areas where material culture and local architecture was not overtly copying or referring to Italian or Gaulish models (Vinogradoff 1911). Essentially, this latter theory is centred on a trickle-down emulation where local elites would use newfound ways to express older identities. This idea has been modified through the years, but as Chadwick (2008: 354) noted, many approaches in the 1970s, 1980s and 1990s either took up the thin veneer approach directly

(Burnham 1995; Cunliffe 1995) or argued that the local elites actively took up certain aspects of Roman culture to reinforce or expand their existing social status within their social groups (Brunt 1976, and most importantly Millett 1990). Essentially, in this theory, the elites retained power and status through cooperation with and emulation of the Roman world. In the north of England, this is problematic, as noted by Millett (1990: 99) since society was not as centralised as in the southern parts of the island. Romanisation did not take a strong hold there, but rather the presence of large Roman garrisons, with the redistribution of the troops from the Antonine wall in the second half of the second century AD, undermined the emergence of civil authority amongst local elites (Millett 1990: 100-101) and because of social distribution in the region.

> "Romanisation has thus been seen not as a passive reflection of change, but rather as an active ingredient used by people to assert, project and maintain their social statuses. Furthermore, Romanisation has been seen as largely indigenous in its motivation, with emulation of Roman ways and style being first a means of obtaining or retaining social dominance, then being used to express and define it while its manifestations evolved (Millett 1990: 212)."

These approaches to social change might colour our outlook on the nature of the material evidence for Romano-British South Yorkshire. Indeed, using set characteristics to evaluate what is Romanised and what is not might be used to postulate that an area, such as the current study region where standard markers of *Romanitas* are rare, was economically stagnant or simply a backwater (Chadwick 2008: 26-27, 374; Ottaway 2013: 3-4). This is not to say that all the approaches referring to these schools of thought will lead to this directly, but simply that looking for standard sets of given characteristics will definitely change our perceptions. To remedy this last effect, more recent approaches highlighted local variations and local experiences of the impact of the arrival of the Roman culture (Mattingly 2011; Terrenato 1998).

> "[The] Roman Empire was not a monoglot or monolithic power, but socially and ethnically diverse, and power and sexuality were exercised and portrayed in many different ways throughout the Empire" (Chadwick 2008: 355).

This type of approach has crystallised around the work of David Mattingly, who emphasized the idea of identity and discrepant experiences between regions and communities (Mattingly 2011). Mattingly sees identity not only as differences between people as seen through different material cultures but also through differing behavioural patterns. It is important because identity is not only built on a local level in isolation but this creation process is entangled with the power negotiations within the Roman Empire (Mattingly 2011: 206). Central to this understanding of Romanisation is Simon James's community of soldiers (1999), which emphasizes the sense of identity that was created within individual units of the Roman Army, which often came from far away regions, and in the army as a whole through the profession of soldier (James 1999: 24). This community would have as much influence in the modification of local behaviours and local material culture as any other institution or groups (James 1999: 24). All in all, Mattingly concludes his British case study with the observation that:

> "It should be apparent already that the definition of broad communities with some shared elements of material culture and social practice also throws up quite a lot of evidence of further variation within the major groups." (Mattingly 2011: 236)

Concluding Thoughts on "Romanisation" and acculturation.

Romanisation as a concept is now unpopular. The use of this term has been evaluated as restrictive and perhaps even pervasive. Most scholars have stopped using the term, instead focussing on others, such as creolisation, which are thought to be more useful to meaningfully account for the partial or complete acculturation of pre-Roman populations. The argument could be made that this focus on the concept of Romanisation is actually pointless. Indeed, if the experience of people at a local level is what defines how and to what extent the Roman way of life is adopted, syncretized, or rejected, and it is the opinion shared in this thesis, then broad syntheses are of questionable value unless they are directly rooted in the local level, where people live, act, and go about their daily lives (see chapter 2 on Agency and Habitus).

However, rejection of the term Romanisation does not really deal with the concept itself as much as it attacks what it entails (Inglebert 2005: 432). Indeed, most of the aspects brought out by discussion Romanisation are still contained, to various degrees, in recent scholarship. Thinking that there is a single definition of *Romanitas* seems to be an error in much the same way as thinking that a set of cultural aspects or material presences define an entire population (Inglebert 2005: 432).

As Hervé Inglebert (2005: 431, 448-449, 457-458) highlighted, all these aspects are important in the formation of identity, but at the same time, it does not reveal if these people on an individual level felt Roman or thought of themselves as Romans. This is not to say that material conditions cannot inform modern thought on the processes of acculturation at play in the Roman conquests, but rather that material conditions can emphasise a certain aspect of that acculturation. Indeed, it seems plausible to suggest that people could buy into certain aspects of Roman material culture, but not to the overarching narrative attached to these objects.

It stands to reason and is emphasized by the Rural Settlement of Roman Britain that forming a research around a collection of local contexts and forming detailed regional and intra-regional pictures is paramount to approach localised expressions of identity and ways of living. It seems improbable that we will ever be able to probe the past human's minds and see how they truly identified themselves; that is an interpretational level simply unattainable to modern researchers. However, focusing on local contexts and the acts and practices of past people regardless of the settlement type could be the key to substantiate this level of interpretation. Indeed, as seen in chapter 2, people build and reaffirm their identity and place in their social world through the repetition of their tasks in their daily lives. The consideration of the socio-technical systems that they are a part of might be even more beneficial than empty notions of romanisation. Overall, the process of acculturation of the population of Roman South Yorkshire does not fit traditional views on the concept of Romanisation; instead, it should be looked upon as a dialectic relationship where indigenous peoples did, eventually, adopt some elements of the material culture brought in by the Romans. These adoptions could be an outward sign of specific changes in the lifestyles of the users of material culture, especially when looking at food preparation and consumption (Chadwick 2008: 372) or this could be simply a modification of old techniques to make use of the readily available and cheap pottery available locally. Additionally, there is a clear augmentation of metal products in the study area from the pre-Roman Iron Age, as seen through the Portable Antiquity Scheme. The use of ceramics also follows this trend, where these products are more common (see above in chapter 3). Also, the pottery production established south of Doncaster, along with a general increase in the exploitation of the resources present in the study area, is significant in understanding the regional dynamics (see chapters 7-8) and an interesting marker of the impact of the Romans on the region. Furthermore, in Roman South Yorkshire, the settlement pattern seems mostly to be centred on continuity from the Iron Aage, with a generalised augmentation of the occupation of the territory and the addition of uncommon military and nucleated settlement types. Materially, there is a broad increase in finds, but some categories are still relatively under-represented in certain types of rural settlements. Generally, the impact of the Roman military on the region is not as noticeable archaeologically as older narratives suggest (Allen 2016: 280). The area retained its predominantly agricultural character even with the foundation of new types of settlements. Field systems mostly remained unchanged and were maintained. Trends identified in the settlement pattern between the late Iron Age and the Roman period continued through to the third century AD before a marked period of abandonment, especially in the Coal Measures.

These notions of continuity and change will be especially relevant when we explore the distribution and organisation of metallurgical production in the region. The next moves to discuss the methodology used to collect and analyse the dataset used in this thesis to construct a model for the organisation of the manufacture and transformation of metals in the study region.

Chapter 4: Methodology of the Research Project.

This account of methodology is split into five sections representing each type of analytical work conducted to gain the information contained in the dataset of this research. First, the desk-based assessment will be discussed, followed by the methodology and the sources used for the creation of the Geographical Information System. Further, the different methodologies used to analyse the artefact collections, as well as the individual artefacts and the work carried out in the field, will be explored.

Desk-Based Assessment.

The first step in data collection was the identification of relevant archaeological sites. These were selected according to three criteria: the presence of metallurgical production and manufacture debris, the attribution of the site to the Roman Period, and the location of these sites within the study area. To do so, different sources of documentation and sites were examined to gather as much information as possible from different groups. The information recorded included names of the sites, location, date, and the type of metallurgical processes identified there. These sources were evaluated and compared to each other to ensure that the database would be as complete as possible since all the sources would be compared together.

The original database was constructed using Microsoft Excel. It was then moved into Filemaker Pro for easy access and processing. Each individual site or consolidated groups of archaeological features was given a unique identification number, and then the information for the sites was added in each entry. This database holds the name of the site, its location, the type of site, the nature of the metallurgical activities found there, if any and finally, its date if such information is available. The site types which were recorded in the database are findspots, landscape features, military sites, nucleated settlements, rural settlements, mining sites, industrial sites (querns, slags, ceramics, etc.), villas, “religious” sites, and others. The other categories grouped sites that could not be classified within any of the other categories. The attribution of types to sites was made in reference to the size of the site and to the activities recorded there. The fact that this thesis is centred on craft production means that the production activities on each site were the primary characteristic for its classification.

The first source consulted was the South Yorkshire Sites and Monuments Record (SMR). Thanks to the work of the South Yorkshire Archaeological Services (SYAS), this SMR is now available online through the Heritage Gateway with other Historic Environment Records from other regions as a meaningful source of information for the identification of specific archaeological sites (Heritage Gateway 2019). These records were scoured for entries relating to metallurgical debris (clinker, metal artefacts, slag, industrial wastes, etc.). The search was restricted to the study area and encompassed the extent of modern South Yorkshire. The Heritage Gateway (2019) was also searched using the terms: fort, fortification, fortress, frontier defence, Vicus, industrial, craft industry site, metal worker workshop, extractive pit, ironstone workings, lead workings, charcoal production site, furnace, metal industry site, mineral extraction site, mineral product site, mining industry sites, bar iron, blank, bloom, clinker, litharge, slag, casting waste, metal working debris, offcut. Although invaluable, the South Yorkshire Sites and Monuments Record sometimes only provide snippets of information on specific sites, and although it was written by archaeologists, the actual data can sometimes be provided by someone else or by recorded from rumours or old information from the 19th or early 20th centuries. This is especially common on older records which sometimes only provide a sentence noting the presence of a site rather than a description.

Secondly, the paper archives were studied, especially the Dorothy Greene Collection of Clifton Park and Museum in Rotherham. This source is included because the first and the main unstudied assemblage examined for this research is the archive of metallurgical debris from the Roman fort of Templeborough, currently housed in the Clifton Park Museums' collection. This assemblage is significant because of the uncertain nature of the metallurgical material culture there. Indeed, the slags excavated before the 2000s had not been looked at in detail. These archives provide insight not only on the various excavations that took place at Templebrough but also on further work undertaken in the area of Rotherham and Brinsworth. Although in some cases more detailed than the SMR, these archives often present older information compiled in diary forms or old journal cut-outs. Furthermore, this information is often not compiled by archaeologists or researchers but sometimes by librarians or amateurs. This information may be helpful, but it is often anecdotal rather than scientific in nature.

Thirdly, South Yorkshire Archaeological Services graciously shared access to their database regarding Roman archaeological sites in South Yorkshire. This database details all the sites registered by SYAS in the region, the majority of which are located within the online repository of the South Yorkshire SMR (HER). Hence, only three sites were added to the database. This database was compiled by archaeologists and provided up to date information on more recent excavations. It was, however, plagued with the same problem as the SRM regarding older sites which lacked detail. Nevertheless, this paper access provided more detail for the majority of the sites where metallurgical debris was identified even though these were not always information from specialists on the actual debris but rather site details and additional context information.

Finally, a literature review on the subject was conducted, including published works on sites and archaeological features in South Yorkshire and documents from the grey literature available through the Archaeological Data Services. These books, articles and reports were used to provide more context, such as detailed site phasing, debris location and material specifics for individual sites identified through this research. Combined, this information enabled a better understanding of the phases of these sites and supported the subsequent analysis of the physical collections. As with many other regions of Britain, published reports or syntheses are rare and dated. However, this major problem was mitigated partly by the work of the people behind the Archaeological Data Service, which compiles Grey Literature reports to a single database, that can be searched by specific terms. These reports are compiled by archaeologists and specialists and provide up to date and precise details on recent excavations.

Critically, these sources need to be rigorously evaluated to understand their limitations. As previously mentioned, the main issue with all these paper resources is the reporting. A number of entries in the database reflect that these sites were known to be excavated, but these were unreported in all the previously listed sources. This problem seems to be difficult to overcome since its solution is rooted in the voluntary disclosure of thorough reports of surveys and excavations. For this research, the database compiled by SYAS was relied upon more so than the other sources.

Geographical Information Systems.

Geographical Information Systems (GIS) are “computer systems whose main purpose is to store, manipulate, analyse and present information about geographic space” (Wheatley and Gillings 2002: 8). In other words, GIS are a “spatial toolbox” (Wheatley and Gillings 2002: 8). GIS are widely used in most branches of archaeological science to inform researchers on the spatial aspects of their data and to visualize it in the landscape. They can be used to gather information on easy paths within the landscape, as well as to discover the field of view from a specific point. However, within the scope of this thesis, a GIS was built and used mainly as a visual aid and as an analytical tool to infer simple links between landscape features that were deemed significant for the project. These features included sites, roads, and geological regions. A technique to visualise the landscape was needed in the scope of this research, and a GIS was selected for its flexibility and easy integration with a Comma-separated values database. This ensured that proper visualisation of the landscape relationships within Roman South Yorkshire was achieved. The geographical data used to produce the GIS for this thesis was gained through a licence from the University of Sheffield for the website Edina Digimap. From there, the author acquired Ordnance Survey maps, contour data, raster data, geological maps, as well as hydrological data. The data for the display of Roman roads in the study area was obtained through the gracious generosity of David Inglis from the University of Sheffield and from the Digital Atlas of Roman and Medieval Civilisation (McCormick *et al.* 2013).

Collection Analyses.

Following the creation of a GIS and the production of a desk-based assessment identifying archaeological sites of metallurgical interest, museum stores were accessed to look directly at the evidence held in the archaeological archives. These museums include the Clifton Park and Museum in Rotherham and the Doncaster Museum and Art Gallery in Doncaster. Furthermore, access was obtained to the slag collection of Manor Farm stored by Map Archaeological Consultancy Ltd. in Malton. Permissions for access, analyses, photography, and publication were negotiated with each individual group. Once access to the collections was gained, specific categories of artefacts were looked for and selected. Specifically, research was focused on identifying and locating metallurgical debris and artefacts which could be linked to primary and secondary production of iron, lead, copper, and copper alloys.; namely: slags, pyrotechnical ceramics, metal scraps, unworked and partially worked pieces of metal, and hammerscales. Once the artefacts were assigned to a specific category, individual or grouped entries were created in the database that notes an identification number, collection reference, category, sub-categories, weight, measurements, magnetism, porosity, etc. The main artefact categories were divided into subcategories. The slags were subdivided into the following categories: smithing hearth bottoms, furnace slags, non-diagnostic slags, tap slags, furnace conglomerates, and fuel ash slags. The pyrotechnical ceramics were subcategorized as tuyères, furnace lining, furnace wall, and fragments. These categories cover primary and secondary productions. Primary production comprises the extraction of ore, the smelting of these and the final preparation of the metal created for secondary production (see chapter 2). The latter includes the transformation of metal into objects. For ferrous metallurgy, this covers smithing, while for non-ferrous metallurgy, this includes melting, alloying, pouring into moulds and annealing (see chapter 2). The volumes of debris analysed vary greatly between assemblages, from two or three pieces for a whole site to several kilograms of diagnostic and non-diagnostic pieces. This is often due to collection biases, where in older excavations especially, only a limited amount of metallurgical debris was recovered and stored. This is also due to the nature of archaeological excavations, which often cannot excavate the totality of a site due to time or budgetary constraints and can simply miss the area where the ancient slags were discarded. The recording and visual analysis of the artefact collections involved a Salter scale for weighting, a Rabone non-digital calliper for lengths measurements and a magnet to ascertain the magnetism of the samples. These analysis criteria respect the methodology laid out by Bachmann (1982: 4-6) and are concordant with the vocabulary and techniques recommended by Historic England in the Guidelines for Best Practice for Archaeometallurgy (Dungworth, Bailey, and Paynter 2015). At times it was difficult to locate the metallurgical debris within the museum stores. To remedy this, the storage boxes containing artefacts from relevant sites were carefully examined for any debris.

Artefact Analyses.

Samples of artefacts were selected from sites where primary production was said to have taken place and where permission for laboratory analysis was given by the owner of the material. The samples were chosen to represent significant aspects of selected assemblages and answer further questions regarding aspects of the production of iron. Therefore, when appropriate, slags associated with smelting were prioritised as these can be cut and polished for microscopic analysis and can give details on the production techniques used by ancient craftspeople. Due to the scarcity of smelting sites, as will be explored in the following chapters, the sites where slags were selected are first and foremost chosen because of availability. Slags related to secondary production were also selected, when possible, to provide details on the practices that created them.

Microscopy.

The sampling strategy for the microstructural analysis aimed to create a manageable number of artefacts; in this case, around three or four slags representing each identified type were selected. This generally represented between 20 and 25 per cent of the chosen artefact category. This was, of course, less for non-diagnostic slags, but due to the large amount of these, it was deemed unreasonable to sample 25% of this category. The only exception to this selection was Templebrough, where analysis was conducted to ascertain if the slags were indeed created by secondary production as presumed here or if they had been created by the smelting of ore, as previously reported in the SMR.

The slags selected from the museum archives were prepared for examination using the following technique. The samples were cut using a ceramic saw and sealed in epoxy resin to keep the structure of the slag intact and to prevent small fragments from becoming detached and falling on the polishing papers. This prevented the observation surface from becoming scratched by these small pieces during polishing. Prepared samples were polished down to one-micron level polishing paper. This was first done on a rotation Buehler polisher with grit papers going from P220 to P2500. The samples were then polished with diamond paste down to one micron using a different Buehler polisher. Two different polishers were used to prevent cross-contamination between the two and ensure a smooth sample surface. The samples were cleaned with a non-ionized cleaning product in an ultrasound bath between each stage of grinding and polishing and at the end of the processes to ensure that all loose grains were removed from the surface of the slag piece.

Prepared samples were then assessed under a binocular microscope using reflective light microscopy. The favoured lens was 20x because of the detail of the microstructure it revealed, but the 10x and 5x lenses were also used to assess a larger area and identify trends in oxides and minerals. The analysis recorded visible evidence of the main phases of the slags. These were usually iron oxides, either in the form of magnetite (Fe_2O_3) or wüstite (FeO), fayalite (Fe_2SiO_4), and calcium oxides (CaO) (Bachmann 1982: 14-15). The form, size, and location of the iron oxides in the sample were recorded in pictures and in notes (i.e. dendritic wüstite, isolated magnetite, large wüstite clustered in a specific area of the sample, etc.) (Bachmann 1982: 14-15). The form and location of the fayalite phase were recorded to determine if it was lath-like or equiaxed in shape (Bachmann 1982: 14-15). The samples were also looked at to ascertain the presence or absence of metal prills. The samples were then placed in safe storage within the Department of Archaeology at the University of Sheffield or returned to the museum or service from where they were borrowed depending on the arrangements agreed with the administration of these groups.

Chemical Analysis

Thanks to the non-destructive nature of the instrument, a hand-held portable X-ray fluorescence (HHpXRF) analyser was used to determine the chemical signature of selected slags and, at the same time, determine the type of alloys that were employed to produce artefacts. Compositional results were used qualitatively. The XRF is well suited for this kind of analysis as it can be used on solid samples (Price and Burton 2011: 86). Furthermore, this instrument was selected because of its portability which meant that it could be brought directly to the artefact and be used there. The HHpXRF instruments used in this study, both Niton XL3t analysers, rely on miniaturised X-ray tubes rather than radioactive isotopes and could easily be taken into the various museums and locations where material was stored. The use of HHpXRF in archaeology is nowadays accepted, but the technology is still under development and still is not as commonly used in the archaeological communities when compared to laboratory-based analysers, such as laser ablation-inductively coupled plasma-mass spectrometer (LA-ICP-MS) (Nolan, Hill, and Seeman 2017: 1). However, these devices stand out in the field of chemical analysis for three main reasons. First of all, they are highly mobile, being small and easy to carry over large distances as well as in the field for analysis. This mobility gives immediate results to the researchers and can be used to inform excavation practices and strategies (Frahm and Doonan 2013: 1433). Secondly, they are precise. Indeed, as demonstrated by Thompson (2019: 178-180), the HHpXRF can achieve a percentage of error on major metal elements of 1% and less consistently. Thirdly, the use of HHpXRF is non-destructive and non-intrusive on the artefact; however, it only analyses the first few millimetres of a sample (Dussubieux and Walder 2015: 170). Furthermore, multiple readings can be taken on a sample and can also be re-analysed. However, this last positive point hides the main drawback to the use of an HHpXRF: it only analyses the first few millimetres (Dussubieux and Walder 2015: 170). This means that when a material is markedly heterogeneous, like a piece of slag, the chemical composition will vary between readings. Furthermore, analysing the first few millimetres of a sample cannot reflect the inner composition of such samples. Therefore, the compositional results for slags should be regarded as qualitative rather than quantitative, meaning that the actual quantity of specific elements should not be taken as absolute quantity (Roger Doonan pers. comm.). Furthermore, even in relatively homogenous pieces, such as copper and its alloys as well as lead, the surface analysis can be a problem, as materials may suffer from corrosion, surface enrichment and other effects. These would give a false idea of the chemical composition of the sample. Hence, to achieve a suitable degree of accuracy, the recommendation of analysing each sample on multiple points and then averaging the results (Pollard *et al.*: 310; Thompson 2019: 180) was followed.

In the research presented here, metal traces were analysed for in the slags and the metallurgical debris (spills, fragments, crucibles, furnace debris) (Cu, Fe, Zn, Sn, Pb) (Dussubieux *et al.* 2008, 645; see also Hancock *et al.*1991; Hancock *et al.* 1993; Hancock *et al.* 1994; Thompson 2019). The selection of these elements supported the methodological framework of this project which aimed to identify the metals melted or produced in the furnaces where the analysed pieces were created. For the purpose of this thesis, the chemical analyses aimed at providing a picture of compositional variety of a representative selection of slags and metallurgical debris (mainly worked fragments and spills). To achieve that, as many pieces as possible were analysed in the time frame allowed by the holding institution. For slags, diagnostic pieces were prioritised, and then interesting (size, shape, traces, presence of hammerscale) non-diagnostic pieces were targeted to identify if other traces of metals were identified, which could indicate if a metallurgical process was taking place but was not shown through typological evidence. Each sample was analysed multiple times, between two and five depending on the size of the piece, to gain an average reading of the composition of the slag. This method was followed to analyse pyrotechnical ceramics (crucibles and other non-metallic debris). The analysis of metallic metallurgical debris (fragments and spills) looked at standard elements that would enable the recognition of the alloy used, copper, tin, zinc, lead, and arsenic (as seen above). This was mainly conducted on copper alloy pieces and lead pieces; the latter to ascertain the possible presence and quantity of zinc, which would indicate pewter rather than pure lead and the copper-rich examples to identify brass, bronze or gunmetal. This picture of compositional variety was then used to make conclusions on the nature of the metallurgical activities that were conducted on different sites.

Field Analyses.

Following the visual and laboratory-based analyses of selected material and sites, field walking surveys were conducted in relevant portions of the study area. Field survey locations were chosen to provide more information on sites that were recorded in the SMR but did not provide many details on the nature of the metallurgical debris recovered. In total, eight sites were surveyed. These were in Thorpe Salvin, Langsett Reservoir, Broomhead Reservoir, Sprotbrough, Tickhill (not the villa, but areas in the village), Stainforth, Shafton, Huggin lakes. After the completion of these surveys, Shafton, Thorpe Salvin and Tickhill were taken out of the project for lack of evidence.

These surveys were conducted with the help of volunteers, following a grid of 10m x 10m when possible. The surveyed areas were surveyed by finding the location of the site as listed on the South Yorkshire SMR (Heritage Gateway 2019), mapped on the GIS and then created a grid encompassing the whole field(s) or wooded area where this site was located. Permission to enter and walk these sites was gained from the landowner prior to any work being undertaken. Artefacts identified during these surveys were not collected, but the nature of the artefacts, their sizes and their picture were recorded, and the pieces were geo-located using a Garmin eTrex 32X GPS device. The sites chosen for the surveys were those where metalworking evidence was identified or recovered in previous work, but that information for the site was scarce or incomplete. No further geophysical tools were used during these surveys, but the potential of the hand-held portable X-ray fluorescence analyser to identify elements linked to metallurgical practices (Cu, Pb, Sn, Zn) in the ground, which could suggest the location of craft areas was recognized (Slater and Doonan 2012: 106-107, Carey *et al.* 2014: 10) and the machine was brought on-site to analyse the soil where there was concentrated find spots of slags or artefacts.

Summary.

This chapter detailed the methodology employed to gather meaningful data and create a database that can be used to reflect on the organisation of metal production in Roman South Yorkshire. Through the study of the grey literature, classical literature, and museum collections, artefacts were catalogued and analysed, and sites were added to the database. The next chapter will present the findings of this database, which can be found in its entirety within the appendix. Not every site will be described in great detail, but the chapter will present an overview and analysis of the metallurgical sites in the region in regard to site distribution and types.

Chapter 5: Regional Site Distribution.

Introduction

After setting the scene and describing the employed methodology in the previous chapters, this chapter will present and describe maps of the area created to highlight the distribution of the archaeological sites present in the database. This will highlight concentrations or dispersions in site distribution across the landscape. These observations will be paramount in chapters 7 and 8, where regional interpretations will be discussed. The information provided for specific sites was collected in the Desk-Based assessment, as well as in artefact analyses in museums and storage (see chapter 4) and presented in chapter 6, as well as in annexe A. The nine sites presented in chapter 6 were totally or partially analysed by the author, while the majority of the metallurgical sites (i.e. the 22 others) were identified and characterised thanks to the information contained in the grey literature or published reports. To begin with, the totality of the sites will be presented, and different types of sites will be identified, and their distribution considered. Then, metallurgical sites, that is, archaeological sites where metallurgical practices took place, will be looked at by metal groups. Firstly, sites where iron was produced and worked. Then, the same will be done with sites where non-ferrous metallurgy took place. To conclude, general observations on the distribution of the site categories recognized in the chapter will be described.

In order to make the information more manageable, the study area was divided into two zones. The first zone, which is the area containing the most archaeological sites, is defined by the two main roads established North-South: Ermine Street and Ryknield Street (see figure 5.1 to see a visualisation of these areas). It is geographically determined to the east by the former zone of marshes located east from Doncaster and to the west by the middle of the coal measures and a line going north-south from the confluence of the Don and the Rother rivers. The second area is demarcated to the east by the first zone and is bordered on the west by the Roman fort of Navio and the Hope valley. Although the sites that were directly worked on by the author will be described in chapter 6, the sites that are shown here and present metallurgical debris are described in annexe A. This was done in order to lighten the text by removing long descriptions from the main body of the thesis's text and make it more manageable. All the maps are located at the end of this chapter.

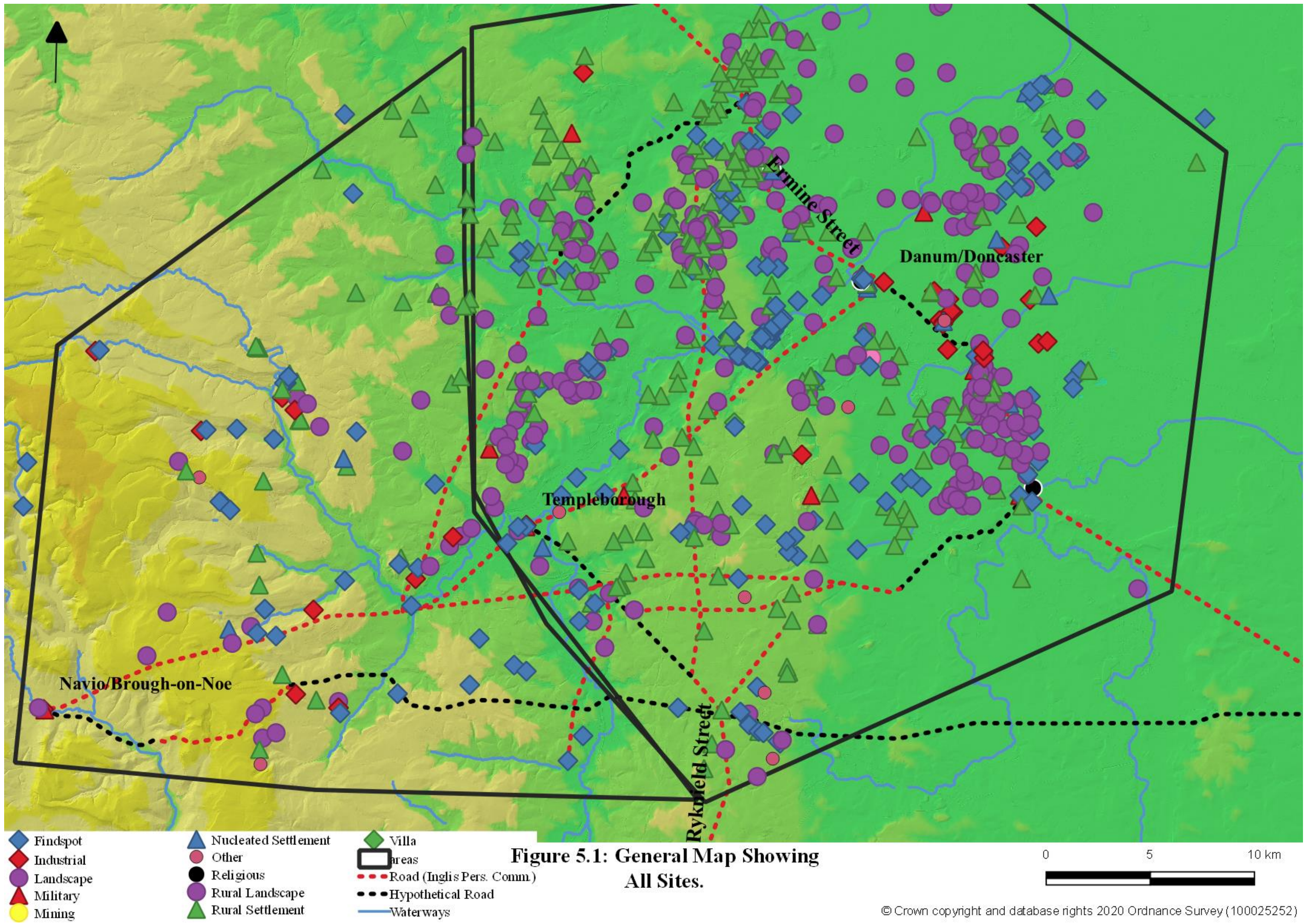
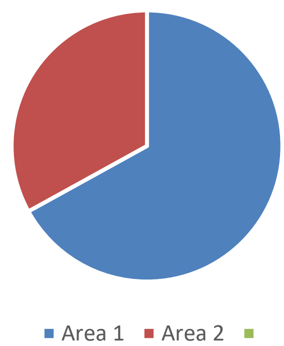


Figure 5.1: General Map Showing All Sites.

Site distribution

Overall, there are 920 archaeological features within the study region and recorded in the South Yorkshire Archaeological Services Sites and Monuments Record (Figure 5.1).

Figure 5.2: Sites per Area.



Out of this total, which also contains findspots (211) and landscape features (297), 629 are located in Area 1, and 291 are outside of this zone (Area 2) (Figure 5.2). The findspots and landscape features are not counted in the following maps and graphics. In the maps, the Roman roads are represented as dotted lines: in red are those that have been located archaeologically previously and compiled by David Inglis (pers. comm.), while the black lines are potential road extents that were hypothesised through the creation of least-cost paths by David Inglis and the author of the present thesis. It is important to note that not all missing segments of roads were treated that way but only the most meaningful ones when considering site concentrations or size of the missing area. The start and end points of these least coast paths were selected to suggest a possible road from Navio to the Humber estuary and another road potentially between Kiveton and Templeborough (David Inglis pers. comm.). In addition, three least cost path analyses were added by the author to reflect areas of site concentrations in the north of the study area, to fill in segments of Ermine Street, and to complete the east-west road between Doncaster and Brough-on-Noe through Templeborough. Furthermore, path 18ee was chosen instead of 18e for Ryknield Street (David Inglis pers. comm.; Haken 2017).

When it comes to sites where human activity would have been significantly organised, such as military establishments or settlements, 276 are located within area 1, while 136 are situated outside of it (Figure 5.3).

Within SYAS Sites and Monuments Records, thirteen records were identified as military, nine are within area 1, and four are in area 2. Twenty-two sites are identified as nucleated settlements: eighteen in area 1 and only four in area 2. All the villas and pottery industries are located in the

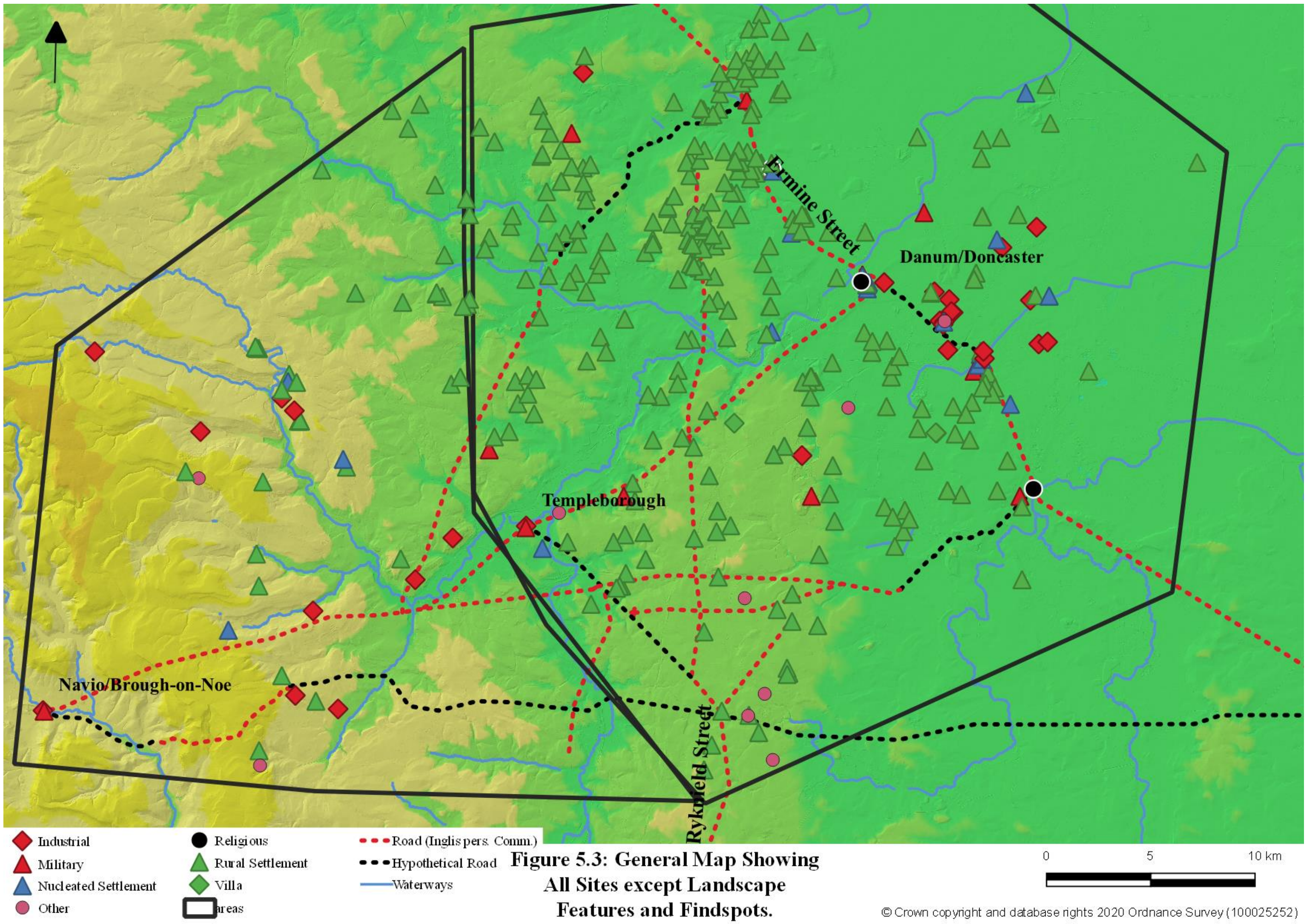
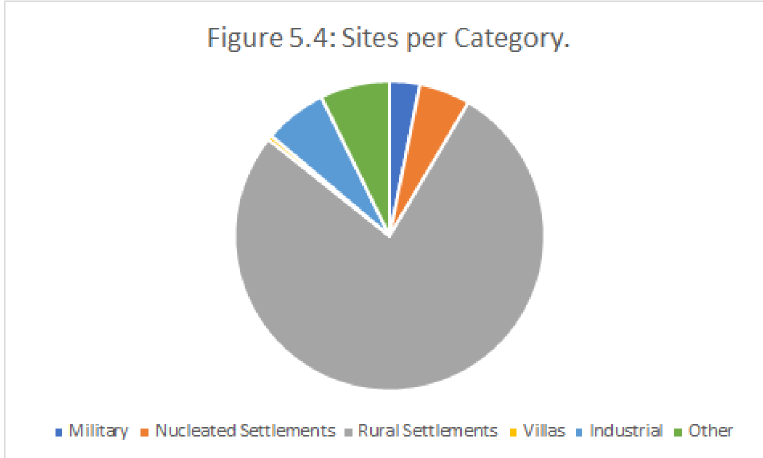


Figure 5.3: General Map Showing All Sites except Landscape Features and Findspots.

first zone. The largest category of sites is by far the rural settlements. Three hundred and nineteen sites were identified as such throughout the region. Of this impressive number, 212 are situated in area 1, while only 107 were found in area 2 (Figure 5.4). These categories were gleaned from the SYAS dataset.



The 31 metallurgical sites (Table 5.1) in the study area are mostly located in area 1, which might have been expected considering that this area was also where most sites, regardless of whether they were associated with metallurgy, were identified (Figure 5.5). For eleven of these archaeological sites, a specific metallurgical activity could not be identified either because of a lack of source material.

Mining for metallurgical minerals potentially took place in two sites that we know of in the study area. Evidence of ironstone working was discovered close to one of the villa sites in Clifton, south of the fort of Danum (00911/01). The other one was a possible lead mineral or galena extraction site to the west of the fort at Navio on the furthest edge of the study area (RIB II/1 2402. 30-60). The exact nature of both extraction sites is not yet perfectly understood. In Clifton, the excavation is not well reported in the grey literature, which impacts our understanding of the activities there. Regarding the galena extraction site, it seems probable that the site was exploited during the Roman period since lead metallurgy and potentially storage took place at the nearby site of Navio, but the evidence is scarce because of probable subsequent mining during the medieval and modern periods.

Primary production of metals from ore was recorded on six sites within the study area (Figure 5.6). Four of them can be directly associated with the process of iron production, while one, possibly in the 'civilian' settlement at Navio, can potentially be associated with the production of lead. The latter was, however, marked as lead working only because clear evidence of lead primary production was not, as of now, recovered. All the sites exhibiting primary production of iron were

Table 5.1: List of Metallurgical Sites.

ID	Site Name	RSRB Types	Site Type	Datation	Iron	Lead	Copper
1	Ashfield, Kirton Road, Stainforth	Rural settlement	Rural Settlement	2nd to 3rd-4th AD	Smithing		
2	Billingley Drive, Thurnscoe	Rural settlement	Rural Settlement	2nd to 4th AD	Smithing		
3	Bradfield	Not present in Database	Findspot	Unknown	Unknown but Present		
4	Caesar's Camp, Scholes Coppice	Not present in Database	Enclosure	3rd and 4th AD	Unknown but Present		
5	Carr Lodge Farm, Doncaster	Rural settlement	Rural Settlement	0 to 100	Smithing		Working
6	Denaby Wood, Denaby	Not present in Database	Findspot	Unknown	Unknown but Present		
7	Doncaster (Fort and Settlement)	Fort/Nucleated settlement	Military/settlement	Late 1st to 2nd and Late 2nd to 4th AD	Smithing	Working	Working
8	Doncaster A638 QBC, Scawthorpe.	Rural settlement	Rural Settlement	Late 1st to 4th AD	Smithing		
9	Doncaster Roman Pottery Production Area	Industrial Rural Settlement	Industrial	2nd to 5th	Smelting		
10	Field Lane, South Elmsall	Rural settlement	Rural Settlement	abandonned by the 2nd	Smithing		Working
11	Field system, Mexborough	Not present in Database	Rural Landscape	Unknown	Unknown but Present		
12	Hatfield Lane, Edenthorpe	Not present in Database	Rural Settlement	2nd to 3rd AD	Smithing		
13	Hemsworth Bypass	Industrial Rural Settlement	Rural Settlement	2nd and 3rd AD	Smithing		
14	Holme Hall Quarry, Stainton.	Rural settlement	Rural Settlement	2nd to 3rd AD	Smithing		
15	Huggin Lakes, Armthorpe	Rural settlement	Rural Settlement	2nd to 3rd, reoccupied 4th	Smithing		
16	Loversall	Not present in Database	Findspot	Unknown	Unknown but Present		
17	Manor Farm	Industrial Rural settlement	Industrial	Late 1st to early 3rd	Smelting		
18	Metalworking find in Tickhill	Not present in Database	Findspot	Unknown	Unknown but Present		
19	Navio Roman Fort, Brough-on-Noe	Not present in Database	Military/settlement	late 1st AD to early 2nd AD then mid 2nd to mid 4th	Smithing	Working	
20	Newmarket Road, Cantley	Not present in Database	Findspot	Unknown	Unknown but Present		
21	Pitsmoor	Not present in Database	Findspot	Unknown	Unknown but Present		
22	Rossington Bridge Pumping Station	Industrial Nucleated Settlement	Industrial	2nd to 4th AD	Smithing	Working	
23	Rossington Grange Farm	Rural settlement	Rural Settlement	4th BC to 1st AD	Smelting/Smithing		Working
24	Smarson Hill Plantation, South Anston	Not present in Database	Rural Settlement	3rd and 4th AD	Smithing		
25	Smelting Farm, Sheffield	Not present in Database	Findspot	Unknown	Unknown but Present		
26	Sprotbrough	Not present in Database	Rural Settlement	At least the 3rd	No Iron Metallurgy		Working
27	Stancil Roman Villa, Tickhill	Rural settlement	Villa	3rd AD	Unknown but Present		
28	Templeborough Fort	Not present in Database	Military/settlement	Late 1st AD to early 2nd AD then mid 2nd to 3rd	Smithing	Working	Working
29	West Moor Park I and II / Gunhills, Armthorpe.	Industrial Rural Settlement	Industrial	Late 1st to 4th AD	Smelting/Smithing		
30	Whirlow Hall Farm	Rural settlement	Rural Settlement	mid-late 1st to late 2nd	Smithing	Alloying/Working	
31	Redhouse Farm (Area 7)	Rural settlement	Rural Settlement	1st to 2nd AD	Unknown but Present		

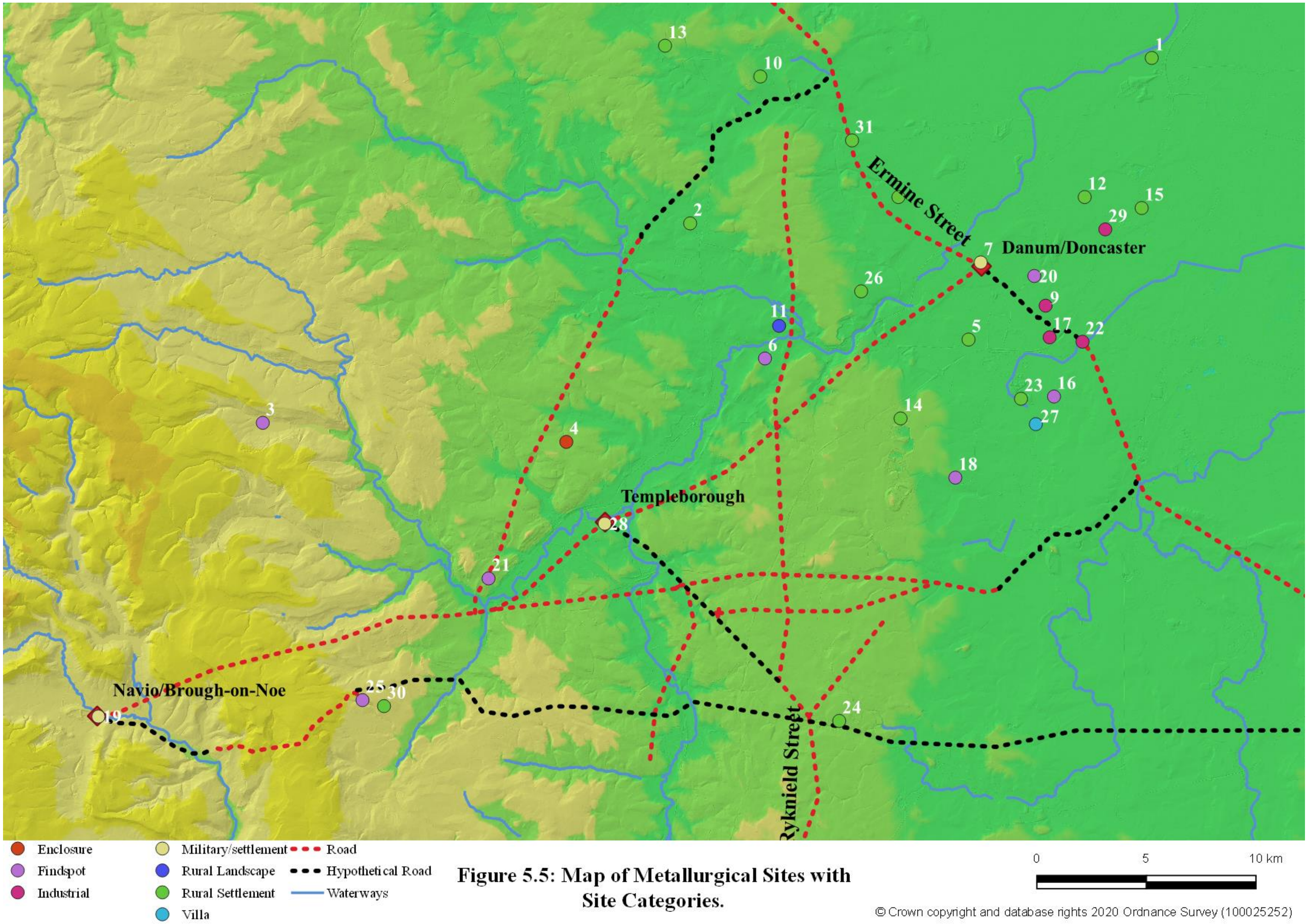


Figure 5.5: Map of Metallurgical Sites with Site Categories.

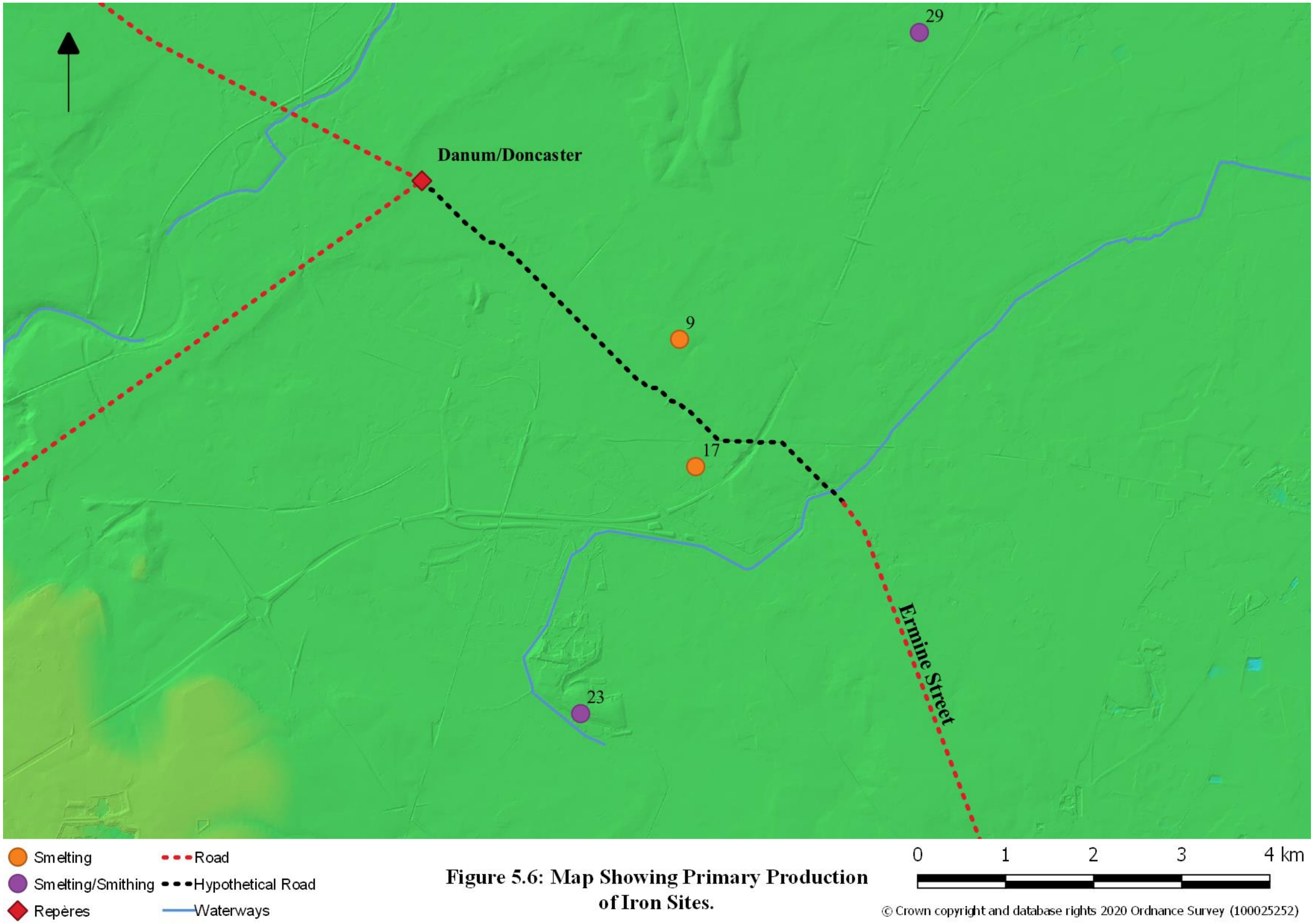


Figure 5.6: Map Showing Primary Production of Iron Sites.

located within Area 1. One of these is located in Cantley in the vicinity of the pottery production area. To the south of this production area is Manor Farm. Others can be found at West Moor Park II (Gunhills) to the northeast and on the site of the Rossington Colliery (Rossington Grange Farm) south of the latter sites. One of these four sites is situated on the east side of the fort towards the marshy lands present there in antiquity. The majority of the sites linked with the primary production of iron are not part of a settlement directly, but rather are found in specific areas in the rural landscape dedicated to agricultural activities or crafts.

As for secondary production, 17 sites were associated with iron working (15 within area 1 and two in area 2), while five can be associated with lead and six with secondary copper metallurgy (Figure 5.7). These sites were not clustered together but distributed throughout the region. Also, nine of the 17 sites where iron working was conducted were located less than one kilometre away from one of the numerous major Roman roads that were built in the study area. If one considers the sites where slags were recorded but not collected or not identified as secondary production sites, which is more probable than primary production, the number of sites in proximity to a road comes to be 16 out of 28.

As for lead metallurgy (Figure 5.8), five sites were identified in the study area. Three are located within area 1, and two are outside that zone. With regards to the secondary production of copper (Figure 5.8), six were identified in the regional database. All six of these are located in area 1, where the majority of sites from all categories are found.

The majority of metallurgical sites are located within one kilometre of a road (16 out of 31 or 52%). When excluding sites where the evidence of metallurgical activities could not be associated with a specific practice, this percentage almost stays the same with 53% (9 out of 17). This road association also stays true when considering all settlements within the study area, with 42% located within a kilometre of a road (172 out of 412). Most of the sites where metallurgy was practised near the road network presented multi-metallic assemblages (six out of nine) where more than one of these metals were worked or produced. To add to this multi-metallic nature of the assemblages, all sites exhibiting evidence of lead metallurgy also presented evidence of iron smithing. In the case of the forts and *vicus* of Templeborough and Doncaster, copper alloy working is also present in conjunction with the other two. In addition, half the sites where copper alloy secondary

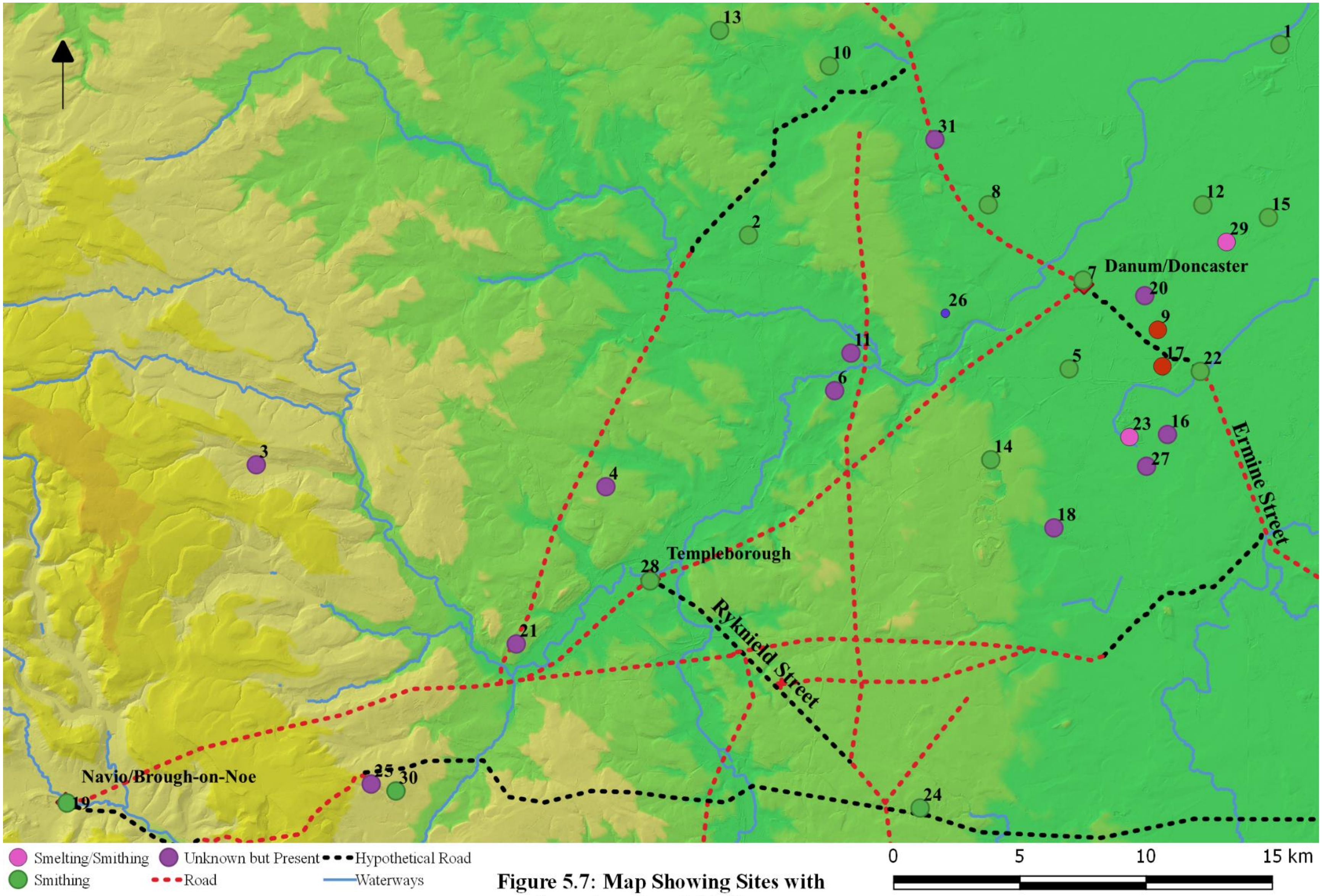


Figure 5.7: Map Showing Sites with Secondary Iron Metallurgy.

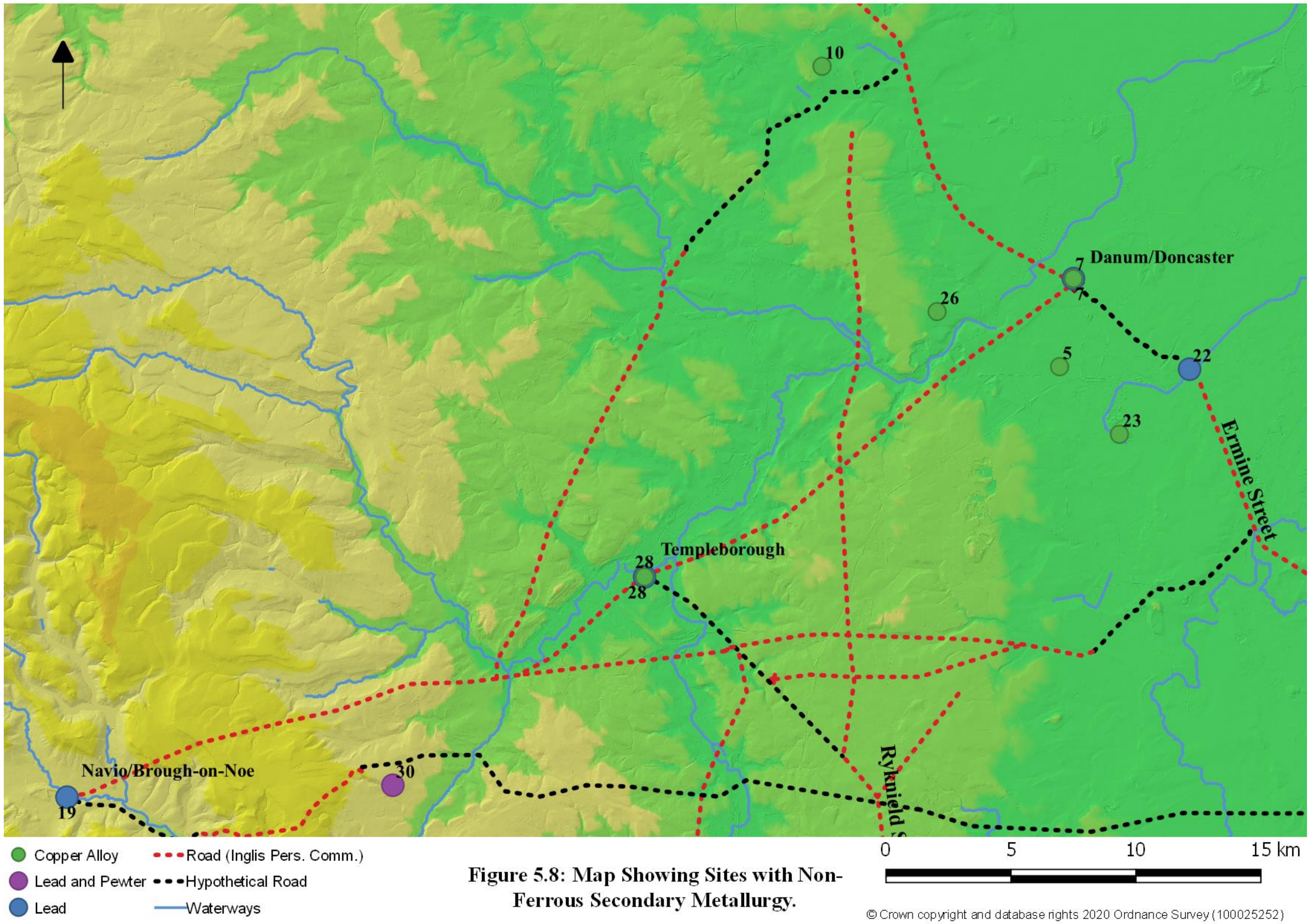


Figure 5.8: Map Showing Sites with Non-Ferrous Secondary Metallurgy.

production was present were associated with iron smithing but without lead metallurgy. Finally, in one instance, Sprotbrough Hoard, copper working alone was present.

Observations.

As seen throughout this chapter, metallurgical sites represent only a small percentage of all the sites in Roman South Yorkshire. Metallurgical practices are not confined to a specific site type and are present in all settlement types. Indeed, metals were not only worked or produced in military establishments (Templeborough, *Danum*/Doncaster and *Navio*/Brough-on-Noe) or nucleated settlements (Rossington Bridge Pumping Station and the *Vici*), but also in smaller rural settlements (Holme Hall Quarry, Huggin Lakes, Field Lane, among others), in dedicated craft spaces within the rural landscape (Manor Farm) or in association with industrial areas where pottery was produced in significant amounts (Doncaster Pottery Production Area in Cantley).

Geographically, all archaeological features are concentrated around and between the roads that lead north from the main east-west axis between Navio and Danum. To the south of Doncaster, the focus of site distribution would appear to be the pottery production area which could have played a role in the aggregation of sites in that zone. The western part of the study area does not appear to be focused on specific points.

The next chapter will provide a closer look at the archaeological sites where evidence of metallurgical practice was recovered and that the author worked on the material directly. It is to be noted that the majority of the sites presenting metallurgical debris were analysed through existing reports or Sites and Monuments Record cards and that these site descriptions are located in annexe A. The fact that the majority of the sites could only be studied through reporting means that information is uneven. Indeed, sites were investigated at various times (early 20th century AD to the last decade) and to different extents (metal detecting find, field walking surveys, limited excavations, large scale excavations, etc.). This, in many cases, impacted the precision of metallurgical interpretations (debris not collected but only mentioned, debris lost and unreported) or the dating of these activities (surface finds, partial reporting, older excavations). In all cases, efforts were made to gather as much precise information as possible and present the best possible interpretations of the metallurgical activities of Roman South Yorkshire. However, this means that, in the case of poorly reported metallurgical debris, the evidence is underplayed for safety and noted only as present. In chapter 7, these cases are thought to be representative of iron smithing as older scholarships would often report non-ferrous metallurgy as such, and most amorphous slags or debris would be discarded.

Chapter 6: Site-Specific Analyses.

Introduction

From the 31 archaeological sites where metallurgical debris were identified within South Yorkshire, assemblages from nine sites were selected (see chapter 4 for more information on the selection process) and access was secured for further investigation. These sites are discussed in detail in Annexe A, but the following summaries focus on interpretational aspects to support the discussion of the last two chapters of this thesis. To facilitate discussion and comprehension, the nine sites selected for further analysis were subdivided by site type described in the Rural Settlement of Roman Britain (RSRBp from now on). Not all of these sites were present in that database, and therefore they will be individually identified by their site type as defined in the present research. First, three nucleated settlements are described: two *vici* with associated military establishments in Doncaster and Templeborough and one other associated with pottery production in addition to metallurgy in Rossington Bridge. Templeborough was not originally in the Rural Settlement of Roman Britain, but it is clear that there was a *vicus* there in addition to the fort, and these were classified as nucleated settlements. Then, four rural settlements will be further described. Two of them, Manor Farm and the Doncaster pottery Production Area had an industrial character, the former with iron production and the latter with pottery production in addition to metallurgy. The two other rural settlements are Holme Hall Quarry and Huggin Lakes. Finally, two other sites were not identified in the RSRBp database and will be grouped together. One of these was a findspot near Broomhead water reservoir. The last one is the findspot of the Sprotbrough Hoard that was recovered near the existing scheduled site of Sprotbrough and categorised in the South Yorkshire Archaeological Service as a rural settlement (Figure 6.1).

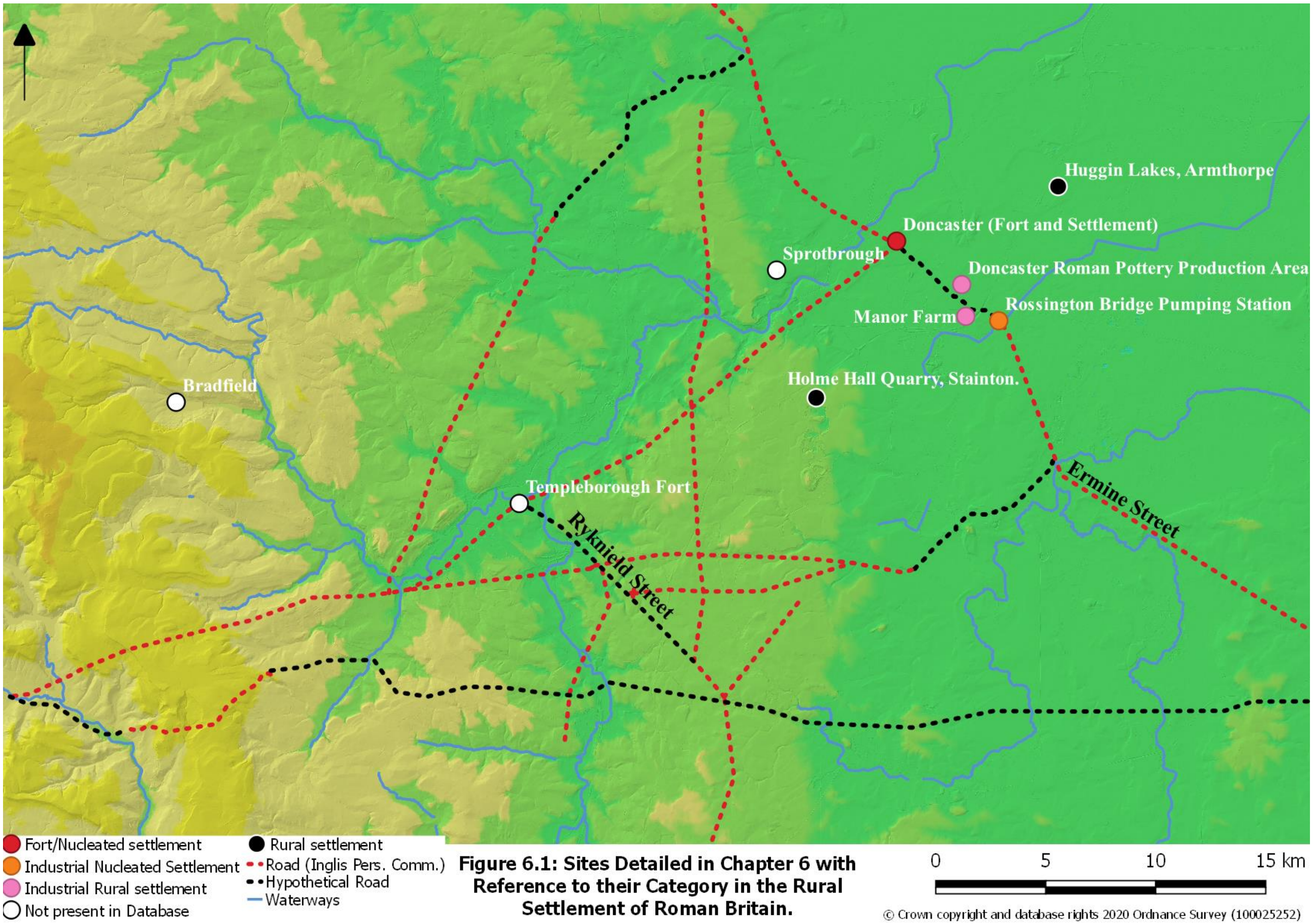


Figure 6.1: Sites Detailed in Chapter 6 with Reference to their Category in the Rural Settlement of Roman Britain.

Nucleated Settlements

Doncaster Fort and vicus

A complete evaluation of the metallurgical debris relating to the military establishment and associated settlement in Doncaster was conducted. The fort was first constructed in the late first century AD (Buckland and Magilton 1986: 12) and then abandoned in the second century AD. It was then reoccupied later in the same century until the end of the fourth century AD (Buckland and Magilton 1986: 12-13, 17). It is categorised in the RSRBp as a nucleated settlement, with the fort being disregarded by that study which focused on rural settlements. This is the same as its categorisation in the South Yorkshire Archaeological Services (SYAS) database. The site is located close to the Doncaster Pottery Production Area (Figure 6.1). It is also located at the crossroads of the Ermine Street's deviation away from the Humber estuary and the road going east-west to Navio and Templeborough (Figure 6.1). The extent of the adjunct settlement is still difficult to ascertain. The start of the occupation is also difficult to determine, but it seems that it was indeed occupied at some point in the second century AD (Buckland and Magilton 1986: 40-41). In total, 60 metallurgical slags along with pyrotechnical debris and metal fragments (6 copper alloy and 24 lead amorphous fragments) the fort and settlement in Roman Doncaster (Table 6.1). Evidence for secondary production of iron and copper alloys was expected and identified in the

Table 6.1	**Doncaster Fort**		**Doncaster *Vicus***			
	Pieces	Weight (g)	Pieces	Weight (g)	Total Pieces	Total Weight
Iron						
Fragment	2	109	3	92	5	201
NDS	0	0	46	2285	46	2285
Tap Slag	1	33	1	14	2	47
Furnace Slag	1	88	0	0	1	88
SHB	0	0	10	3173	10	3173
Copper Alloy						
Slag	0	0	0	0	0	0
Fragment	4	66	2	24	6	90
Lead						
Fragment	20	1389	3	277	23	1666
Pyrotechnical Ceramics						
Furnace Lining	1	59	7	222	8	281
Tuyères	0	0	1	51	1	51
Fragments	0	0	1	28	1	28
Crucibles	0	0	0	0	0	0
Total	29	1744	74	6166	103	7910

metallurgical debris assemblage. Quantities and weights between the fort and the *vicus* are presented in the adjoining tables (Table 6.1). These came in the form of spills and fragments of lead and copper alloys, as well as smithing hearth bottoms and hammerscales in the case of iron metallurgy. These were found in the fort and in the settlement (Table 6.1). However, the concentration of debris is scarcer in the settlement than in the fort regarding the non-ferrous metallurgy, while the iron is present in greater quantity in the settlement than in the fort (Table 6.1). The former is especially represented by 20 fragments of lead. Two tap slags were identified, one in the fort and one in the settlement collections. This, however, does not indicate that primary production was conducted to a large extent or even that smelting is certain. It could indicate that it took place in the vicinity, but the locus of this activity is not yet discovered. Microstructural analysis of a selection of slags did not provide meaningful details to add to our understanding of the iron metallurgy in Roman Doncaster. However, the chemical analysis of the slags showed significant levels of manganese (over 2000ppm in one sample), along with iron and other less significant elements, which is more often than not associated with the smelting of iron (Mackenzie 2007: 80; McDonnell 1984; 52; 1991: 25; Photo-Jones *et al*. 1998: 30). This could indicate that primary production, in fact, happened, but without further diagnostic pieces, any conclusion remains difficult to reach. These data seem to suggest that multiple metals were worked simultaneously in the fort, and the vicus and activities were not overlapping in scale with significantly more slags in the *vicus* and more lead fragments inside the fort. These conclusions seem to be further confirmed by the post-excavation report on the metalworking debris excavated behind High Street, Doncaster, by Cowgill (2008: 298) (Table 6.2). These debris were not located in the Museum Stores and, therefore, were not added to the numbers presented in Table 6.1, but only compared to it and presented in Table 6.2.

Table 6.2	**Doncaster *High Street (Cowgill 2008: 298)***	
	Pieces	Weight (g)
Iron		
Cinder	2	15
NDS	59	451
Smithing Slag Lump	13	222
Proto-hearth Bottom	7	199
SHB	136	3173
Copper Alloy		
Slag	169	5095
Mould	55	137
Lead		
Fragment	3	277
Pyrotechnical Ceramics		
Furnace Lining	1	3
Tuyères	78	1208
Fragments	26	170
Crucibles	2	14
Total	551	10964

Templeborough Fort and Vicus

Second, a new analysis of the metallurgical assemblage from the fort and associated nucleated settlement of Templeborough was conducted for the purpose of this project. Three phases were identified by May (1922) and revaluated by Davies (2016). The first one was associated with the late first century AD and the early second century AD, the second from the middle to the late second century AD (Davies 2016: 56-57). A third phase was identified by May in 1916 but has not been identified in subsequent excavation and its existence refuted by more recent work by Davies (2016: 56-57). It is located near an important crossing of the river Rother and at an important meeting of north-south (Ryknield Street) and east-west roads (Figure 6.1). Excavations there are quite dated (Leader 1877, 1878; May 1922; Dorothy Green Collection) and explain in part some of the problems in the comprehension of the site, although more recent researches were undertaken in the last two decades (NAA 2004, Chan 2006; McCoy 2008; Davies 2016). It appears that the majority of the metallurgical debris was recovered in association with the fort annexe just outside of the fortifications, where a hearth was discovered by May (1922) (Table 6.3). Only two were recovered from the vicus in 1948, but more were noted in the excavation notes in the Dorothy Green Collection (Table 6.3). It is not known to which phase these should be associated, but it seems reasonable that it might be late in the first phase or in the second phase due to its location outside of the later ditches (see Davies 2016). In total, 47 metallurgical slags were identified in the collection of Clifton Park Museum in Rotherham (Table 6.3). First, the analysis of the metallurgical debris assemblage showed no clear indication of primary production of iron, copper, or lead (Table 6.3). In fact, the situation is similar to what is seen in Doncaster with a limited number of macroscopically diagnostic pieces linked to iron smelting (only two), but the chemical analyses highlight a significant amount of manganese in a large portion of the iron slags (38 slags), which is an element often associated with iron smelting

Table 6.3	**Templeborough Fort**	
	Pieces	Weight (g)
Iron		
Fragment	181	2168
NDS	31	1430
Tap Slag	2	42
Furnace Slag	2	588
SHB	3	811
Copper Alloy		
Slag	0	0
Fragment	12	305
Lead		
Fragment	10	566
Pyrotechnical Ceramics		
Furnace Lining	8	840
Tuyères	1	51
Fragments	2	165
Crucibles and fragments	4	112
Total	256	7078

(Mackenzie 2007: 80; McDonnell 1984; 52; 1991: 25; Photo-Jones *et al.* 1998: 30). This, however, should not be taken as absolute proof of significant primary production, even though it could potentially be taking place in the vicinity of Templeborough. It is probable that a significant bias in slag collection is a main contributor to the lack of detail about this practice. Indeed, the original excavation that recovered most of the metallurgical debris dates from 1916, when slags would not have been routinely and completely collected. Second, it is evident that the main metallurgical activity is related to the secondary production of iron objects. That is demonstrated by a large amount of worked fragments of iron, smithing hearth bottoms, along with hammerscale (both plates and spheres). The microstructural analysis did not yield many details about the assemblage but indicated that there were no clear technical traditions in secondary iron working since most slags exhibited differing microstructures. Finally, the chemical analysis, along with the presence of spills and fragments of lead and copper alloys, confirmed the multi-metallic nature of the metallurgical assemblage hinted by three complete crucibles, one crucible fragment and 21 non-ferrous spills (Table 6.3) from Templeborough, including three confirmed casting ingate fragments. This multi-metallic nature is interesting as it gives a clear insight into the crafting practices of Roman military metalworkers, who, it appears, were capable of working different metals and alloys. This characteristic of the assemblage points to craftspeople who have the skillset to work a variety of metals requiring quite different techniques.

Table 6.4	**Rossington Bridge Pumping Station**	
	Pieces	Weight (g)
Iron		
Fragment	0	0
NDS	11	722
Tap Slag	1	21
Furnace Slag	0	0
SHB	7	935
Copper Alloy		
Slag	0	0
Fragment	0	0
Lead		
Fragment	4	125
Pyrotechnical Cera		
Furnace Lining	4	42
Tuyères	0	0
Fragments	2	107
Crucibles	0	0
Total	29	1952

Rossington Bridge Pumping Station

The third nucleated settlement which was further worked on for the purpose of this research is Rossington Bridge Pumping Station. Structures at the site were occupied from the second century AD to the fourth century AD, with a peak in activities (domestic and industrial) in the second half of the second century AD (Buckland, Magilton, and Dolby 1980: 146). This site was categorised in the RSRBp as an industrial and a nucleated settlement, while it is categorised as an industrial site in the SYAS database (Figure 6.1).

Metallurgical debris was identified there alongside pottery production. Nineteen iron slags were identified along with four lead fragments and four furnace lining pieces (Table 6.4). One tap slag was identified macroscopically, although this cannot be complete and unequivocal evidence of smelting. It seems, however, that most of the slags show an iron smithing nature rather than smelting. Furthermore, the amorphous lead fragments were interpreted as evidence of lead secondary production (melting and casting or moulding). Microstructurally, the slags exhibited a large quantity of magnetite, which could indicate that it was formed in the presence of an oxidising atmosphere. Two hypotheses arise from the latter observation. Either the slags were formed in the oxidising part of a shaft furnace, or they indicate the presence of a bowl furnace. Furthermore, they do not exhibit significant similitude between each other, indicating a lack of systematic cooling at the very least. Chemically, only a percentage of the slags were analysed (27% or five slags). However, the averaged chemical signatures of the slags show only trace amounts of copper, zinc, or lead. In the case of lead, this could indicate that these slags were not in contact with the lead metallurgy that took place on-site (showed through the amorphous fragments). The presence of iron metallurgy alongside lead metallurgy is significant as it points to a craftsperson who is knowledgeable in two different metallurgical processes, pointing to some form of specialised knowledge. The presence of a single smelting diagnostic slag does not indicate that smelting definitely took place at the Rossington Bridge Pumping Station. It is possible that smelting was conducted in another part of the site or that it was formed in the smithing hearth through high temperature, but this cannot be ascertained with the information available from reporting.

Table 6.5	Manor Farm	
	Pieces	Weight (g)
Iron		
Fragment	0	0
NDS	Over 123	107270
Tap Slag	24	593
Furnace Bottoms	4	29500
Non-Tapping Blocks	14	16000
Furnace Slag	77	66435
SHB	2	9000
Copper Alloy		
Slag	0	0
Fragment	0	0
Lead		
Fragment	0	0
Pyrotechnical Ceramics		
Furnace Lining	0	0
Tuyères	0	0
Fragments	0	0
Crucibles	0	0
Total	Over 273	228798

Rural Settlements

Manor Farm

This is the first rural settlement looked at in more detail, with an evaluation of the new material that was not analysed at the time by Mackenzie (2011, 2017a, 2017b) (Figure 6.1). The occupation of the site started in the late first century AD and was abandoned in the early third century AD. It is defined in the RSRBp as an industrial and rural settlement of enclosed nature. This is consistent with its industrial categorisation in the SYAS database. The slag analysed in Manor Farm all relates, at this point in the analytical process, to iron metallurgy. All the slag had already been analysed by Mackenzie (2011; 2017a), except for block four which was partially visually examined for the current research (Mackenzie 2017b; Table 6.5). In total, over 256 slags were identified between Mackenzie's work (2011; 2017a) and the count made of block 4 for this thesis (Table 6.5). Interestingly, evidence of non-tapping furnaces being used in the form of slag cakes or non-tapping blocks (14 in total at this point) were recovered from the site, as well as evidence for a tapping furnace or furnaces in the form of slag runs (24 at this point) (Mackenzie 2017a: 150). This suggests one of two things: either both smelting techniques were used concurrently on-site, or we have here an example of a long smelting tradition that changed techniques to accommodate transformations in the metallurgical demands of the region. Tapping furnaces have been interpreted as being more efficient at producing larger quantities of iron (Paynter 2007a: 209), and a conscious change of smelting technique on a smelting site could indicate a desire to keep up with a growing demand by using a technique better suited for this end. However, as recommended by Mackenzie (2017a: 151) and confirmed through the block four review for this research, further sampling and analyses were not conducted at this point in time since more excavations were planned and were expected to recover more metallurgical debris.

Holme Hall Quarry

The second rural settlement is Holme Hall Quarry, where a revaluation of the slags was conducted along with chemical and microstructural analysis for the purpose of this research to add to MacKenzie's own analysis (2007). The site was occupied in the first century AD and was abandoned by the third century AD. Both in the RSRBp and SYAS databases, it is categorised as a rural settlement (Figure 6.1). In total, 69 iron slag, iron offcuts and pieces of iron bars, part-

Table 6.6	Holme Hall Quarry	
	Pieces	Weight (g)
Smelting Slags		
Block	0	0
Furnace Slag	19	790
Smelting Slags	0	0
Tap Slags	11	450
Smithing Slags		
Hearth Bottoms	0	0
Smithing Slags	10	228
Non-Diagnostic	29	691
Non Specific Types		
Fuel Ash Slag	4	16
Total	73	2175

forged iron bloom, and recycled objects were recovered from the site (Table 6.6) (O'Neill 2007: 103-104). The metallurgical debris was analysed by MacKenzie in 2007, and he concluded that the assemblage present here was created through secondary iron production. Furthermore, he identified tap slags, but these were not deemed evidence of iron smelting based on the chemical composition of these debris which was low in manganese, an element usually thought to be indicative of smelting (Mackenzie 2007: 80; McDonnell 1984; 52; 1991: 25; Photo-Jones *et al.* 1998: 30). After studying the slags from that site present at the Doncaster Museum and Art Gallery, none of the debris could be identified as tap slags. It is to be noted, however, that not all slags were present in the stores and that some of them may have been lost, misplaced, or misidentified. Nevertheless, some did show flowing surfaces, potentially indicative of tap slags, and three of these were selected for further analysis. These slags did not suggest a uniform practice in terms of their microstructure. The chemical analysis of the slags selected from Holme Hall Quarry does seem to concur with the analysis produced by Mackenzie (2007: 73), with low levels of manganese present in the composition of the slags. Considering these results, it appears that the metallurgical activities conducted at the site were indeed linked with the maintenance and creation of iron objects rather than the smelting of ore, as had been suggested by MacKenzie (2007).

Doncaster Roman Pottery Production Area/Kilns 22-25.

Table 6.7	Doncaster Pottery Production Area	
	Pieces	Weight (g)
Iron		
Fragment	3	134
NDS	11	1018
Tap Slag	7	961
Furnace Slag	3	498
SHB	0	0
Copper Alloy		
Slag	0	0
Fragment	0	0
Lead		
Fragment	0	0
Pyrotechnical		
Furnace Linin	24	61
Tuyères	0	0
Fragments	0	0
Crucibles	0	0
Total	48	2672

Metallurgical debris were found in association with the kilns located near Doncaster in the excavations in the 1950s and reported by Cregeen (1958). The production of pottery and, in general, the site was occupied in the second half of the second century AD, with production and occupation ceasing in the second half of the fourth century AD (Buckland, Magilton, and Dolby 1980: 146). The furnace can be further dated by its association with a quern dated from the late first century to the early second century AD (Cregeen 1958: 40). In the RSRBp database, the Doncaster Pottery Production

Area is categorised as an industrial and rural settlement (Figure 6.1). In total, 25 pieces of slag were recovered alongside the remains of a furnace (Cregeen 1958: 40). Typologically, the slags indicate that iron smelting occurred rather than iron smithing (Table 6.7); it is unclear if bloom consolidation happened at all on-site. Cregeen (1958: 39-40) emphasizes that the fabric of the furnace has nothing in common with the fabrics of the Cantley kilns, but without fabric analysis, it is impossible to say if there are any similarities in inclusions type and quantity which could indicate a shared tradition regarding pyrotechnical ceramics. Tap slag represent~~s~~ more than a third of the slag assemblage recovered from this site. This indicates the smelting occurring here was done through tap furnaces. It is unknown if all the slags were recovered or if the ones stored at the Doncaster Museum and Art Gallery were only a selection collected during the excavation. Three of those tap slags were analysed microstructurally by the author for this thesis. Their similar microstructures suggest that they were produced in the same smelt or in a uniform practice. Three more samples from the same site, but associated with a different excavation feature (Trench east) were also analysed. These are, again, similar microstructurally. One of the slags had a variation in cooling rate between the exterior and the interior, which could indicate that it was rapidly cooled once out of the furnace. Chemically, these do not show significant levels of tin, zinc, copper, or lead. However, manganese, phosphorus and sulphur were present in significant amounts. In terms of chemical composition, the slags from that assemblage appeared to be similar to the first group analysed in that they exhibit significant amounts of phosphorus and manganese; the latter being usually associated with smelting (see Mackenzie 2007: 80; McDonnell 1984; 52; 1991: 25; Photo-Jones *et al.* 1998: 30). Bog iron was suggested by Cregeen as a source of ore, considering the distance from the closest known ironstone bed in Scunthorpe (Cregeen 1958: 41). This use of bog iron is probable as it is thought to have been present in the marshes located east from (P. Robinson pers. comm.; see chapter 1). Although it is probable that bog ore was used extensively, the reason given by Cregeen (1958: 41) for its use is not satisfactory. It is not because the Scunthorpe ironstone bed was far away that bog ore was considered. It is because bog iron ore was of a satisfying purity and composition for smelting using ancient furnaces (Thelemann *et al.* 2017: 479) and was present in close proximity to the site. Therefore, ancient craftspeople could have brought iron ore from the Scunthorpe bed in a seasonal trip to smelt in their seasonal smelts, or ironstone could have been collected in smaller deposits, or even, bog iron could have been used because it was favoured by the smelters as a suitable ore as we know it is (Thelemann *et al.* 2017: 479).

Huggin Lakes

Trial trenches were excavated in Huggin Lakes in 2010. The site is categorised in the RSRBP database as a rural settlement (Figure 6.1). These documented the presence of a complex of ditched enclosures occupied in the second and third centuries AD (Meadows 2010: 18). Along with domestic and agricultural activities, iron working evidence was also identified (Chapman 2010: 15). These were identified by Chapman (2010) as remains associated with iron smithing. Surveys conducted on-site did not provide additional evidence to these activities.

Other

The three following sites were not recorded in the RSRBp, and unlike the situation of the fort and *vicus* of Templeborough, it was not obvious how they should be categorised and therefore are discussed separately. All three are identified as findspots in the SYAS database.

Bradfield/Broomhead Reservoir

For the former, evidence was solely identified as notes in the SMR (03170/01 – MSY5931). It was described in the SMR as a smelting site of Roman date on the basis of slags, clinker, and a hearth (Figure 6.1). It was presumably dated by the association of the slags and the hearth with a beehive quern (03170/01 – MSY5931). After negotiations with Yorkshire water, access to the edge of the basin was gained, but not to sections where the water had retreated. Smelting slags, along with iron working ones, were identified but could not be recovered. The nature of these activities and their dating is impossible to ascertain, but these discoveries do confirm the notes presented in the Sites and Monument Record. Furthermore, the slags that were identified were consistent morphologically to bloomery slags.

Sprotbrough

Sprotbrough, where the Sprotbrough coin hoard was recovered, was surveyed by Andy Lines of SYAS in 2010 (05771 – MSY13342) (Figure 6.1). He managed to identify a number of additional earthwork features that added to the scheduled enclosure already identified there. The field survey conducted in this research did not add further information to this narrative. The site's occupation is dated from the second century AD to the third century AD (05771 – MSY13342). No evidence of iron metalworking was recovered. However, the coin maker hoard was revaluated since its last assessment dated from the 1980s (Mattingly and Dolby 1982) (Table 6.8). The pottery found in association with the hoard was dated from the early of the third century AD to the middle of the fourth century, and the circulation and formation of the imitation *antoniniani* or barbarous radiates in the second half of the third century AD seem to offer an interestingly short dating window for this metallurgical activity. One hundred fifty pieces of copper alloys were available to study in the store of the Doncaster Museum and Art Gallery (Table 6.9). These coins were made by cutting pieces off the rounded rods using a chisel (Price 1982: 32-33). These were then struck, potentially at the site, but it is unknown at this time if these were hot or cold at that point (Price 1982: 32-33). Chemical analysis was also conducted by Price (1982: 31) (Figure 6.10) using an ISI Super IIIA scanning electron microscope (Price 1982: 31). The chemical analysis showed that the blanks came from different casts of leaded bronze (Price 1982: 31) (Figure 6.10). It seems peculiar that a skilled bronze craftsperson or craftspeople would be making coins in an agricultural enclosure at this site. These metalworking skills are not usually required for the maintenance or the fabrication of agricultural tools, which were at this point an integral part of life (Sims 1998: 1). Therefore, this would suggest the presence of a specialist metalworker who might have practised his or her craft seasonally, occasionally, or permanently. Although this was probably not an official mint, these coins may have been recognised or at least accepted locally (Boon 1972; Hill 1949: 2), and there

Location	Sprotbrough	
	Quantity	Weight (g)
Cut Sections	119	134
Straight Lengths	12	80
Tubes	7	20
Globules	3	2
Round Fragments	9	8
Wire	X	10
Sheet	1	5
Blanks	13	13
Total	164	272

Table 6.9: Metallurgical Debris from Sprotbrough located in Doncaster Museum.

Location	Sprotbrough
	Pieces
Cut Sections	120
Straight Lengths	12
strip	1
Globules	4
Round Fragments	9
Wire	1
Sheet	1
Blanks	186
Total	334

Table 6.8: Metallurgical Debris from Sprotbrough. (Mattingly and Dolby 1982: 22-23)

Sample	Sn	Zn	Ag	Pb	Fe
Cast rod	3.5	0.9	1.6	0.8	0.5
Cut blank	3.9	1.2	1.5	2.2	1.0
Hammered blank	3.0	1.0	1.5	5.0	0

Figure 6.2: Chemical Composition of the Sprotbrough Hoard (Price 1982: 31)

are some indications that these coins were circulated widely during their lives, suggesting that these were recognised widely (Davies 1992: 212).

Conclusion

The additional analytical work conducted on these selected assemblages gave further details on the nature of the production techniques. The main point that seems evident from these site descriptions is that metalworkers in this area during the Roman period worked made different objects or broadly things out of different metals, with a strong focus on iron rather and copper, lead or their alloys. However, it appears that most sites exhibit different production conditions for these slags, which would suggest that there is no uniform metalworking tradition regionally. In other words, it would appear that the production is heterogenous in practice and does not represent a group of smelters using similar “protocols”, nor does it suggest any form of regional traditions. Three of those sites exhibited evidence of non-ferrous metallurgy; two of them (Doncaster Fort and Templeborough) even showed copper alloy and lead working in addition to iron metallurgy. The next chapter will collect data from chapters 5 and 6 to construct a narrative of the organisation of the metal production in Roman South Yorkshire.

Chapter 7: Metalworkers of Roman South Yorkshire.

Introduction.

This penultimate chapter explores the data gathered within the thesis and attempts to create a coherent narrative of metal production organisation in Roman South Yorkshire. It is important to note this chapter will concentrate on the available data and work from the study area focusing on the local and regional scale. Broader considerations will be explored in chapter 8. More specifically, this chapter will start with a description of when, where, and how the metals were produced or worked in the study area. This will be followed by an interpretation of the possible reasons or uses of these sites in relation to transport dynamics in the region.

Practice.

Chronology.

As mentioned in chapter 3, the dating of enclosures in Roman South Yorkshire remains difficult due to the lack of ceramics recovered on sites and the inconsistent use of absolute dating (see chapter 3; Ottaway 2013: 54 and 60). Indeed, out of the 31 sites where evidence for metallurgical activities was found, eight cannot be dated. This is in part due to factors mentioned previously (see chapter 3), along with the nature of the archaeological work conducted on some of these sites (un-intrusive surveys or metal detection). It would appear that the most intense period of metallurgical activity was in the second century AD, as most of the datable sites were occupied during that timeframe (Chapter 5-6 and Annexe A). Only eight sites were occupied during the first century AD, and two of those would be abandoned early in the second century AD. Only six sites were occupied from the second into the fourth century AD, two from the third to the fourth century AD, two from the first to the fourth, and one potentially from the second into the fifth century. Therefore, the region seems to be the most intensely occupied in the second and the third century AD. Metallurgical activities in South Yorkshire would be most intensive, according to evidence in the same period of time.

Primary Production.

When considering the production of metal, the study area is surprisingly lacking in material. Even though iron seams are present in the area and ironstone workings are recorded in the Sites and Monuments Record (see chapter 1 and chapter 5), the primary transformation of iron ore into wrought iron occurred only on a limited number of sites and to a limited extent. Excluding Manor Farm, all the sites where evidence of iron smelting was found did not produce large quantities of metallurgical slags when comparing the debris recovered to production in other major iron producing centres in the Weald, the Forest of Dean, and the Jurassic Ridge (see chapter 1, 6 and annexe A). In the latter three areas, slags were recovered in large quantity throughout the landscape and on multiple sites, indicating large scale iron production (see chapter 1). In Roman South Yorkshire, most of the sites exhibited only a limited amount of metallurgical debris, seemingly

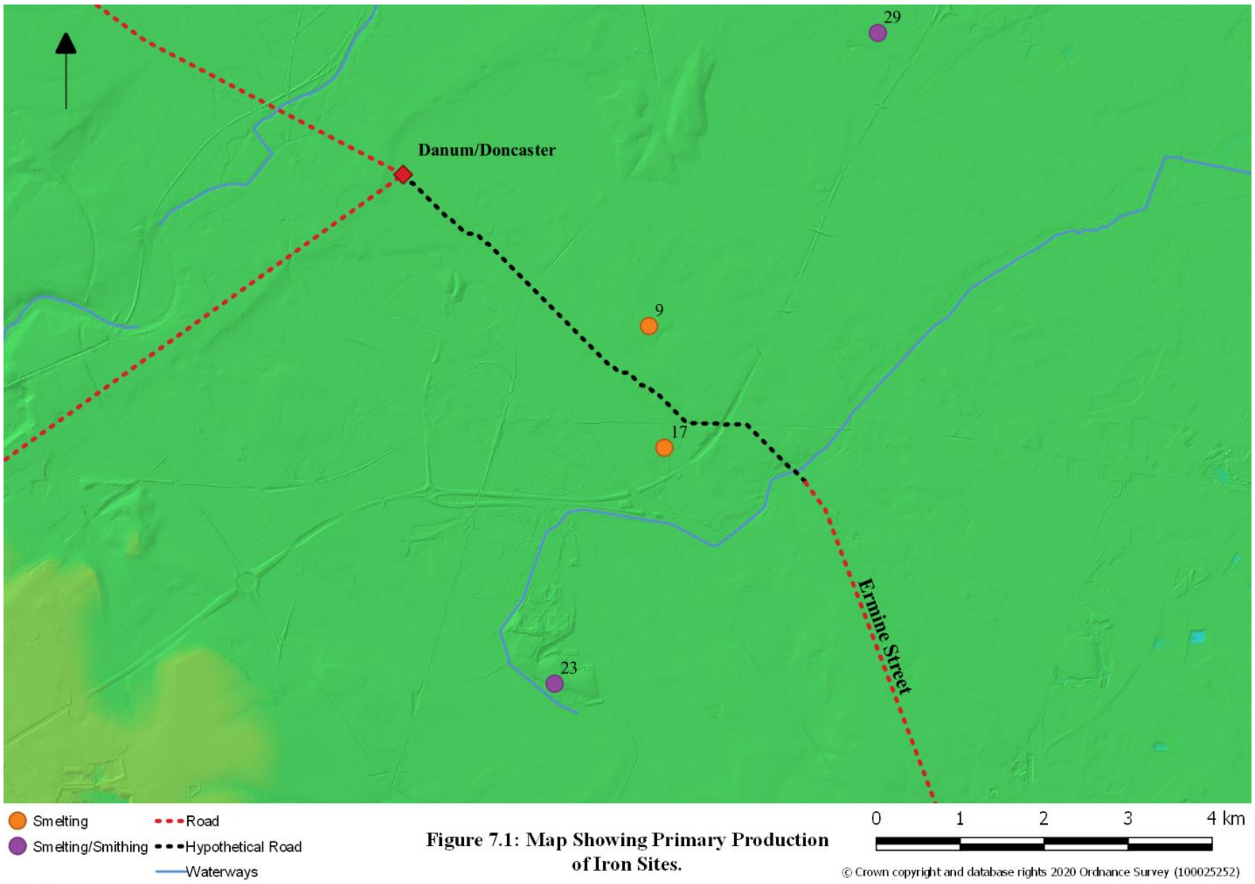


Figure 7.1: Map Showing Primary Production of Iron Sites.

indicating that the primary production was not very extensive (Chapter 6 and annexe A) (Figure 7.1 and Table 5.1). The scale of the primary iron production is small in comparison, even when we consider that, overall, the major iron production areas were in function for twice the length of time, which could indicate a large disparity in the intensity of the practice. The local production associated with the Doncaster pottery production area in Cantley was perhaps meant to provide a local, limited supply of metal to the forges producing the tools needed for the local agricultural needs and potentially for the local pottery industry (Chapter 6). The notable exception to this is Manor Farm, where approximately 230 kilograms of metallurgical slags were recovered, including a large amount of tap slags and of slag blocks, indicating that both tapping and non-tapping furnaces probably were used there (Chapter 6; Mackenzie 2011, 2017a). This larger production is not on par with the Weald, for example, but does indicate that the people living at Manor Farm in the late first and second century AD (Stubbings 2017a) were producing iron in significant quantity, perhaps to supply the local forges independently from the major iron production centres further away. The proportion of smelting sites on non-industrial sites against purely industrial sites is in line with what was identified in the Rural Economy of Roman Britain (30 per cent on industrial sites and 70 per cent on mixed economy sites) (Allen *et al.* 2017: 183; see chapter 3).

The potential use of bog iron ore to produce significant amounts of metal is interesting, notably since it emphasises the deep understanding of local resources by the metalworkers. It also indicates that they possessed the means and experience to acquire this valuable resource. It might be hypothesised that metalworkers used local bog iron to answer the local needs instead of taking advantage of large-scale production elsewhere in the province. It brings to mind the example of the iron production in the Lowland East Yorkshire, where production, while not as extensive as the Weald or the Jurassic Ridge and not set mostly in the Roman period, was an important part of the local economy (Clogg 1999: 95; Millett 1999: 223-224). In the examples from Holme-on-Spalding moor (see chapter 1), it is suggested that it would have been possible to bring iron ore from mineral beds south of the Humber, but Clogg (1999: 90) seemingly dismisses that hypothesis and suggests that the nearby presence of bog iron ore would be more likely. Thelemann (2017: 488) also recognises the potential of bog iron to supply resources to an iron production industry. However, it is open to question if the use of bog ore would really make a meaningful impact, in terms of technological practice, for the ancient smelters. Chemically and morphologically, this type of iron ore is obviously different. It needs, however, to be collected, roasted, crushed in a similar way to many other mineral ores (Thelemann *et al.* 2017: 479). Past these initial steps, ancient smelters could then follow the practice and the same gestures as with other ore sources. Therefore, when reflecting on skillsets and knowledge, one has to recognise that, on the whole, the skills and knowledge relating to the use of bog iron ore is not dissimilar after the acquisition of the resource. This means the knowledge, the skillset, and the learning of practices by metalworkers needed to smelt bog iron ores would not fundamentally be different to smelting other iron minerals. Therefore, the smelting of bog ores would not on its own suggest a unique and different practice. It is probable that in the case of South Yorkshire, the bog ore was used on a local level, but this should not be taken to mean that bog iron can only support small-scale exploitations, as was extensively shown with the important production in the Lowlands of East Yorkshire (Clogg 1999; Halkon and Millett 1999). All but one iron smelting site are found close to the pottery production area. This is interesting as pottery production and metal production share similar skillsets related to furnace making and heat control. A similar association was made in Holme-on-Spalding Moor, where iron production tradition could have transformed or informed pottery production later on in the Roman period (Millett 1999: 226).

As for non-ferrous metallurgy, although alloying was potentially practised whenever casting was conducted on archaeological sites, no direct reduction of copper ores was found. This should perhaps not be seen as a surprise, as the closest known source of copper ore is located far away in the Peak District at Ecton. Galena, or lead ore, on the other hand, was present in large quantity in the rakes and veins of the Peak District (see chapter 1), which may be considered an important aspect of local metallurgy in the scope of this research.

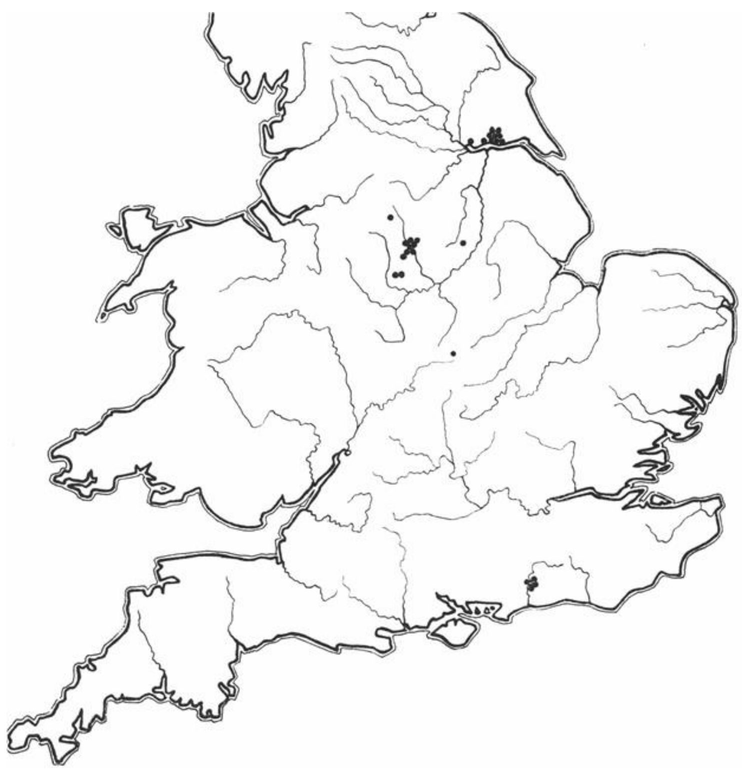


Figure 7.2: Distribution of the Derbyshire Lead Ingots. (Dool and Hughes 1976: 15)

The primary production of lead in the Peak District is thought to have been undertaken at least since the Roman period (Barnatt 1999: 19). It is, however, to this day an enigmatic metal production area as we still lack many details concerning the organisation of the exploitation of lead minerals in the Peak District during the Roman period. This is, in most part, due to a lack of direct evidence related to the mining of the minerals and the production of lead at this time and in this location. Indeed, the exact location or even locations and the actual intensity of the smelting operations are unknown. The only direct evidence is the stamped and marked ingots found in excavations or through metal detecting, or even as fortuitous finds that were associated with the lead ore field of Derbyshire (Barnatt 1999: 25; Dearne 1990: 363-364). These ingots were marked to indicate their weights and stamped to indicate their origin (RIB II/1 2404. 39-60 for the inscriptions linked to the Derbyshire ingots). When inscriptions are present, it notably contains a name, which will be explored later in this chapter (RIB II/1 2404. 39-60). Their wide distribution, most notably in the Peak District and in the Humber estuary, shows how and where material from the Derbyshire ore field would move (Figure 7.2). Especially important for the purpose of this thesis are the eight ingots associated with the Peak District exploitation, which were found at the port of *Petuaria* on the Humber estuary (Bradwell 2014: 14; RIB II/1 2404. 48-50, 52, 55). These ingots tie the production of ingots in Derbyshire with cross-provincial exchanges as well as with the movements of material between the ore field and the Humber estuary and, therefore, potentially to the wider exchange networks of the Empire. Two aspects of this production will be further explored here: location and inscriptions.

As mentioned previously, it is still debated whether the inscription LUTUDARUM (or LUT or LUTUD) (RIB II/1 2404. 39-64) is supposed to designate a single location (administrative or productive) or the whole Derbyshire lead ore field (Bradwell 2014; Hirt 2010). For the current thesis, it seems the dispersed nature of the lead veins throughout the whole region could suggest that the whole ore field was referred to as LUTUDARUM. Furthermore, as mentioned in chapter 3, the militaristic nature of the Roman forts in the study area seems unlikely when considering that no military activities were identified in the study area past the initial establishment of the Roman presence. Breeze (2011) suggests that beyond campaigning, Roman military establishments might serve other functions. Considering this, the presence of the fort at Navio in Brough-on-Noe far from any potential administrative centres in the ore field and its long-term occupation (potentially through the fourth century AD (Breeze 2011: 126; see chapter 3 for more details on this issue) would be difficult to explain without assigning it a function with the surveillance or the exploitation of the lead veins (Breeze 2011: 119 and 123). The other forts in the study area, Templeborough and Doncaster, would not directly share in that function, but it seems plausible that these military establishments could have been maintained to watch, supervise, protect, and/or control the materials, including lead ingots, and people moving on the road network thanks to their positions on important crossroads and river crossings in the study area. Further work on the nature of the fort and, indeed, on the organisation of the lead production will be needed in the future to understand in detail the workings of that industry. Recent work by Clarke (2017) on the geochemistry at and around the fort and by David Inglis (upcoming) with excavations in the *Vicus* will hopefully shed more light on these matters.

Finally, the work of Hirt (2010) on the mines and quarries in the Roman Empire is relevant to the discussion regarding ingot stamps and inscriptions. He makes the point that these inscriptions refer solely to the owner of the ingots rather than “lessees, occupiers or private owners of the mines” (Hirt 2010: 282). Considering this for the lead production in the Peak District, one can see that the ingots coming out of the Derbyshire ore field had different owners throughout the history of the production. Some were owned by a *societa* (RIB II/1 2404. 53-55, 57-60), some others by individuals (RIB 2404. 39-51), and even the Emperor, or the imperial administration (RIB II/1 2404. 39, 41-45). This change of ownership of these products, along with their wide distribution, indicates a dynamic industry with a lot of interest in the products produced over a long period of time.

Secondary Production.

Sites where the transformation of metal into objects took place are more common than sites where metals were produced from ore (Figure 7.3 and Table 5.1). Secondary lead metallurgy was identified at five sites that could safely be associated with the Roman period. This activity is present in the three excavated military establishments, Doncaster, Templeborough and Navio (Brough-on-Noe), as well as on two other locations (Rossington Bridge Pumping Station and Whirlow Hall Farm), which are not directly associated with the military. Conclusions cannot be

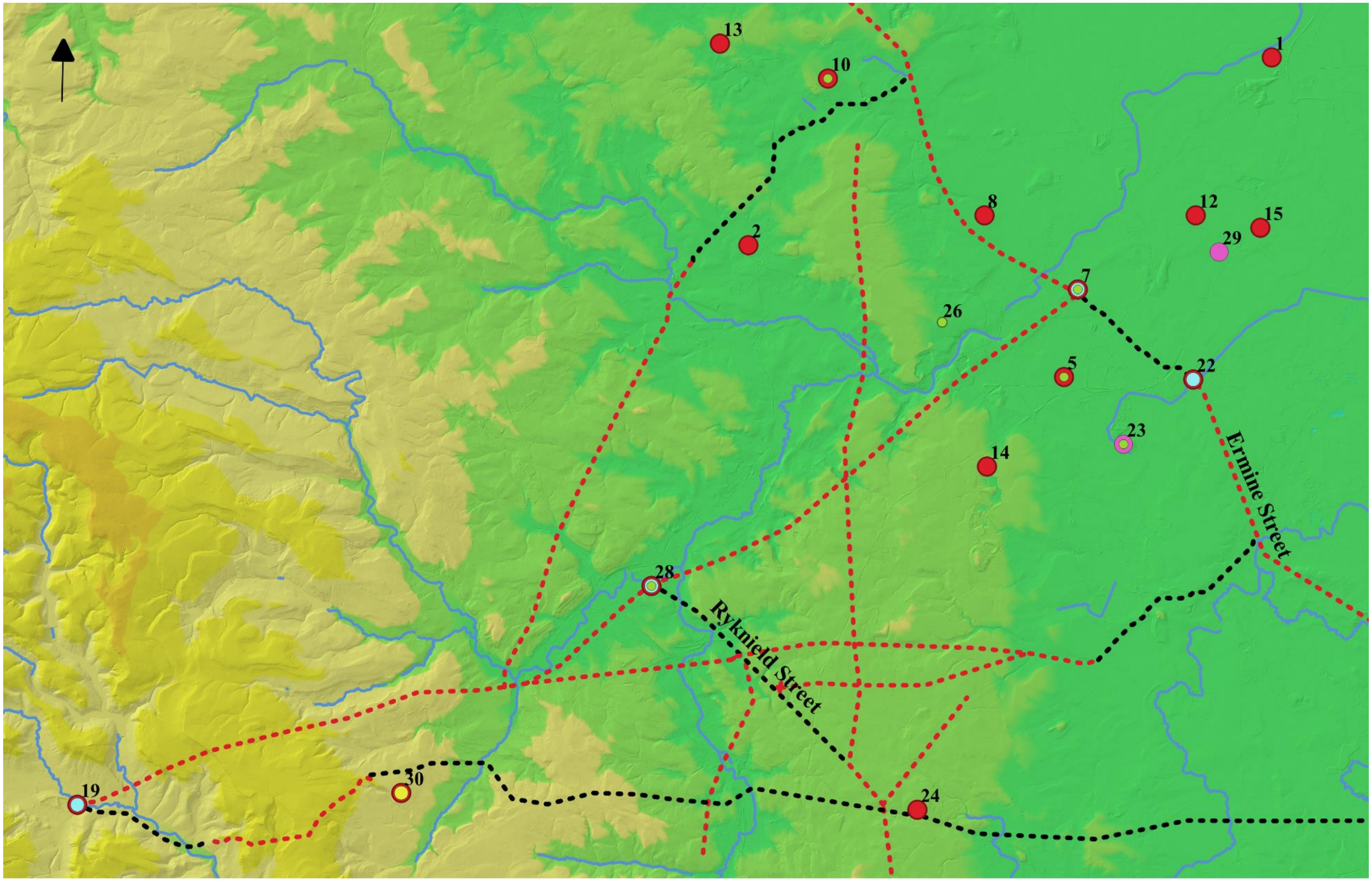


Figure 7.3: Sites with Metal Secondary Production.

formulated about the secondary production of lead, as the number of sites and the intensity of the activities are not significant enough. Whirlow Farm is the only one producing pewter in the study area (Doonan 2017; Doonan and Slater 2017; Waddington *et al.* 2017).

With the exception of the site at South Elmsall, which is said to have been linked with the production of copper-based objects, all the sites working copper and its alloys are close to the fort in Doncaster and the crossroad between Ermine Street and the east-west road through the study area or are part of a military establishment at Templeborough.

This is interesting as this might suggest that this is where there was the most demand for products of bronze, brass and gunmetal. Further interpretational points related to copper alloy work will be made later in this chapter.

Iron working or secondary iron production mainly aims to provide essential tools and objects used by the people living in the area, from nails to hoe blades. Iron is the most common metal worked in the study area in terms of quantity and of presence on sites. The presence of secondary iron production in specific settlement types is in line proportion-wise with the proportion identified in Allen *et al.* (2017: 186-187) with 8% of sites with evidence of secondary iron production (chapter 3) (less than 40% identified in Allen *et al.* (2017: 186-187). These proportions are also suitable for other site types (chapter 3), with over 80% of forts and over 60% of nucleated settlements with evidence of secondary iron production (Allen *et al.* 2017: 186-187). Iron slags were identified in all but one excavation that were studied in this thesis. The highest density of sites where secondary production of iron was observed stretches from within 10km south of Doncaster all the way to the northern limit of the study area, along and between the roads going north-south. In other words, secondary iron production is most abundant around and between the main roads going north-south through the region. The rest of the region is not marked by an abundance of iron working sites, even though it is present on two archaeological features and seven excavated sites in that area. However, in addition to the day-to-day activity of the craftspeople working iron, another function can be envisaged.

Moving Around

Research by Michel Mangin and Philippe Fluzin (2003) on the occupation of the Haut-Auxois around Alésia in France provides us with an interesting example of secondary iron production involved in the flow of resources on roads to consider. In that region, a dual system of metal production and transformation was identified. On the one hand, a system linking bronze working and iron working within a small town and, on the other, and more importantly for our purpose, a web of forges in the countryside and on the region's roadways. In the latter, forges located in the countryside were used by the inhabitants to produce objects needed for local agricultural activities. Additionally, wrought iron blooms were refined to be used in other agricultural and roadway sites of the region. Interestingly, a large proportion of the sites where smithing activities were identified were located on or in close proximity to the regional transportation axes and were dubbed "roadside forges" or "multifunctional service stations" (Mangin and Fluzin 2003: 144). In fact, 26 out of 45 (58%) sites were located on great axes of transportation (Mangin and Fluzin 2003: 144). This was associated, by Mangin and Fluzin (2003: 153), with the intensity of exchanges between other forges and the density of external transport. Furthermore, they note that we should not only consider the movement of things and the need for metal this creates, but also the movements of metal products between sites, within the entire region and outside of the region where the iron was produced (Mangin and Fluzin 2003: 153). These roadside forges would have provided maintenance services for the people going through the region, in the form of tools, maintenance of carts, oxen and horses, as well as supplies for other crafts and buildings. This led them to two conclusions. First, they posited "the existence of regular exchanges and therefore of intermediate wholesalers located between the reduction sites, regions and forges" (Mangin and Fluzin 2003: 154). Second, "the existence of two types of products provisioning forges in Gaul; on the one hand, iron needing consolidation and therefore initially cheaper, in regions with fewer revenue streams such as the Haut-Auxois […]; and on the other hand, high-quality ingots for craftspeople having better revenues, enabling them to free themselves of work […]" (Mangin and Fluzin 2003: 154-155).

These ideas of roadside forges resonate with this research on South Yorkshire. Indeed, as mentioned in chapter 5, out of the 17 sites where smithing activities were identified, 9 of them were located in close proximity to or on one of the major roads present in the study area (major roads here refer to Roman roads rather than trackways and droveways) (Figure 7.3). When considering sites where metallurgical debris was found but where a specific metallurgical practice could not be defined (Bradfield, Denaby Wood, Mexborough, Loversall, Tickhill, see chapter 6 and annexe A for more details), 16 out of 28 sites are located within one kilometre of a road. This suggests 53% of the smithing sites are roadside forges, almost equalling the 58% identified by

Mangin and Fluzin (2003) in the Haut-Auxois. This trend is also present to some extent when considering the non-metallurgical sites in the study area, although to a lesser degree, with 42% of all sites are located within one kilometre of a road. This further emphasises the pull roads would have on the local economy and life. Roads link settlements, regions, and people together. To go somewhere, there must be some sort of road leading to it. The incorporation of Britain into the Roman world led to the creation of paved roads. Large quantities of material and people would be moving in the landscape using these paved roads and therefore became a major focus economically and, in some cases, culturally for the different people living in Roman South Yorkshire. Moreover, these roadside forges, also, are not solely of one site category. Some are in military establishments (Templeborough, Navio, Doncaster), some other in nucleated settlements (Doncaster, Rossington Bridge Pumping Station), while others are in rural settlements of varying complexity in layout and function (South Elmsall, Smarson Hill Plantation, Whirlow Hall Farm, Doncaster A638 QBC). Considering these proportions in various site categories, it is possible that these sites could have similar maintenance functions to the roadside smithies that were theorised by Mangin and Fluzin (2003). Furthermore, six of the nine smithing sites mentioned here, or a third, also provided evidence of non-ferrous metallurgy in the form of secondary copper-alloy or lead working. Multimetallic assemblages were present on all excavated military establishments and their associated nucleated settlements (Doncaster, Templeborough and Navio), as well as on two rural settlements (Whirlow Hall Farm and Field Lane) and one nucleated settlement (Rossington Bridge Pumping Station). This point of interpretation is meaningful. The metals exhibit different physical properties (melting points, viscosity, and crystalline structure, among others), and this is reflected in the practice of metalworkers as these properties will directly affect the manipulations craftspeople would need to make to work these materials (see chapter 2). The material evidence is not simply about things but is representative of the metalworker's knowledge and skillsets. These physical properties, however, should not be considered as representative of a certain *Agency* of things (see chapter 2). On the contrary, the physical properties of materials are challenges that craftspeople had to overcome using their own knowledge of the material and characteristics impacting gestures. The different gestures and metalworking paraphernalia should be seen as the physical and archaeological manifestation of the metalworker's will and *Agency* to cope with these different challenges. Secondary production of lead, iron and copper alloys being present together at a limited number of sites suggest specialists or multiple metalworkers. These metalworking practices required quite different skillsets from each other. No evidence present at this point can point out whether these site-specific assemblages were created by one craftsperson, craftspeople working together, or different metalworkers working independently. It should be noted that different skillsets do not necessarily indicate different people. Assemblages were not recovered in clear different work zones for different metals on any sites. Furthermore, out of the eight sites where evidence of multi-metallic practices was present, six are within one kilometre of a road. This could indicate that the metalworkers who have the knowledge and the skillset to work multiple metals might be interested in using these skills to offer services supporting both the flow of materials and the people involved in it.

It seems important at this point to reflect on specialisation and crafts, as well as on the artisans themselves. This discussion on producers will be followed and integrated into chapter 8 with ideas linked to the identity and status of producers. Considering specialisation, Costin (2007: 150) suggests that a single universal definition is unsuitable and instead suggests that individual research should define what makes a specialist. However, she presents three elements to distinguish between specialists and non-specialists in production contexts: “intensity, compensation, [and] skill (mastery of a set of knowledge and/or motor habits that confer special ability)” (Costin 2001: 279). The first is linked to the amount of time spent crafting, which in turn is intricately intertwined with scheduling. Full-time artisans would work their craft as their main occupation. However, part-time producers would craft at certain times only. Although it is possible that these times could be weekly or monthly, it seems probable that they would work their craft “during seasons of low productivity or favourable environmental conditions and/or preceding periods of seasonal demand for their wares” (Costin 2001: 280). These variations in the intensity of practice are, according to Costin (2001: 280), exceedingly difficult to substantiate from the archaeological record. The second element, compensation, relates to both the nature of the compensation (foodstuff, money, services or other) received in exchange for the craftsperson services and the amount of the compensation, whatever the nature of it, an artisan would receive in exchange for the services he or she provides. This point is impossible to demonstrate archaeologically as one cannot really know how money or objects or even food came to be in possession of a producer (Costin 2001: 281). This point is more often than not speculated rather than clearly and definitely demonstrated and is often central to define specialisation in the past (Costin 2001: 281). Finally, in many cultures and social groups, crafting is not performed by all.

It is generally skills and skillsets that distinguish between crafters/producers/artisans and other people. These skillsets are inferred from material remains of the production and finished or partly finished objects (Costin 2001: 281). Evaluation of skill is often subjective and simply asserted through modern evaluation of the quality of objects produced (Costin 2001: 282). Other measures have been tried to substantiate our claims of skills, such as "error or success rates in the execution of particular techniques (Arnold and Munns, 1994; Clark, 1997; Pigeot, 1990), numbers of gestures (Hagstrum, 1985; Mills and Crown, 1995:10), movement control (i.e., consistency and regularity; Costin and Hagstrum, 1995), and use of materials (e.g., avoidance of defective or suboptimal materials; Karlin and Julien, 1994)" (Costin 2001: 282).

In the present research, it seems meaningful to link specialisation with knowledge and skillsets. Taking from Costin's characteristics of craft specialisation, all the metalworkers in the study area might not work with regularity or intensity, but they nevertheless had the skills to produce and maintain metals and metal goods which is not in itself a simple task. The skillsets involved in working different metals are complementary but not identical. The absence of clearly defined metalworking areas for different metals (see above in chapter 7) would indicate that, in the case of multimetallic assemblages, individual metalworkers or metalworkers working in the same area had the skillsets to work different metals. Furthermore, even on sites where secondary iron metallurgy was found without evidence for other metals, some form of specialisation needs to be considered. Indeed, iron smithing, as an example, is not simply a matter of hitting heated metal with a heavy rock or hammer (see chapter 2). The practice of welding broken pieces together or simply straightening a bent edge without compromising the quality (strength and toughness) of the material required a deep understanding of the material and an expert control of heat and furnaces. It is tantalising to imagine local rural smiths using their skills on a seasonal basis where farmers or shepherds in the area or potentially of their own kin could come together at some point in the agricultural cycle to have their tools maintained and repaired or on an occasional basis during and after the harvest. This practice would be an integral part of the rural life (i.e. part of the socio-culture system (see chapter 2)) and potentially repeated from year to year, cementing and defining the place and the identity of the metalworkers within the groups (see reflections on the importance of the concept of *Habitus* in chapter 2). Many rural settlements presented evidence of agricultural practices and smithing together, as well as domestic activities. These are Ashfield, Billingley

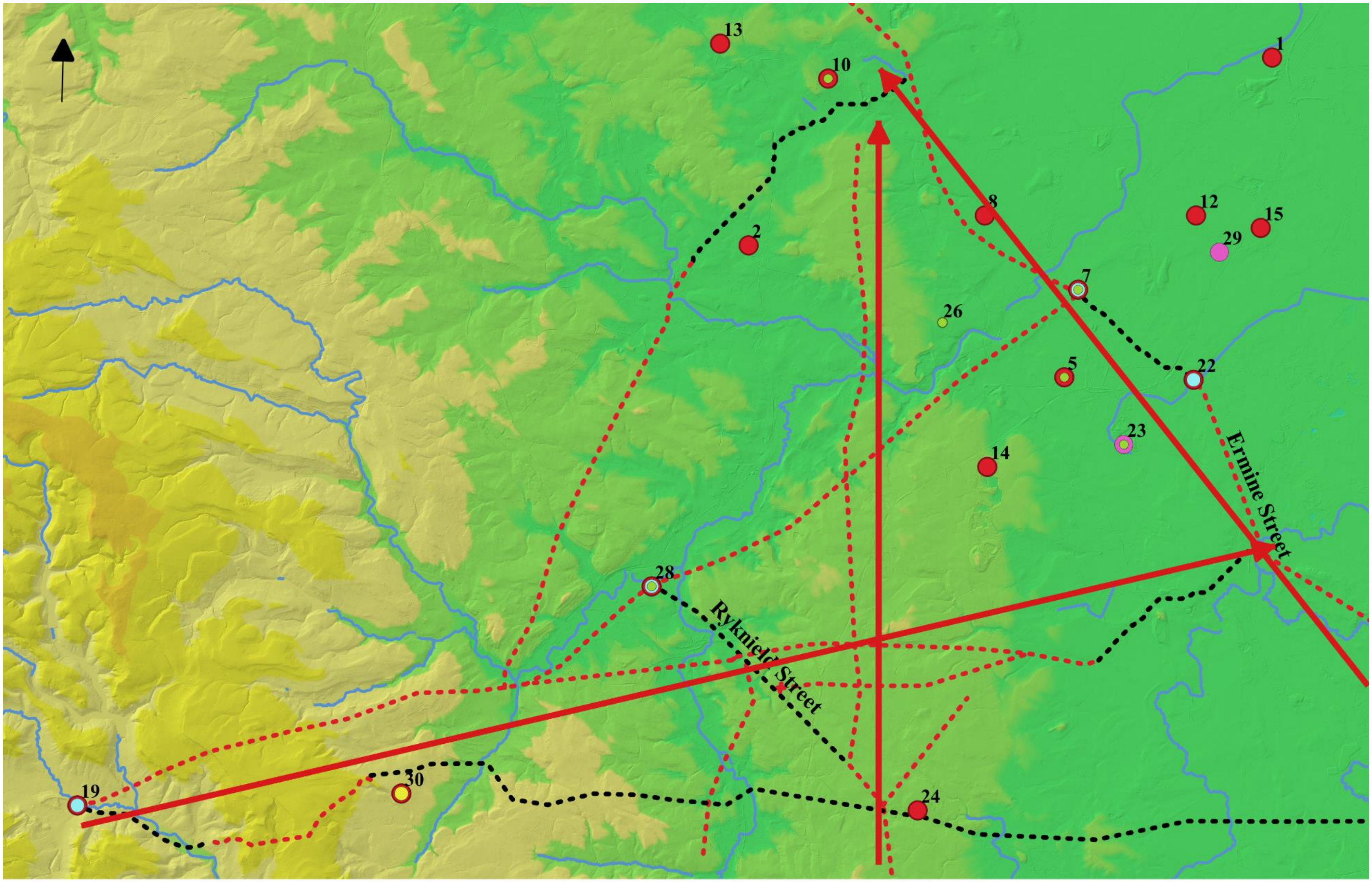


Figure 7.4: Sites with Metal Secondary Production with Arrows Representing the Network Flow.

Drive, Carr Lodge Farm, Doncaster A638 QBC, South Elmsall, Hatfield Lane, Holme Hall Quarry, Huggin Lakes and West Moor Park (see chapter 6 and annexe A for more details on individual sites). Some other sites did not produce material evidence of agricultural practices but are located within a rural landscape and field systems and are classified by the RSRBp. These are Rossington Grange Farm, Hemsworth Bypass, Smarson Hill Plantation (see chapter 6 and annexe A for more details on individual sites). Other sites with undefined metallurgical practices, but where metallurgical debris were noted, could also be part of such traditions. This definition of specialisation is easy to weave into a model based on Costin's (2001) model characteristics presented in *Craft Production Systems*, which will be described and reflected upon in chapter 8. This could mean, as suggested by Mangin and Fluzin (2003), that secondary iron production was recurrent but not systematic in rural enclosures, and it might rather have been linked to the movement of goods within the region. However, the consolidation of iron blooms that were so important to the inner dynamics of the Haut-Auxois study area is not present in South Yorkshire.

Nevertheless, other dynamics could also explain the importance of roadside forges, such as the position of South Yorkshire in the Romano-British road network (Figure 7.4). Indeed, both Ermine Street and Ryknield Street pass through the region on the way to North Yorkshire and beyond.

This sets Roman South Yorkshire within the larger road network of Roman Britain, where multiple regions are connected through roads and to the larger European-wide networks of the Roman Empire. Indeed, goods and people going north would have to pass through the region unless they travelled straight towards the southern side of the Humber estuary to be shipped to other parts of the Empire. Goods and people going from the Peak District towards the east would also pass through the region on their way to the Humber estuary or the north. This flow could mean that most goods going overland to Hadrian's Wall from the southeast of Britain and from the east of the island would pass through the study region. For our purpose, that could mean that iron ingots from the Jurassic Ridge production centre could use Ermine street to move northwards towards Malton, Castleford and Hadrian's wall. Some of these iron ingots would be retained in the area potentially to supply local practices and supplement local production (Doncaster Pottery Production Area, West Moor Park II, Rossington Grange Farm, and Manor Farm) while a larger quantity would continue northwards towards the forts on Hadrian's wall. Furthermore, whether or not lead was being produced at the fort at Navio, it stands to reason that at least some part of the production of lead from the Derbyshire ore field would have gone through the major roads located in South Yorkshire. Much like objects, networks have emergent properties (Knappett 2007: 23; Rivers, Knappett, and Evans 2013: 132), and as the transport in commodities would go eastwards and northwards, other resources and supplies, such as food, craftspeople, fodder, shelter, etc. would have aggregated to sustain the individuals involved in the movement and production of metals. Networks bring with them a certain gravity, and they act in themselves as an attractor of action.

Conclusion

It would appear that metal production in Roman South Yorkshire first and foremost aimed to provide metal products at the local level. Compared to the major iron production centres, the small number of sites with evidence of primary production of iron and the absence of copper primary production within the region does not indicate that the exportation of these metal goods would have been the main goal of metal production in Roman South Yorkshire. This is, of course, at odds with the production of lead in the nearby Peak District that was destined principally for export. The direct production of lead at Navio is still uncertain, but it stands to reason that the movement of some of the lead from the source to its plausible exportation point would have gone through Roman South Yorkshire.

Similarly, the secondary production of copper alloy, lead and iron in the study area seems to be aimed first and foremost at supplying the local population with the tools and objects they would need in their daily lives. However, the high proportion of iron working sites on or near roadways is not to be discounted, perhaps as a secondary source of income for the local craftspeople. This distribution of smithing sites is reminiscent of similar organisations elsewhere in the Empire, where the movement of goods along roads would create an impetus for craftspeople to build their forges close to transportation axes to take advantage of people passing through the area and needing goods or maintenance for their modes of transport (Mangin and Fluzin 2003).

The organisation of metal production in Roman South Yorkshire is centred on movement and local supplies. Surprisingly, however, there is no evidence of large-scale, sustained production of iron in the area even with the known presence of quality, exploitable iron ore. As previously noted in this chapter and in chapters 5 and 6, the site at Manor Farm is a notable exception when it comes to smelting, but the production found there is in no way comparable in scale to the production observed in the major iron production centres of Roman Britain (Cleere and Crossley 1995;

Fulford and Allen 1992; Hodgkingson 1999; Schrüfer-Kolb 2004; Walter 1992). The following chapter will explore this issue in more detail.

Chapter 8: Conclusions and Reflexions.

Introduction

The evidence presented here strongly suggests that metal production in Roman South Yorkshire was organised to sustain local needs in agricultural tools and other objects, as well as to maintain these tools and objects, while also providing additional support to commodities and people moving through the region from the South and West. However, it remains surprising that the primary production of iron did not occur in significant quantity, such as that of the major iron production centres of the Weald, the Forest of Dean and the Jurassic Ridge (see chapter 1). This is especially surprising as the study area is known to have large deposits of iron ore suitable for smelting in the form of sideritic ironstone nodules and bog iron (Aitkenhead *et al.* 2002: 151; Peter Robinson, pers. comm.; see chapter 1). This chapter will explore different types of models of modes of production and offer a critique of models based on strict types of craft production and their implications for an understanding of metal production in South Yorkshire. The absence of large-scale metal production will be assessed, and a hypothetical explanation suggested. Moreover, typological issues related to slags will be considered. To conclude, the organisation of the production in Roman South Yorkshire will be addressed, and future questions or research foci will be suggested.

Roman South Yorkshire's Place in Existing Models

To begin these reflections on models, it seems important to mention that the study of craft production and its ties to the socio-political organisation of a group has been made in three main directions, as argued by Costin (2001). Firstly, craft production was investigated for its perceived role in the creation and maintenance of hierarchical societies. This idea, however, has been questioned and discredited because it is seen as a simplistic assumption of unilinear development (Costin 2001: 274; Cobb 1993; Sinopoli 1998). Indeed, this unilinear development and rather simple link to hierarchy in a society does not account for the variability in the production types within a group (Costin 2001: 274). Secondly, a popular current method is to consider craft production as embedded within the social, political, ritual, or even ideational aspects of human lives (Costin 2001: 274; Cobb 1993; Cross 1993; Pope and Pollock 1993; see chapter 2 on *Habitus* and sociotechnical systems). In these models of craft production, it is considered a wholly social act (see chapter 2) as participation in these activities shape participation in the society as well as access to goods and services of various kinds (Costin 2001: 274; see also chapter 2: Agents and

Activities in Space-Time for reference to *Habitus*). The third type of study investigates the utility and social meaning of craft goods (Costin 2001: 274; Appadurai 1986; Hodder 1982; Schiffer 1999). Although this final way to study craft production was presented as a third way that socio-political organisation is linked to craft production in the literature (Costin 2001: 274), it is considered here to be a part of the second approach rather than one on its own, as was suggested in the original text (Costin 2001: 274). Indeed, this third approach to the study of craft production seems to be more of an object-centric version of the second approach, which is artisan-centric but still imbues power and meaning into objects.

To look at this diversity of craft production, one approach has been to formulate typologies of different modes of production through the selection of different criteria (Costin 2001: 276; see Costin 1991; van der Leeuw 1977; Peacock 1982 for examples). These are particularly notable because they differentiate household and non-household productions. In her publication of the Jurassic Ridge Iron Production Centre, Irene Schrüfer-Kolb (2004: 99-100) produced a list of different levels of industrialisation on the local and regional level for iron production (Figure 8.1). Her list of modes of production and characteristics were based, for the most part, on Condron's own classification (1997: 4-10) but modified by Schrüfer-Kolb to be compatible with her own work (2004: 99-100).

When compared to this modelling of iron production, it would appear that the sites in Roman South Yorkshire can be associated with four different levels: Military production, household industry, nucleated workshop, and household production. Military sites (Templeborough, Navio, Doncaster) are quite self-explanatory, as the production of metals occurred on the excavated military establishments present in the area. Non-military sites in proximity of major roads and sites that exhibited a multi-metallic production of metal (primary or secondary) should be linked to the household industry level (Doncaster *Vicus*, Navio *Vicus*, Templeborough *Vicus*, Rossington Bridge Pumping Station, South Elmsall, Smarson Hill Plantation, Billingley Drive, Scholes Coppice, Pitsmoor, Redhouse Farm, Denaby Wood, Smelting Farm, Newmarket Road, Mexborough, Carr Lodge Farm, Whirlow Hall Farm, Doncaster A638 QBC (see chapter 5-6-7)).

Mode of production	**Pottery**	**Iron**
Household production (as in Condron 1997)	• Production for own consumption, sporadic bath production • No technological innovation • Secondary economic importance, relegated to the women as a household chore	• Largely smithing and repair work for own needs (hearths on villa estates or rural settlements) • On an occasional basis, when the need arose • Not on a commercial scale • No economic importance but maintenance, carried out by one or few semi-skilled workers.
Household industry (Condron's specialists in larger farming communities)	• First craft specialisation • Skilled professionals • For-profit, marketing yet still 'part-time' occupation by women; supplementary economic importance • Few investments	• First craft specialisation (evidence for mixed economy together with pottery production and/or agriculture • Skilled professionals working for profit, marketing (evidence of rural settlements operating on a more efficient basis with several furnaces working at one time) • Seasonal or probably rather year-round in addition to other economic activities • Transition to specialised iron production definitely on this level
Individual Workshops (Condron's urban artisans or specialist production centres)	• Principal economic importance even if 'part-time.' • Now male-dominated • Market-dominated • Efficiency important • Team of workers	• Principal economic importance • Market-orientated • Not clearly distinguishable for smelting process but probably similar to household industry • Blacksmith's shops
Nucleated workshops (Condron's specialist production centres)	• Individual workshops grouped together for an industrial complex • Production major activity • Year-round production • Innovation • Middlemen involved	• Individual workshops grouped together for an industrial complex • Production major activity • Large-scale production
The manufactory (Condron's specialist production centres)	• Several highly specialised workers in one building • Process divisible into individual steps • Mass production	• Highly specialised industrial units • Single site • Large-scale production • Substantial output • Smelting furnaces aligned in rows and slag heaps of considerable size
The Factory	• Highly specialised mass production • Artificially powered	• Use of water-power for ancient iron production still debated
Estate production (Condron's specialists in larger farming communities	• Similar to household production or more commercial • Several skilled labourers • From internal needs to external trade	• Varying scale, intermediate to industrial • Several skilled labourers • From internal needs to external trade
Military and other official production (Condon's specialist production centres)	• Done only when civilian supply was not possible • Streamlined and highly efficient • Reflects military strategy or official interest and control • Direct or indirect state control through lessees	• Generally more controlled due to importance of resource • Within the military environment for military needs • Also, in connection with other industries such as pottery production • No state production known

Figure 8.1: Schrüfer-Kolb's Model of Iron Production. (Schrüfer-Kolb 2004: 99-100).

Indeed, the multi-metallic nature could indicate that the craftspeople working there developed multiple skillsets and mastered their trade, while the roadside settlement could indicate that these sites do not solely work metals for their own purposes but also are market-orientated to a certain degree. The site at Manor Farm again stands out because of its scale of production. Its definitive classification is difficult to ascertain until the excavations are completed, and a full analytical report is published, but it seems reasonable to link it with the estate production level or nucleated workshop, depending on the final interpretation of the site. It is also possible that if the production is not the sole activity present (mixed economy), the site could be associated with the household industry category. Finally, the remaining sites (Ashfield, Bradfield, Hatfield Lane, Hemsworth Bypass, Huggin Lakes, Loversall, Tickhill, Rossington Grange Farm, Sprotbrough, Stancil) should be associated with the first category: household production. These sites appear to exhibit occasional work of maintenance rather, but that should not exclude the occasional production of pieces from ingots or scrap to finished artefacts. Costin's (1991) typology is slightly more fluid. It still relies on categories similar to the previous model, but it creates a slightly more permissive system articulated along two axes: Household to Workshop and Independent to Attached (Costin 1991: 5-6). It is, however, the same in principle as it creates specific criteria-based categories. In the end, it creates four base types of craft production and is often referring to "degrees" of specialisation and levels of production or even industrialisation. Although interesting, to compare different scales of production as well as to set cross-cultural or cross-regional comparisons, this model brings a number of critiques to mind.

First, typologies or models created from a number of specific and tightly defined characteristics cannot exhibit the intense variability of craft production organisation. This, on its own, almost certainly outweigh the benefits of providing a common vocabulary between researchers, research, and contexts. Indeed, if these typologies cannot reflect the organisation of craft production between regions and societies adequately, how could they provide a vocabulary enabling meaningful cross-regional comparisons and discussions. Furthermore, different groups are working metals for different reasons, and this should be reflected in how we study craft production.

Secondly, as mentioned by Schrüfer-Kolb (2004: 102), the gender assignment of the pottery activities in the model used to base the Schrüfer-Kolb model does not hold up to scrutiny. Indeed, the identification of preferred genders for certain activities in antiquity, and especially in regions where pre-Roman society is not known for its explicit exclusion of women of prestigious standing (e.g., Cartimandua and Boudicca), is dubious. Household production may not be the sole domain of women, while men have no agency over it and vice-versa. Gender assignments should not be assumed in any modelisation of craft production.

Thirdly, the inclusion of the forges linked to the transportation network or rural smiths in the household industry level is not without its problems. Indeed, how does one categorise production such as that at road-linked forges, or rural metalworkers working, on occasional or seasonal basis (Rossington Bridge Pumping Station, South Elmsall, Smarson Hill Plantation, Billingley Drive, Scholes Coppice, Pitsmoor, Redhouse Farm, Denaby Wood, Smelting Farm, Newmarket Road, Mexborough, Carr Lodge Farm, Whirlow Hall Farm, Doncaster A638 QBC, Ashfield, Bradfield, Hatfield Lane, Hemsworth Bypass, Huggin Lakes, Loversall, Tickhill, Rossington Grange Farm, Sprotbrough, Stancil)? These are skilled individuals performing complex manipulations of materials and who have a complex understanding of resources and techniques. These skilled metalworkers would be available all year round for the maintenance of transports or for other opportunities, which could then be said to be an economic complement to their principal activities. This should, perhaps, be described as an opportunistic metalworking activity, an extension of the inhabitants' maintenance work of metal objects for visitors, travellers, merchants, and passers-by. Furthermore, rigid typologies such as these mask the fact that all metallurgical skillsets, regardless of perceived "industrialisation" levels, are complex operations requiring skill, knowledge, and experience to produce usable quality goods. Metalworkers in household production (Ashfield, Bradfield, Hatfield Lane, Hemsworth Bypass, Huggin Lakes, Loversall, Tickhill, Rossington Grange Farm, Sprotbrough, Stancil) are thought to be less skilled than metalworkers in household industries (Rossington Bridge Pumping Station, South Elmsall, Smarson Hill Plantation, Billingley Drive, Scholes Coppice, Pitsmoor, Redhouse Farm, Denaby Wood, Smelting Farm, Newmarket Road, Mexborough, Carr Lodge Farm, Whirlow Hall Farm, Doncaster A638 QBC). However, as mentioned in chapter 7, iron smithing, as an example, is not as simple as hitting hot metal with a heavy rock or hammer (see chapter 2-7). The practice of repairing broken objects through welding or restoring a bent tool while retaining the quality (strength and toughness) of the material calls for a deep understanding of the material and an expert control of heat and furnaces.

Finally, if we, as researchers, decide on a specific set of craft production types and then try to negotiate our own data with these fixed theoretical categories, there is a very real danger that researchers might identify elements needed for the specific typology and give them, unconsciously, more importance in the dataset that they should have. For example, rural smiths in Roman South Yorkshire would fit the idea of household independent specialised production, but this would not reflect the very real possibility that the craftsperson there could be embedded into local seasonal agricultural activities along with their neighbours or their kin (see chapter 7). Household production is not necessarily solely for household uses, especially with metals, and these infinite variations in craft production cannot possibly be reflected by a unique shared typology.

Costin's Scheme.

Instead of using typologies to look at craft production, another approach was suggested by Costin (2001). As a substitute for creating fixed types, she suggests that we look at a set of parameters that would define and cover all aspects of production. Basically, while typologies qualify modes of production by defining a category and looking at the data to establish where the data fits, this approach looks directly at the data to identify meaningful characteristics of the craft production. This would eliminate the limiting nature of the typologies and allow great variability and specificity since individual sites do not need to fit into static groups. Costin (2001) suggests "elucidating a set of six constituent components that together constitute the production system. These are artisans, means of production, organization of production, objects, relationships of distribution, and consumers" (Costin 2001: 277).

Artisans.

Craft production is articulated through the artisans. Therefore, the identity (status, gender, age) of the latter is paramount to the understanding of the socio-political relations involved in production. As discussed in chapter 7, craft specialisation is a far more complex process than simply asserting degrees of specialisation. Even "simple" manipulation of metals for maintenance is a complex process that cannot be simply reduced to hammering metal together. It all requires some specialised skillsets. As Costin (2001: 276) points out, the core of the problem is that "fewer people make a class of objects than use it" (Costin 2001: 276). This is well reflected in the study area where only 8%, or 31 out of 384 archaeological sites and features present in the South Yorkshire Archaeological Services, presented evidence of metallurgical practices of any kind. As for the identity of these craftspeople, gender and age are next to impossible to demonstrate on the basis of archaeological data alone and, in the case of gender especially, it is important not to simply guess gender roles in ancient societies (Costin 2001: 284). The other element of identity that is looked at by Costin's scheme (2001: 282-283) is the social status of the craftsperson. The two methods to approach this aspect are by looking at the physical location of the crafting activities or the use of textual evidence, which is unavailable in the study area. However, in Roman South Yorkshire, excluding the military sites, no archaeological site presents clear, irrefutable evidence of being of high status based on its location or material remains. The Stancil "villa" is still contentious due to the nature of its reporting, and the RSRBp classified it as a rural settlement rather than a villa. The other site with a potentially different status is Whirlow Hall Farm with its "Roman-style" rectangular stone-based building and a piece of *tessera* (Waddington *et al.* 2017: 122). On this site, it is thought that the Roman period occupation destroyed the Iron Age remains and established a whole new permanent occupation with possible Roman features (Waddington *et al.* 2017: 122). However, considering James' Community of Soldiers (1999), soldiers in the Empire had "a highly visible special status and resultant professional pride. […] They stood outside the local civil hierarchies; alternately despised and feared. Soldiers (and particularly wealthy veterans) were nevertheless courted by civilians of many levels […] The *milites* grouped in regiments scattered across the Roman world were very much aware of their special, shared status, forming a self-conscious 'imagined community'" (James 1999: 15). Therefore, metalworkers in forts and vici would be part of that group or associated with it. Status-wise, this would potentially set metalworkers embedded within soldiers' communities apart from the metalworkers working in rural communities (see chapter 3).

Means of Production.

Means of production can be split into two points: raw material and technology. Raw material in craft production is articulated through its sources or source, its procurement, and its performance. While performance was specifically discussed in chapter 7 in reference to bog iron ores, in the case of procurement, two options are basically possible: local production and extraction and/or cross-regional supply. In the study area, iron was produced in the Doncaster Pottery Production Area, Manor Farm, Rossington Grange Farm, and West Moor Park. These are the only attested primary metal productions in the area. In the case of copper and lead production, it stands to reason that unused or broken objects could be recycled through melting to be transformed into new objects. Furthermore, ingots of lead and iron would potentially pass through the region from the Peak District mines on its way to the Humber Estuary in the case of lead (see chapter 7) and in the case of iron between the Jurassic Ridge and Hadrian's wall (see also chapter 1 and chapter 7). Although the study area was not the main "market" for these resources, it is probable that some parts of these shipments of iron ingots could be sold directly in sites on the way to their final destination. It is also possible that arrangements were in place to supply the smiths embedded in the communities directly from the source. As for technology, it has been established that it has a role and a meaning in society as part of the socio-economic and socio-political organisation of societies (see chapter 2; Dobres 2000; Dobres and Hoffman 1994, 1999; Dobres and Robb 2000; Pfaffenberger 1992). Furthermore, it is increasingly accepted that variations in techniques and technologies are potentially representative of "different sets of artisans" (Costin 2001: 287). In the study area, the microstructural and chemical analyses presented in chapter 6 and discussed in chapter 7 would indicate that these are different craftspeople working on different sites, and this would discredit the idea of itinerant smiths being present in the region. Also, at Manor Farm and West Moor Park, two different smelting technologies were present in the same location, although a complete report on the former's metallurgical debris will shed more light on this matter (see chapter 6). This dual presence of smelting technologies might represent the producer's or producers' adaptation to new needs, more than the arrival of new people.

Organisation of Production.

Craft production is located in physical and social spaces. Once crafts are located in sites, it is possible to reflect on the concentration of these activities in the landscape. Concentration is articulated between the even distribution of craftspeople in a given region, with everyone sharing even access, and a highly concentrated distribution that can restrict access to the fruits of this production. In Roman South Yorkshire, metalworkers are distributed throughout the landscape but are slightly more concentrated between and around the main north-south axes present in the region. This might not result in uneven access, as this distribution of craft production sites follows the general distribution of sites in the region.

Moving away from purely geographical considerations, craft production is also organised in social space. Two aspects of this organisation can be characterised to inform our understanding of the social construction of craft production. Firstly, the composition of the production units refers to two variables: size and labour recruitment. The principles of recruitment cannot simply be inferred from archaeological data, and more often than not, interpretation needs to be based on ethnographic comparisons (Costin 2001: 296-297). The size of production was often investigated through the physical location of production areas. This, however, is not self-evident, and these terms themselves carry institutional and cultural baggage. Household, for example, is often taken to refer to purely kin-base production for usage within a household, which is too simplistic an interpretation of what a production within a household context can be (Costin 2001: 296-297; see Costin 2020 for more detail and examples on workshops as well as Kay 2020 for a discussion on epistemological problems with the use of households as social units). Within this thesis, these terms are not used to refer to any particular category and instead, "production areas or zones" are privileged as recommended by Costin (2001: 296). Secondly, individual craft productions are set within socio-political contexts which need to be addressed. This context of production relates to the "affiliation of the producers and the sociopolitical component of the demand for their wares" (Costin 1991: 11). This is articulated around the concepts of attached specialisation and independent specialisation, where the former is supported and managed by an elite, an institution, or patrons, while the latter is seen as producing for the "market" without specific affiliations. Both of these production contexts evolve differently and under different conditions. Independent specialisation is affected primarily by economic incentives, while attached specialisation works mostly under social and political conditions. In the study area, forts would be the only potential attached production identifiable at this time, but the main drawback of this concept is that even if they fulfil orders from the military, metalworkers embedded in the military forces potentially still could be a part of the other non-military activities and could diversify their production to fulfil local needs. All other sites appear to be linked with independent specialisation. Independent production is embedded into social life and responds to economic opportunities. It is possible that Whirlow or Stancil Villa could be of higher or different social status, and if so, this could indicate a potential attached specialisation. Specifically, the production of pewter objects at Whirlow could be significant since it is, as of now, the only demonstrate pewter production site (see Annexe A), a metal often used in the Roman world, but not nearly as common in non Roman contexts, and if the site could demonstrably be associated a different status than other rural settlement in the area, it could be a unique example in the study area of an attached specialisation linked to the supply of local pewter needs. Nucleated settlements would fulfil local demands for goods. Rural settlements would supply demands linked to social conventions such as seasonal demands for the maintenance of agricultural tools as well as occasional needs. In addition, rural sites presented in chapter 7 as having a potential road-linked production would fulfil opportunistic demands linked to the transportation network, which would add to their usual metallurgical activities. (Table 5.1)

Means of Distribution.

For a craft production to be socially significant, products need to go from the producers to the consumers (Costin 2001: 305). Therefore, an important part of any production system is to facilitate that movement within a region, as well as facilitating the movement of materials and people leaving the regions. In Roman South Yorkshire, major paved roads would link forts and settlements along their path not only with each other but with the wider transportation networks of Britain and of the Empire as a whole. Adding to this, on a local level, paths, trackways, and droveways would still play a role in the movement of goods and people in the region during the Roman period and would link places together and to the new major roadways (see chapter 3). Furthermore, these paths, tracks and roads would facilitate the movement of people embedded into the seasonal agricultural or communal activities and would play a part in the social life of the locals (see chapter 3-7).

Objects and Consumers.

These two final aspects of any production system are significant as the consumption of objects made by craftspeople is also socially articulated to the production itself. Furthermore, objects are imbued with meaning and purpose by their creators. However, the detailed study of demand and consumption of metal products in Roman South Yorkshire is not part of the mandate of this thesis. Significantly more research would be needed to produce a meaningful dataset on this aspect of production, which would include the complete re-evaluation of the objects found on all archaeological sites in the region as well as a detailed and critical evaluation of the Portable Antiquity Scheme.

Instead of fitting the individual sites concerned in this thesis into a rigid typology of craft production, this research took a different approach to model making by characterising components of a production system as suggested by Costin's scheme (2001). This characterisation bypasses the limitations of typological models and allows a greater emphasis on the localised variations of metal production. To summarise these characteristics of the organisation of metal production in Roman South Yorkshire, craftspeople in the study area were skilled individuals with a deep understanding of the materials they worked and of the techniques needed to conduct their crafts.

There is no clear indication of craftspeople with a higher social status. This would mean that they were an integral part of their local communities and participated in the day-to-day activities of their groups in a variety of ways. Most metalworkers would potentially be crafting on an occasional basis and, perhaps, as a part of the seasonal cycles of agricultural activities. However, metalworkers associated with the Roman military in the study area would be part of these unique communities of soldiers (James 1999), which potentially would set them apart from the metalworkers in rural settings. Iron was produced in four sites (Doncaster Pottery Production Area, Manor Farm, Rossington Grange Farm and West Moor Park) to varying degrees of intensity. These were, all things considered, smaller primary productions, when compared to iron production centres elsewhere in Britain, and could have been set up to complement the supply coming from the Jurassic Ridge production complex (see chapter 1). Lead ingots from the Peak District Mines could have entered the region on their way to the Humber estuary for exportation to other parts of the province and of the Roman Empire. Some part of that production could have been purchased by the local population. Regarding techniques and technology, two iron primary production sites (Manor Farm and West Moor Park) presented evidence of two different smelting technologies. There is no indication of the presence of itinerant smiths based on microstructural or chemical evidence, indicating on the contrary that these metallurgical debris were produced by different craftspeople. Metallurgical practice is distributed throughout the landscape but is slightly more common between and around the major road going north-south. The only form of attached production demonstrated in the region is the metalworkers working in military establishments or *vici*. The other craftspeople would be independent specialists embedded into the social life of their communities and responding to various economic opportunities. The results of these metallurgical practices and the people living in the region would flow on the major roads, along with the paths, trackways and droveways to move around. These roads and tracks would link settlements and people, enabling communities to gather and materials to flow.

Not an Iron Production Centre?

Roman South Yorkshire was not a major iron production area in Roman Britain. It is surprising to us because it appears from a modern archaeological standpoint that everything that is needed to create a production centre is present here, similarly to iron-producing complexes in other parts of Britain (Cleere 1974; Cleere and Crossley 1995; Hodgkingson 1999; Schrüfer-Kolb 2004; Walters 1992; see chapter 1).

Upon review of the available sources in these production regions, it appears that four characteristics defined these areas. Firstly, resources needed for iron smelting need to be present in the local area. That means that the smelters need to have access to ore, wood, and clay. Secondly, production is a local one rather than a centralised one. Indeed, in the three major iron production centres, production may be sponsored or facilitated by a central body, as in the Weald with the *Classis Britannica (*Cleere and Crossley 1995: 67-69; Schrüfer-Kolb 2004: 127; see chapter 1), but the production remains dispersed in the landscape and occurs in a large number of settlements, rather than a central area, like the Doncaster Pottery Production Area, for example. Thirdly, skilled craftspeople are needed to conduct the smelting of ore into iron and to transform wood into charcoal. Furthermore, a certain understanding of raw materials for clay construction needs to be present, as the furnace needs to be fashioned with heat resistant clay with the addition of temper. Fourthly, there is a need to mobilise the local workforce to man the bellows, extract clay and iron ore, cut wood, gather sand, hay, as well as other tempers, and prepare the large quantity of clay needed; in addition, other people would need to sustain a permanent smelter and its helpers.

Since all the material resources needed are present in Roman South Yorkshire, yet primary iron production was not widespread, perhaps the difference lies in the social aspects of production. Potentially, the problem could lie in the ability to mobilise local workforce to sustain the production activities (Charcoal production, clay extraction and preparation, ore extraction, furnace building, smelting, consolidation, etc.). Although it is evident that sustained, concentrated industries existed in South Yorkshire as the Roman potteries in and around Cantley and Rossington exemplify, the organisation of the major iron production complexes suggests a different organisation and, therefore, a different outcome. The potteries were geographically concentrated in an area and, based on the analysis of the stamps marking some of the *mortaria* recovered in the Doncaster Pottery Production Area, were potentially organised around two skilled individuals, SETIBOGIUS and SECUNDUA, who could have been hired or mandated by a well-known and very prolific mortaria maker, SARRIUS, whose stamp mark also appeared in association to other pottery production areas (Buckland, Hartley, and Rigby 2001: 85-87; see chapter 3). The evidence of stamps and their comparison to other pottery production areas is interesting but would benefit from a complete fabric analysis and comparison between groups to potentially identify craft traditions. However, the presence of these stamps on the products of the crafting activities in Rossington Bridge is interesting and does seem to suggest that a limited number of individuals either had ownership of the products or even had the relevant skillset to lead this production. This pottery industry would employ compensated (with products or currency), servile or coerced (through the concept of *corvées* perhaps) workers to produce a large quantity of material (Buckland, Hartley, and Rigby 2001: 87). No evidence pertaining to the identity and status of the people participating in the pottery craft production has been recovered. It has been suggested (Buckland, Hartley, and Rigby 2001: 87) that an entrepreneur (Sarrius) could have used freedmen (Setibogius and Secundua) and bought skilled slaves to operate this production. However, there is no evidence for slave quarters nor any other proof that slaves were living and working in that area. It is true, as mentioned by Buckland, Hartley, and Rigby (2001: 87), that the Roman world was using enslaved workforces, but it is unclear how much and exactly how these aspects of the Roman world were adopted locally in Roman South Yorkshire. It is equally probable that this production could be using local workforce to help with the production or that unidentified apprentices or other skilled compensated workers could be working with the potters named by the stamp marks. As for iron production, evidence from the major production complexes indicates that production was settlement based, meaning that each settlement was producing iron on their own time, or at least on their own land. Therefore, each settlement would have mobilised a workforce, servile or otherwise, to work the smelts. It might then be hypothesised that, while a number of people could be brought together south of Doncaster to produce pottery, the mobilisation of a similar workforce on smaller dispersed locales, as was present in the iron production centres, might be problematic. This should not be seen as an inability, or a lack of competency, to operate such productions, nor should it be thought that the inhabitants of Roman South Yorkshire were too uncivilised to organise in such a way. Rather, it seems possible that the lack of Iron Age tradition of iron production (see chapter 1) and the heterarchical nature of the social relationships (see chapter 3) hampered their interest to congregate on a smaller scale than that of pottery production to take part in an economic activity not related to their own primary occupations. Perhaps more significant, however, is the economic aspect of such a production. Considering the relative proximity of the Jurassic Ridge iron production complex within the road network of Roman Britain, one has to wonder if a local production of iron was indeed needed. Some part of the Lincolnshire production would possibly pass through the study area on Ermine street on the way to the forts on Hadrian's wall. Iron ingots could be purchased from this complex and brought into the area on carts (see chapter 7). This easily accessible source of raw material usable for secondary iron production would certainly reduce the need to produce significant quantities of iron within the study area. In addition, the potentially seasonal gathering of manpower to sustain pottery production in Cantley and Rossington might have also hampered the interest of the locals to also congregate to produce iron in a similar fashion, even if the latter shares many aspects with the former albeit on a smaller, localised scale. The relative rarity of primary productions of iron in the area does seem to reflect this hypothesis (see chapter 5 and 7). Adding to this picture, the largely rural nature of the settlements in the area would mean that the repair of agricultural tools was the main metallurgical purpose of the rural smiths in the region (see chapter 7). This could indicate that there was not a large economic impetus to produce sustained quantities of iron directly in the study area.

Slags and the Archaeological Record.

Considering the theoretical points on the materiality of slags (see the section "slags as Liquid Stones" in chapter 2) and building on the experience of the analyses conducted for this thesis, it appears that slag analysis could benefit from a slight readjustment of focus. Indeed, a focus on bulk analysis and collection should be considered over targeted analysis. Slags are created together in a furnace as a by-product of metal production rather than as finished objects. They are heterogeneous in nature, and their composition and the distribution of elements within each slag is dependent on the metallurgical practice or practices involved in their creation as well as the specific steps in the production cycle, such as time or additives. They share characteristics and form in specific ways that may be different but should all be considered together. Many studies referenced in this thesis produce slag analysis that studies all slags visually but solely characterise a sample of them microstructurally and chemically (Holme Hall Quarry, for example, or the author's analysis in Doncaster as another) (see chapter 6 and annexe A) or not at all (West Moor Park, Rossington Grange Farm, Huggin Lakes, among others (see annexe A and chapter 6 for more details and more sites), often because of a lack of funding or time or simply that the complete analysis would be produced at another time. The heterogeneous nature of the slags makes small scale analyses useful for specific details of the production techniques and factors at play in the transformation from ore to metal. However, the heterogeneous nature means that while limited sampling might indicate such details of production, other specific slag characteristics may easily be missed by a targeted analysis. For example, the analysis of slags from the fort of Templeborough (see Annexe A and chapter 6) did present traces of elemental copper and lead in a number of slags indicating that these metals could have been worked in the same furnaces. However, only 14 out of the 56 slags showed readings of 1000 parts per million (ppm) or more, while the rest often read less than 150ppm. With this in mind, bulk analyses seem better suited to investigate metallurgical processes from slags than targeted chemical analyses, and the latter should be prioritised when possible, especially with the development of portable XRF analysis technologies that allow large sampling strategies and present precise and accurate readings (see chapter 4). This may not be an option for microstructural analyses because of the long preparation of the samples that is needed, but recent technology may allow a different strategy for the chemical characterisation of metallurgical debris. This focus on obtaining a large number of readings to qualify the nature of the slags is even more significant when considering that slags as a material category are more often than not non-diagnostic. Large scale chemical characterisation of slag assemblages has the potential to characterise not only single events, which would then be expanded to the whole group, as targeted analyses would do, but characterise the metallurgical practices as a whole at a given site. This would render our analyses much sounder methodologically as it would reduce the amount of information asserted rather than demonstrated. Furthermore, the routine chemical characterisation of slag assemblages in Roman South Yorkshire would detail the metallurgical activities at sites where diagnostic pieces are rare or where the slag assemblage is limited, such as Billingley Drive, Ashfield and Huggin Lakes to only name a few. This would allow the identification of potential multimetallic assemblages or the identification of smelting practices on sites where the physical evidence is limited. These methodological considerations could hopefully reinvigorate slags as a material category and change its perception as uninteresting debris to meaningful indicators of past craft practices.

Conclusions

To conclude, this research considered the organisation of metal production in Roman South Yorkshire, through a desk-based assessment of the geological, historical, and archaeological background, linked to the creation of a database and a GIS of available sites showing evidence of secondary and/or primary metal production. The conclusion of this work showed that metal production was aimed at fulfilling the local needs and not producing material for exportation beyond local markets. Furthermore, large scale metal production in peripheral regions (Jurassic Ridge iron and Peak District lead) could have been transported through the region on its way to the Humber estuary for export out Britain or to the northern part of the province to Hadrian’s wall supplying the people living in military establishments and settlements there. The absence of large-scale iron production is surprising. It could potentially be caused by two reasons separately or in conjunction. The first can potentially be linked to the difficulty in mobilising local manpower to conduct sustained dispersed smelting operations. The second cause could be the limited need to produce locally thanks to the easy access to the Jurassic Ridge's production through the road network (see above and chapter 7). All in all, much like the economy as a whole (Allen *et al.* 2017), the metallurgical practices in Roman South Yorkshire are rural in nature (see chapter 3-5-6-7), principally being aimed at the maintenance of tools and objects as a part of socially organised, potentially seasonal, practices. In addition to this, metalworkers would also take advantage of economic opportunities in the form of compensation for their crafts. This could have taken many forms, including impromptu repairs and maintenance. Moreover, the presence of many sites close to the major roads built in the study area adds other opportunities for metalworkers on these sites to practice their crafts and receive compensations. Models based on strict typologies are difficult to use in this region and cannot accurately reflect the multitude of ways that these very skilled craftspeople exerted their crafts. Costin's (2001) scheme allows for a much more flexible approach and was followed to characterise the organisation and nature of the metallurgical activities in Roman South Yorkshire between the first and the fourth century AD.

In the future, some aspects of the present research would be interesting to explore and perhaps should be prioritised to better our understanding of metal production in Roman South Yorkshire and Roman Britain. First and foremost, the nature, extent and organisation of the lead production industry in the Peak District should be studied extensively. This industry is perhaps the biggest economic focus of that region, and its internal and external dynamics would have had a tremendous impact on the lives of people and on the landscape inside the area and in its peripheral regions. It is important to note here the ongoing work of David Inglis from the University of Sheffield, which will no doubt expand our understanding of that industry. Similar research focused on the secondary production of different metals in a single region should be carried out elsewhere to expand our understanding of the transportation network of commodities in the peripheral regions of the Roman Empire. This could be extended to a discussion on the commodification of things in the Empire and, perhaps, nuance the debate. Finally, the use of a hand-held portable X-ray fluorescence analysis should be promoted on all levels of archaeological investigation when available. On-site analysis of soil chemistry to direct excavation (Frahm and Doonan 2013: 1427) and instant field-based identification of metal remains (alloys and slag analysis) will inform the excavation on potential metalworking areas and will direct the investigation to look more closely at the use of space in these locations. This will allow a whole new level of investigation of ancient craft production, where the working area will be delimitated and the metallurgical activities, or broadly craft activities, will be mapped out in detail within that space. Moreover, the identification and classification of copper and lead alloys, as well as the analysis of the chemical composition of slags, in post-excavation work and museum collections is overdue in many older excavations, as seen with the Templeborough Fort re-evaluation in this research, and more generally could inform researchers on many aspects of the metallurgical craft production as seen in this research and in the grey literature concerning Roman South Yorkshire explored here.

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Annexe A: Gazetteer of Metallurgical Sites.

The following gazetteer of archaeological sites will present all the locations that were selected to be part of the thesis. As previously stated in chapter 5, only a limited number of archaeological sites in the research area were associated with any type of metallurgical debris that could be associated with the Roman period (39 out of 920 entries in the entire database amounting to 31 sites when accounting for sites with multiple entries). This chapter will provide detailed descriptions of the archaeological sites, with an evaluation of site functions, if possible, along with an analysis of metallurgical practices.

Ashfields, Kirton Road, Stainforth

Targeting known features identified through previous geophysical surveys and known cropmarks, Wessex Archaeology was commissioned to undertake the evaluation of a site north of Kirton Road in Stainforth (O'Neill 2012) (Figure 1). Twenty-five trenches were dug. The site exhibited a high density of features. Several ditches were found, which would either be part of a number of small enclosures or part of an area-wide field system similar to what is seen elsewhere in South Yorkshire (O'Neill 2012: 12). Through careful examination of dating evidence from the fills of the ditches, along with stratigraphic relations between them, it was possible to date the majority of the ditches, which seem to have been in use predominantly from the second to the third or fourth century AD (O'Neill 2012: 12). Artefacts found during the excavation suggest that the site was some sort of settlement, with pottery, tiles or bricks, a flagstone, a coin, and more importantly, metalworking debris.

Although the information was limited in the report, it is noted that a little more than 1.5 kilograms of slag were recovered at Ashfields (O'Neill 2012:

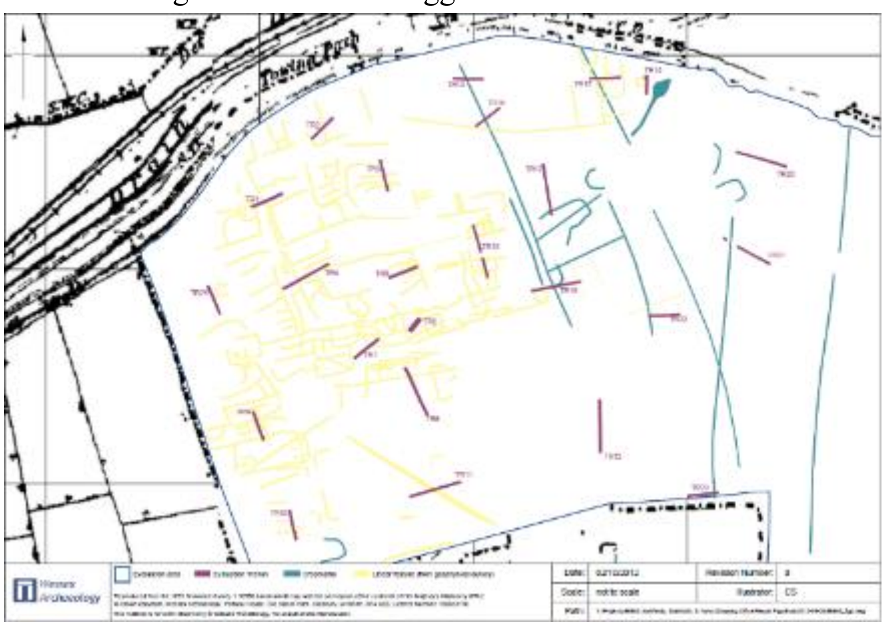


Figure 1: Map of the Site with Features and Trenches from Wessex Archaeology (O'Neill 2012).

10). The analysis of the slag assemblage revealed that it was produced through iron smithing (O'Neill 2012: 10).

Billingley Drive, Thurnscoe

This site, excavated in 1999 by Northern Archaeological Associates (NAA), is located on Billingley Drive, Thurnscoe (Figure 2 and 3). The site consists of a rural settlement established during the late second century AD, which had subsequently changed in layout and size through the second and third centuries AD and was abandoned finally in the fourth century AD (Neal and Fraser 2004: 12, 18-19). While there were no occupation layers identified during the excavation, the site led the archaeologist to gain meaningful insights into the organisation of space and the development of an enclosed Romano-British rural settlement (Neal and Fraser 2004: 88-89). Phases II and III were identified in the report as the most intense periods of occupation, as these phases produced ceramic sherds in large quantity (Neal and Fraser 2004: 19, 26). Furthermore, the post-excavation work produced detailed reports on crops, animals, ceramics, and, most notably for our purpose, slags. A potential smithy floor was identified in Phase I (mid-second to third century AD) or II (third to the early fourth century AD), but only from indirect evidence. Recovered hammerscales were identified by Cowgill (2004: 53-54) as plate hammerscales, which can be associated with smithing processes (Cowgill 2004: 53-54, Sim 1998: 99). The high sensibility of hammerscale to taphonomy renders the localisation of an actual smithing floor quite tricky. The large quantity of hammerscale is interesting and seems to point to a sustained metalworking activity (Cowgill 2004: 53-54) through phase I and/or II (Neal and Fraser 2004: 11, 16).

Three pieces of smithing slags were identified in the post-excavation report. Two were found in phase II and one in phase III (Cowgill 2004; 54). The other slags recovered were of the problematic 'Iron Age Grey' type (Cowgill 2004: 54). These were found in Phase II and are a rare occurrence in non-Late Iron Age contexts (Cowgill 2004:54). None of these latter pieces is firmly datable, but the main hypothesis is that it could all be a redeposition from Phase I, where the largest amount of plate hammerscale was found (Cowgill 2004: 53; Neal and Fraser 2004: 16)

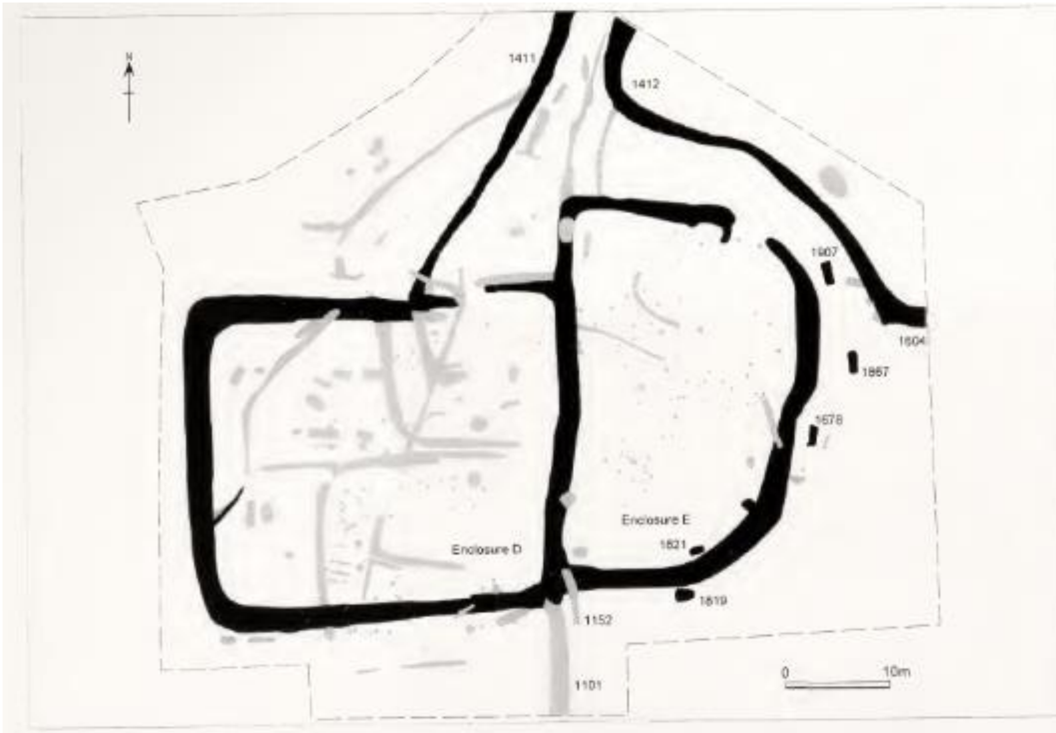


Figure 2: Plan of the Features Associated with Phase II from Billingley Drive (Neal and Fraser 2004: 13).

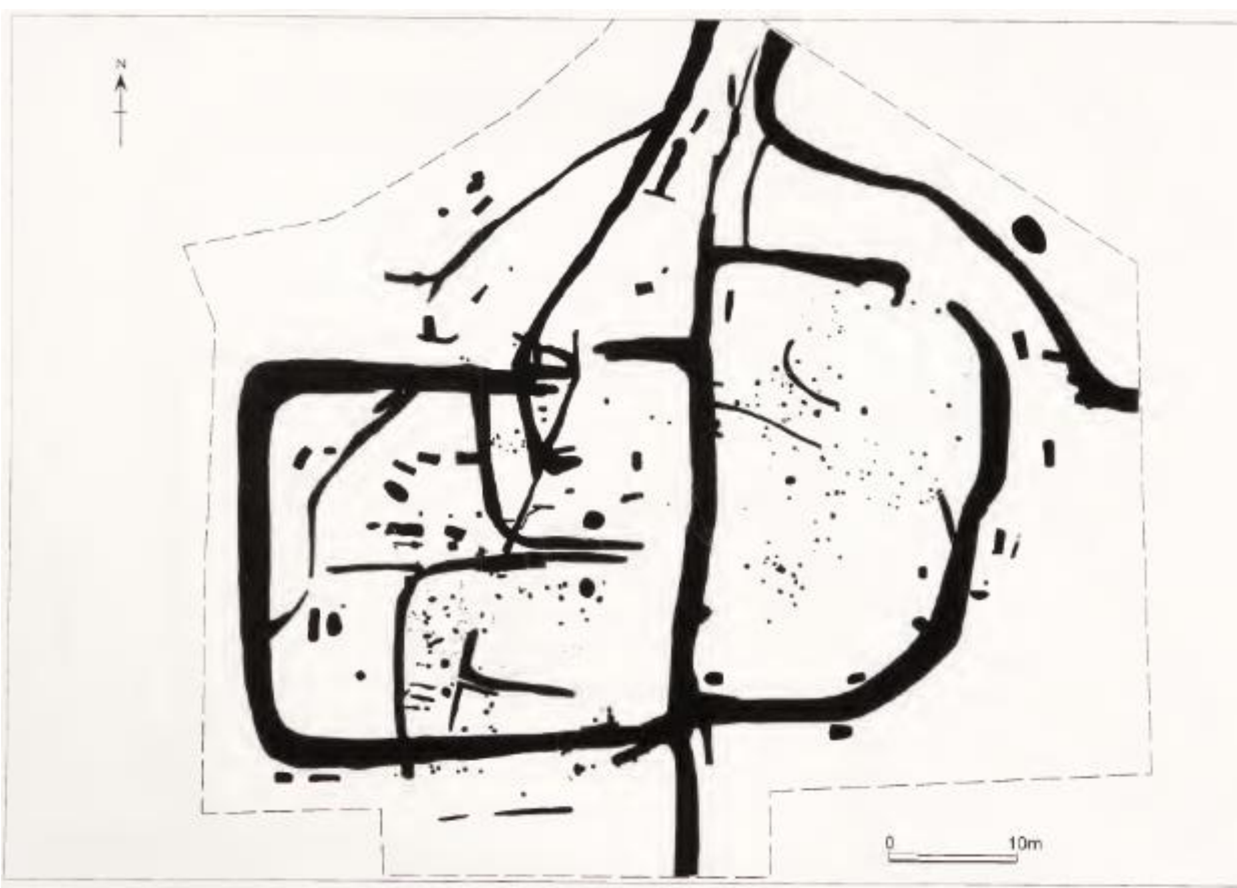


Figure 3: Plan of all the Features from Billingley Drive (Neal and Fraser 2004: 13).

Bradfield

The site at Bradfield, now submerged in the Broomhead reservoir, is sorely lacking in detail. The Sites and Monuments record refers to the features found there in simple terms: a smeltery (03170/01-MSY5931). This smeltery is described as a "rectangular hearth with associated beehive quern with hopper and handle hole. Possible Romano-British smelting site with clinker and iron." (03170/01-MSY5931). Yorkshire Water was contacted to access the area, and after the needed permission was given, a small fieldwalking survey was conducted by the author of this thesis. This investigation revealed some iron working and possibly some iron smelting slags. These were most probably brought to the edges of the reservoir by varying water levels. It is expected that more slags and more remains are to be found on the shores of the reservoir when the water is low.

Caesar's Camp, Scholes Coppice

The site of Scholes Coppice, sometimes called "Caesar's Camp", consists of a defined oval enclosure surrounded by a bank and a ditch (00131/01-MSY376). Although it is impossible to date the length or phases of occupation precisely, an excavation of limited scale in 1992 recovered six sherds of pottery (00131/01-MSY376). Two of these seemed to suggest that the site could have been occupied during the third or fourth century AD (00131/01-MSY376). The exact purpose of the site is unknown due to the lack of significant archaeological investigation. One large piece of slag was discovered at Scholes Coppice and is thought to be of medieval or post-medieval date (00131/01-MSY376). Interestingly, this site is located in close proximity to the Fenton seam and the Tankersley ironstone seam (Parish 2017). Geological features that are known to contain extensive amounts of ironstone that can be smelted, and that have been exploited throughout the history of the area. No direct evidence of extraction during the late Iron Age or Roman period are known, but these could have been obliterated by later use of the land (Parish 2017).

Carr Lodge Farm, Doncaster

This site, located north of Loversall by the Carr Lodge Drain, is one of the earliest examples of metallurgy found in the modern boundaries of the county. While the exact chronology remains problematic, the recovery of the metalworking finds in the fill of the Late Iron Age ditch seems to indicate that these activities took place either in the LIA or shortly after (Stanley and Langley 2013: 20-21) (Figure 4). Along with the metalworking debris, biological remains, animal bones and ceramics were recovered. These finds seemed to indicate that the limited features excavated were possibly part of a larger settlement or occupation (Stanley and Langley 2013: 21).

Location	Carr Lodge Farm									
Context	245		250		251		253		Total	
Iron working slag										
	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)
Non-Diagnostic Slag	X	123	0	0	0	0	X	80	X	203
Smithing Hearth Bottom	0	0	0	0	0	0	2	173	2	173
Iron Concretion	0	0	0	0	0	0	2	77	2	77
Non-Ferrous Metallurgy										
	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)
Crucible	0	0	6	20	0	0	1	96	7	116
Mould	1	16	0	0	0	0	0	0	1	16
Ceramics										
	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)	Pieces	Weight (grams)
Non-Diagnostic Pieces	X	78	X	1332	0	0	0	0	X	1410
Total	X	217	X	1352	0	0	X	426	X	1995
* Total number of pieces was unavailable										

Table 1:Metallurgical Debris from Carr Lodge Farm (from Mortimer 2013: 44).

A little over two kilograms of metallurgical debris were recovered on site. Four hundred fifty-three grams of this total consisted of what was interpreted as iron-working slags, including one smithing hearth bottom (Mortimer 2013: 43-44) (Table 1). The other notable debris were crucibles, a rare occurrence in South Yorkshire, especially at non-military sites. The first was composed of five fragments with traces of copper alloy, which could be a single crucible of fragments of multiple ones (Mortimer 2013: 43-44). The second one was nearly complete but did not exhibit traces of copper metallurgy. Furthermore, pieces of vitrified furnace lining were identified on-site but these cannot be directly associated with metallurgical activities (64 grams) (Mortimer 2013: 44). The assemblage at Carr Lodge Farm, although small in scale and possibly associated with a

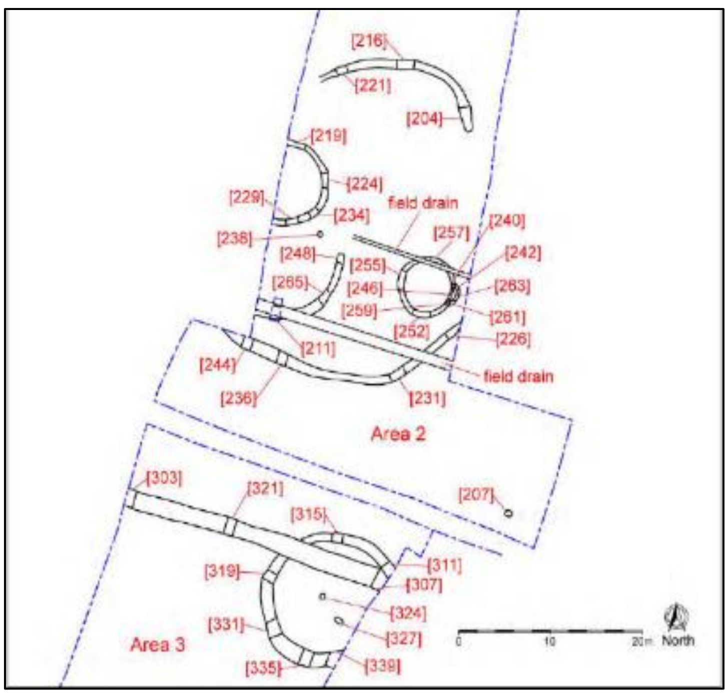


Figure 4: Archaeological Features in Areas 2 and 3 at Carr Lodge Farm (Stanley and Langley 2013: 13).

small or ephemeral activity, is of tremendous interest for the area.

Romano-British Artefact Scatter, Denaby Wood, Denaby

The site in Denaby Wood, identified by the extensive artefact scatter throughout the wood there, is still largely unknown. Two trenches were dug in 1997 and 1998. These excavations allegedly uncovered some Roman pottery, a fourth-century AD coin and a copper alloy bracelet (04672 – MSY12207 SYAS). Furthermore, observation from SYAS seems to show that metallurgical slag was present all over the area. These archaeological operations did not produce reports, and the location of the artefacts is currently unknown (04672 – MSY12207 SYAS). An independent archaeologist reported to the SMR officer investigating the site that metal detectorists had found a few Roman coins and brooches (04672 – MSY12207 SYAS). Furthermore, several ceramic fragments were found. These finds, along with the close proximity of the possible road going through Conisbrough, could indicate that a settlement of a significant size might have been located in Denaby Wood (04672 – MSY12207 SYAS). The extent of the slag and the discovery of surface mining pits detected through LiDAR suggest that metallurgical activities were conducted there (04672 – MSY12207).

Doncaster

The Roman fort and civilian settlement under the modern city of Doncaster have been the subject of a number of salvage and organised excavations since the 1960s (Figure 5). The major impetus for the start of organised excavation taking place in the city was the opening of the Doncaster Museum in 1964 (Buckland and Magilton 1986: 23). After a period during which most excavations were directly conducted by staff from the museum along with local volunteers, large scale excavations, funded by governmental bodies, continued the work between 1970 and 1978, notably along the relief road (Church Way), on St. Sepulchre Gate and the Subscription Rooms (Buckland and Magilton 1986: 23). Rescue excavations played a significant role in providing a better understanding of the archaeological past of the city, with the discovery of significant Roman deposits between French Gate and St. Sepulchre Gate, along with Waterdale and others (Buckland and Magilton 1986: 23).

Roman Doncaster lay in close proximity to the pottery workshops of Cantley/Rossington to the South and East of the modern town, and the town played a pivotal role in the history and economy of Roman South Yorkshire. Three aspects are important in considering Doncaster in this study.

First of all, it would appear that the first military occupation was established in the Flavian period, therefore probably in the late first century AD and possibly soon after AD 70 (Buckland 1986: 12). This first occupation was probably abandoned at some point in the second century, then reoccupied and reduced in size in the latter half of that century, possibly shortly before AD 160 (Buckland 1986: 12-13). The site continued to be occupied throughout the Roman period (Buckland 1986: 17).

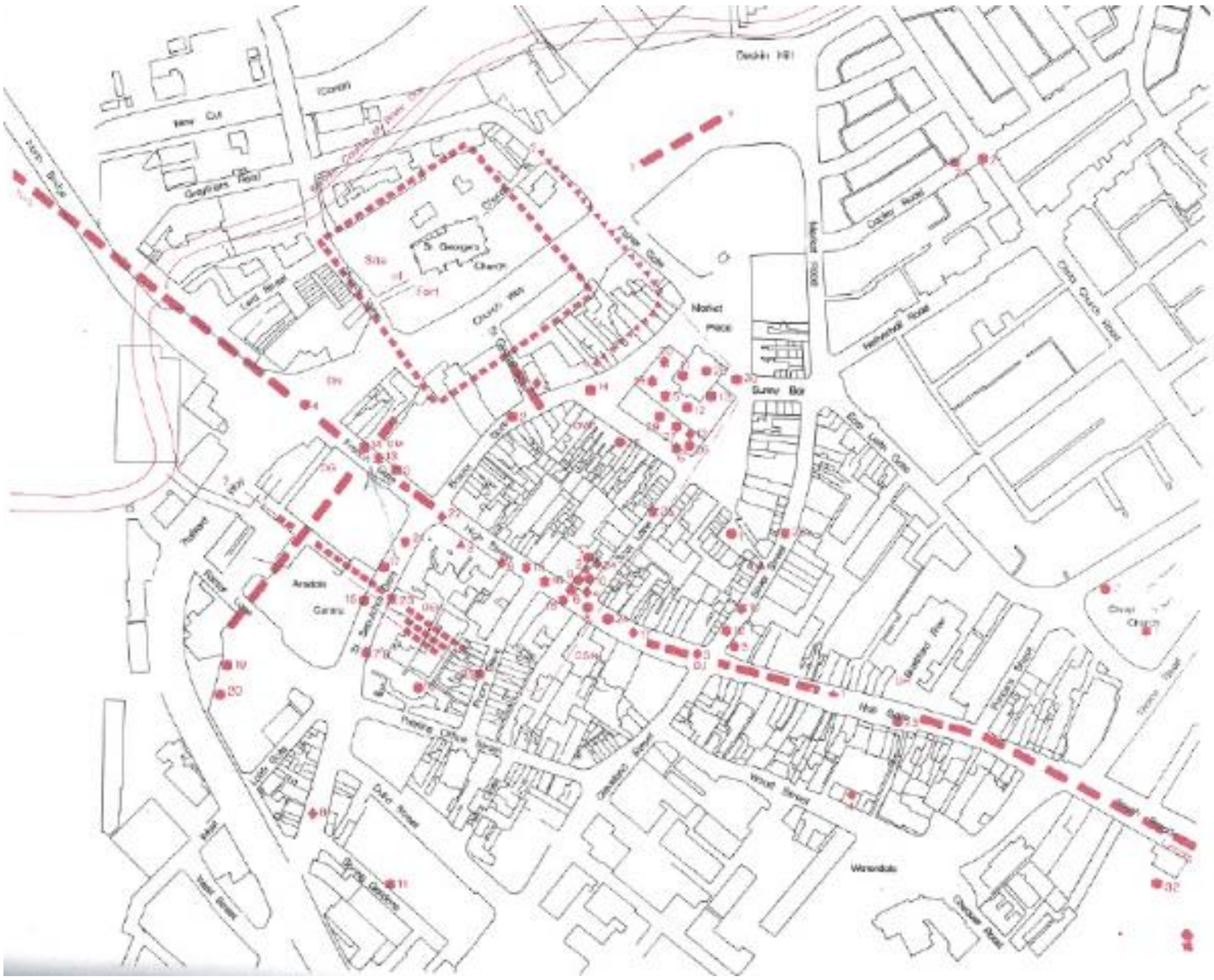


Figure 5: Plan of archaeological Features Associated with the Doncaster (Buckland and Magilton 1986: 24).

Although its extent and exact nature are still largely unknown, due to a lack of features and remains, a 'civilian' settlement was found through a number of archaeological excavations south and west of the fort at Doncaster (Buckland and Magilton 1986: 23). The actual founding date of the settlement is still uncertain, but it appears that a number of defensive ditches were built in the second century AD; that coins and other finds indicate that the settlement may have been occupied until the fourth century (Buckland and Magilton 1986: 34-59 for all excavation groups).

The main significance of Doncaster for the history of Roman South Yorkshire lies in its pivotal position along the road network and at a river crossing that developed through the period. The road would have led to the fort at Burghwallis and then to Castleford. To the south, the road would have reached the vexillation fort at Rossington Bridge, then Bawtry and finally the legionary fort of Lincoln (Buckland and Magilton 1986: 208). To the west, a possible road was identified coming out of the 'civilian' settlement and leading towards Templeborough (Buckland and Magilton 1986: 209). Another road leading east has yet to be identified (Buckland and Magilton 1986: 209). The presence of the fort and civilian occupation at this crossroad is of tremendous importance when considering the movement of material in the region, and it probably played a role in the longevity of the garrison there.

Table 2	**Doncaster Fort**		**Doncaster *Vicus***			
	Pieces	Weight (g)	Pieces	Weight (g)	Total Pieces	Total Weight
Iron						
Fragment	2	109	3	92	5	201
NDS	0	0	46	2285	46	2285
Tap Slag	1	33	1	14	2	47
Furnace Slag	1	88	0	0	1	88
SHB	0	0	10	3173	10	3173
Copper Alloy					0	0
Slag	0	0	0	0	0	0
Fragment	4	66	2	24	6	90
Lead					0	0
Fragment	20	1389	3	277	23	1666
Pyrotechnical Ceramics					0	0
Furnace Lining	1	59	7	222	8	281
Tuyères	0	0	1	51	1	51
Fragments	0	0	1	28	1	28
Crucibles	0	0	0	0	0	0
Total	29	1744	74	6166	103	7910

Table 2: Metallurgical Debris from Doncaster.

Five smithing hearth bottoms were found in the fort during the excavation under the subscription rooms. The military establishment (Table 2) produced one tap slag, which is generally expected to be produced by smelting activities using a tapping furnace. Furthermore, spills and fragments of lead and copper alloys were recovered within the area occupied by the fort. These are all thought to be linked to the Roman occupation, but it is impossible to be more precise with the dating of the material because of the heavy truncation of features. In the settlement (Table 2), hearth bottoms were retrieved, along with one piece of tap slag and lead and copper alloy fragments. Interestingly, far fewer slags were found in the fort than in the settlement.

All in all, it would seem that the metallurgical assemblage from the fort itself indicates a multi-metallic nature primarily oriented towards secondary production of metal pieces and their maintenance. The settlement's assemblage exhibits the same characteristics, although on a smaller scale when it comes to non-ferrous metallurgy. Evidence of smelting was recovered, but the amount does not indicate that large scale smelting operations were conducted in the fort or in the settlement. It is possible that primary production was conducted in the vicinity but has not yet been discovered.

Three samples were selected for further analysis from these contexts. All were from the excavation conducted in 1975 in the settlement attached to the fort. One of the slags was a tap slag, while the other two were categorised as non-diagnostic slags. The latter two were selected because they were from the same context or from the same general excavation area.

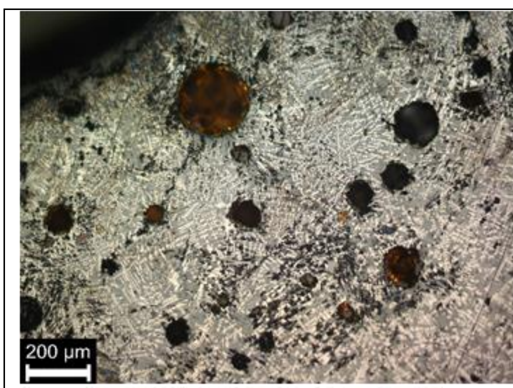
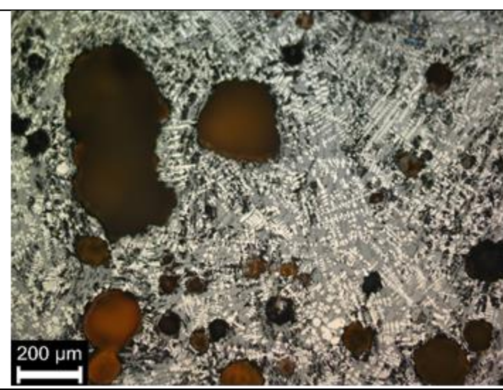
Sample 1 (DC/F 153 2007.117.3.2.85) was a tap slag (Figure 6). Its main phase was lath-like fayalite crystals. Two instances of magnetite oxides were found in the slag. Dendritic wüstite was also present in high concentration in well-formed and ill-formed trees. The slag was very porous.

Sample 2 (DC/F 153 2007.107.3.285) was a non-diagnostic slag (Figure 6). It exhibited lath-like and equiaxed fayalite. Magnetite was not identified in the sample. Dendritic wüstite was also found within the sample. Well-formed trees were located on the right-hand side of the piece, ill-formed trees were located in the middle, and individual oxides were present on the left-hand side. One prill was also seen.

Sample 3 (DC/Ald 1975 1405) was a non-diagnostic slag (Figure 6). Due to a problem with the polishing process, this last sample was not successfully analysed microstructurally.

The two samples, although of distinct categories, showed similar types and structures of oxides. Furthermore, sample 1 seemed to have cooled rapidly, as demonstrated by the lath-like fayalite crystals, while sample 2 exhibits both rapid and slow cooling with the two different crystallisations of fayalite. Since slags are of distinct types, nothing seems to contradict the original conclusion from the visual analysis, which suggested mainly secondary production with possible primary production in the general area. Chemical analysis of the slags showed significant levels of manganese (in excess of 2000ppm in one sample), which is often associated with primary iron production (Mackenzie 2007: 80; McDonnell 1984; 52; 1991: 25; Photo-Jones *et al.* 1998: 30). Further, diagnostic pieces would be needed to reach conclusions about the processes represented.

Adding to these analyses, the excavation of 35 trenches on High Street, which would have been located in the *Vicus*, presented evidence of material dating from the first century AD to the post-medieval period (Chadwick and Burgess 2008: 11). An assemblage of metallurgical debris was recovered on-site and were subsequently analysed by Cowgill (2008). Most of the slags were found in association with the second Roman phase dated to the second century AD. In total, 638 individual pieces of debris were recovered, amounting to 28114 grams (Cowgill 2008: 298). Cowgill interpreted two different groups of slags within this phase were the hearth bottoms, which were small to medium in size in the first group, while the ones from the second were surprisingly large and potentially multi-layered (Cowgill 2008: 299). The assemblage as a whole was interpreted as evidence of a smithy, which would have been in activity during the second century AD (Cowgill 2008: 299). The discrepancy in the size of the hearth bottom was interpreted as a potential deposition of slags from another smith (Cowgill 2008: 301). Cowgill's analysis and its conclusions are consistent with the conclusion formed from the analyses conducted for this thesis that was presented above.

	
Sample 1 Wüstite 10x.	Sample 1 10x

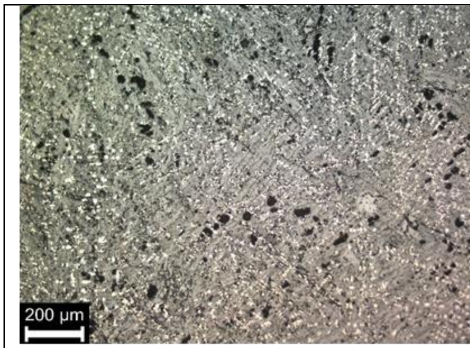
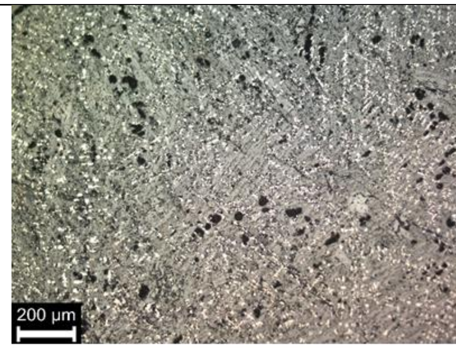
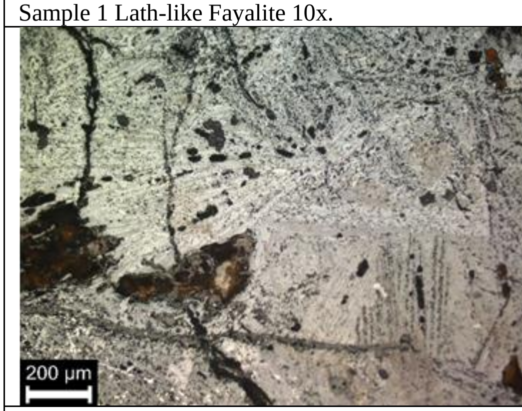
	
Sample 1 Lath-like Fayalite 10x.	Sample 2 Lath-like Fayalite and Wüstite 10x.
	
Sample 2 Lath-like Fayalite	

Figure 6: Microstructural Sample from Doncaster.

Doncaster A638 QBC, Scawthorpe

As part of the evaluation for the York Road Park and Ride scheme, Northern Archaeological Associates, in conjunction with South Yorkshire Archaeology Services, excavated a site near Scawthorpe, north of Doncaster (Bishop 2005: 1; SYAS 2007) (Figure 7). This followed the results of a geophysical survey that took place in this location. Romano-British features were discovered in the southern part of the site. The close proximity of an unexcavated Roman vexillation fortress nearby is also to be noted. Three of the ten trenches dug during this project recovered evidence of occupation and industrial remains that were associated with the Romano-British period (Bishop 2005: 10; SYAS 2007: 85-88). In a possible timber building, there was evidence of the processing of agricultural products and of other domestic activities such as weaving (loom weights) (Bishop 2005: 10). Through ceramic evidence, this occupation was attributed a date ranging between the second and the fourth century AD (Bishop 2005: 10).

The metal working evidence, that was recovered on-site, equated to a total of 25 pieces of slag and fired clay weighing 536 grams (Table 3). It was found in Trench 10, which had been which had remains of Romano-British date (Bishop 2005: 10). Two smithing hearth bottoms (80 grams) and eight non-diagnostic slags were identified in the assemblage. It is to be noted that seven of the

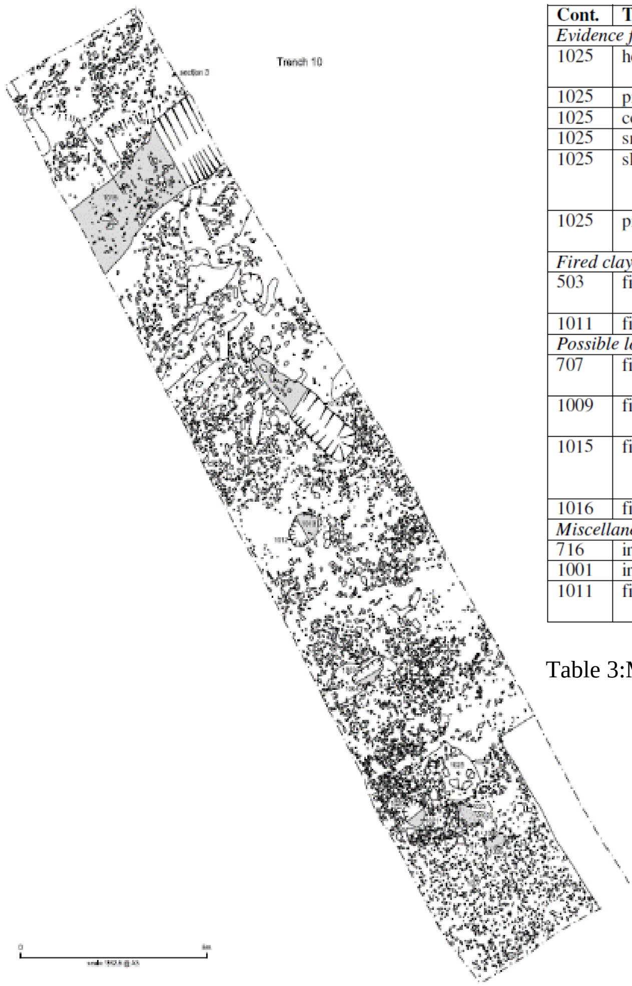


Figure 7: Plan of Trench 10 from Doncaster A638 QBC (Bishop 2005: 45).

Cont.	Type	Count	Weight	Comments
Evidence for iron smithing				
1025	hearth bottom	1	62g	Fresh condition, 50 x 55 x 35mm. Coal fuel.
1025	proto-hearth bottom	1	18g	Encrusted. Coal fuel.
1025	coal	1	2g	Slagged.
1025	smithing-slag lump	7	24g	Fresh condition. Coal fuel.
1025	slag	1	17g	Very magnetic and heavy flat plate, contains ferritic iron or magnetite (Fe_3O_4).
1025	prill			Few very small fragments of magnetic prill.
Fired clays				
503	fired clay	1	5g	Oxidised, slight depression on one side, low fired.
1011	fired clay	1	1g	Oxidised, sandy, low fired.
Possible loomweights				
707	fired clay	4	33g	Dense fabric, large grog temper, shaped surfaces.
1009	fired clay	1	28g	Same fabric as (707), shaped surfaces.
1015	fired clay	2	249g	Occasional organic + ?grog temper, smooth surfaces, large wattle imprint or loomweight perforation.
1016	fired clay	1	38g	Joins piece from (1015).
Miscellaneous				
716	iron stone	1	27g	Natural.
1001	iron stone	2	31g	Natural.
1011	fired clay	1	1g	Probably pot sherd, 1 very smooth surface.

Table 3:Metallurgical Debris from Doncaster A638. (Cowgill 2005: 29).

latter group were identified in the report as “smithing-slag lumps” (Cowgill 2005: 29). This classification, however, is not part of the present study and is not noted in publications known to the author nor in other reports surveyed. Therefore, they were renamed for the current purpose. This rather small assemblage of metalworking debris has been identified as an example of smithing activity that would have happened on site or nearby (Bishop 2005: 10; Cowgill 2005). Further excavation in 2007 added details to this interpretation and furnished evidence of late first century to early third-century AD pottery (SYAS 2007).

Doncaster Roman Pottery Production Area (Cantley East Kiln Group/Cantley Housing Estate, Doncaster: site 3, kilns 7-8 and 22-29)

This pottery production area located at the east and south of Doncaster is composed of three groups with a varying number of kilns in each one. The production of ceramics began in the Flavian period with the foundation of the fort at Doncaster (Danum) in the mid-late first century AD (Buckland, Magilton and Dolby 1980: 146-147). The production of pottery then surged in the early Antonine period probably caused by the arrival of specialised potters from Mancetter (Buckland, Magilton and Dolby 1980: 146-147), who began to mark the pottery with *Sarrius*, *Setibogius* and *Secundua* stamps (see chapter 3 and 7). From the third century AD, the extensive distribution of pottery produced at Doncaster ceased, and the industry remained focused on localised production until it stopped completely in the second half of the fourth century AD (Buckland, Magilton and Dolby 1980: 147).

Doncaster Pottery Production Area		
	Pieces	Weight (g)
Iron		
Fragment	3	134
NDS	11	1018
Tap Slag	7	961
Furnace Slag	3	498
SHB	0	0
Copper Alloy		
Slag	0	0
Fragment	0	0
Lead		
Fragment	0	0
Pyrotechnical Cera		
Furnace Lining	24	61
Tuyères	0	0
Fragments	0	0
Crucibles	0	0
Total	48	2672

Table 4:Metallurgical Debris from Cantley Kilns.

Excavation in the east group near Acacia Road between 1953 and 1957 (Cregeen 1958) yielded an interesting discovery; 25 pieces of slag were found (Table 4). Out of the total of 25 that were associated together, seven were tap slags of various sizes and forms, two were possibly fragments of bloom or pieces lost during the consolidation of the bloom, two were furnace slags, and 14 were non-diagnostic pieces of slags. The slags weighed a total of 2738 grams, with the largest group being tap slags with 961 grams, representing 35% of the total. The associated furnace structure was dated to the late first century AD to the early second century AD through its association with a quern (Cregeen 1958: 40). The metallurgical debris found in the Cantley East Kiln Group can be interpreted as a limited production of iron in the vicinity, most probably using a tapping furnace. It would appear that no smithing took place on-site, although small slag pieces could indicate the consolidation of blooms. It was suggested by Cregeen (1958: 41) that bog iron was used in the smelting activities (see chapters 6-7).

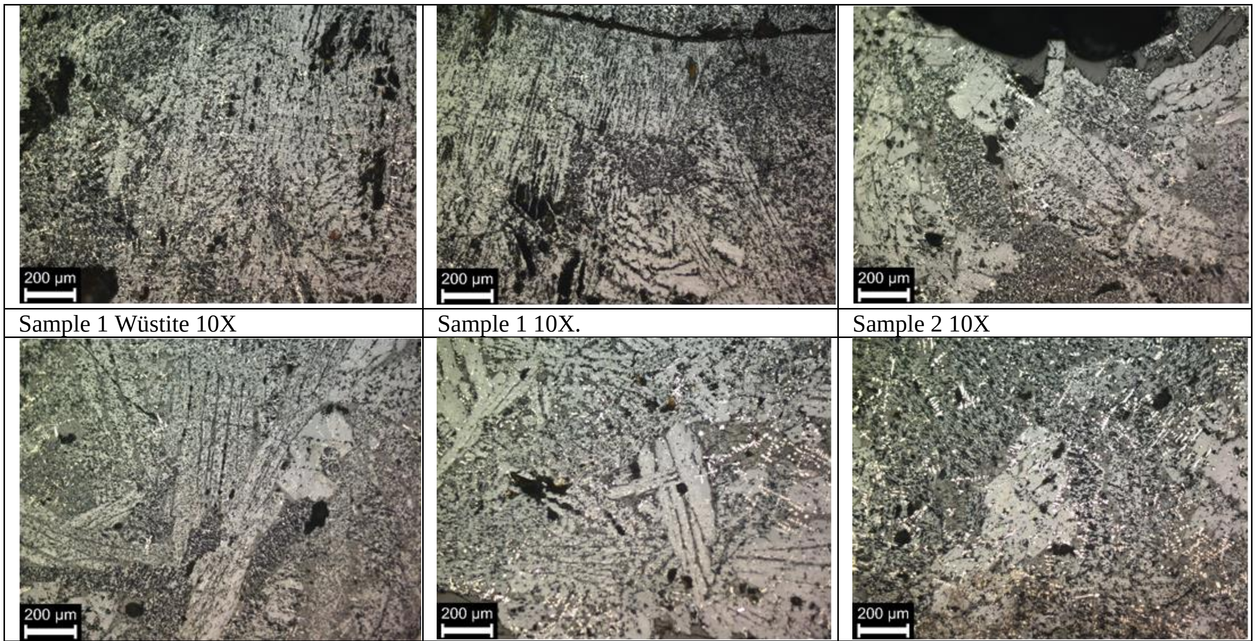
Microstructural analysis of a selected number of artefacts was conducted. Overall, three samples were selected. They were all categorised as tap slags.

Sample 1 (Figure 8) from the "end of trench 2" excavation exhibit a main phase composed of lath-like and equiaxed fayalite. The latter was located on the bottom of the sample. Wüstite was identified within the piece. It was present in the form of well-spaced trees on top of the sample and as ill-formed trees on the bottom. Magnetite was also present, although it was rare. The sample was porous, and prills were found.

Sample 2's (Figure 8) main phase was closely formed lath-like fayalite crystals. Some equiaxed fayalite was also present to some extent at the bottom of the sample but in far less number. The sample did not exhibit a lot of oxidic formations. Some rare occurrences of dendritic wüstite were seen in the form of ill-formed trees and in individual rounded oxides. Furthermore, some rare occurrences of magnetite were found on the top of the sample.

Finally, sample 3 (Figure 8) exhibited lath-like and equiaxed fayalite as the piece's main phase. They were on opposite sides of the slag. In terms of oxidic formations, well-formed dendritic wüstite trees were present on the side of the equiaxed fayalite. The wüstites were also present in the form of individual oxides on the side where lath-like fayalite was found. Magnetite was also present, even if it was quite rare. This sample was very porous, and prills of metal were present throughout.

All the slags analysed showed unequal crystallisation rates as seen through the presence of both lath-like and equiaxed fayalite in each sample. Wüstite was present substantially in each sample, and magnetite was present but less so than the former. This could suggest that a uniform practice was in place or that these slags come from one metallurgical episode. Chemically, phosphorus, manganese and sulphur were present in significant amounts, but these were the only elements linked to metallurgy that were present in a substantial amount except for a small quantity of zinc. These results seem to be in accordance with the smelting nature of the assemblage (see chapter 6).



Sample 1 Wüstite 10X | Sample 1 10X. | Sample 2 10X

Sample 2 Lath-like Fayalite 10X | Sample 3 Lath-like Fayalite 10X. | Sample 3 Wüstite 10X.

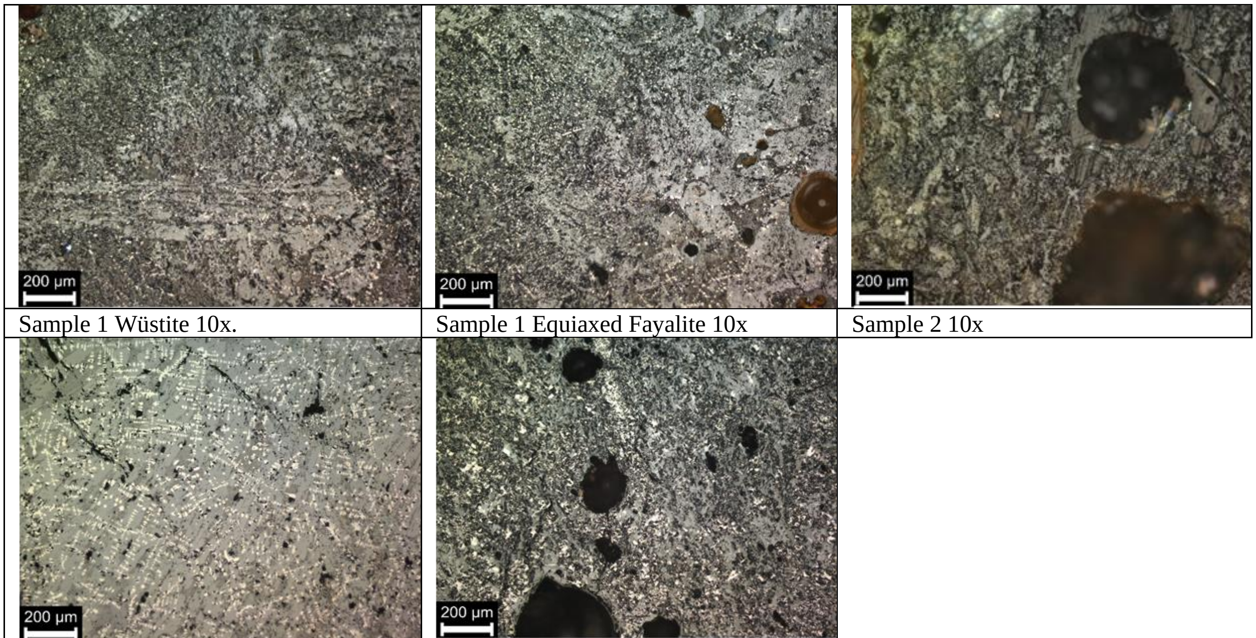
Figure 8: Microstructural Samples from Cantley Kilns

Three other samples from a different archaeological feature were also selected, this time from the excavation on Acacia Road. As for the slags selected from the end of trench 2 in Cantley, the slags selected from Acacia Road were tap slags.

Sample 1 (Figure 9) exhibited two main phases. The centre of the sample showed equiaxed fayalite, while the edges of the sample revealed lath-like fayalite. Wüstite was present in the sample in multiple forms. Well-formed trees of the oxide were all located on one side of the piece in association with the equiaxed fayalite. Ill-formed trees and individual spots of wüstite were present over the whole sample. Some rare (3) occurrences of magnetite were also seen as well as prills.

Sample 2 (Figure 9) exhibited some fractured lath-like fayalite as its main phase. No wüstite was seen, but some magnetite was present, although in limited number. Furthermore, no prills were identified.

Sample 3 (Figure 9), on the other hand, had a number of prills but no magnetite. The main phase of the slag was lath-like fayalite crystals. Wüstite was observed throughout the piece. Individual oxides were present throughout the sample but transformed into well-formed dendritic wüstite in one half of the sample.



Sample 1 Wüstite 10x. | Sample 1 Equiaxed Fayalite 10x | Sample 2 10x

Sample 3 Wüstite 10x. | Sample 3 10x.

Figure 9: Microstructural Samples from Acacia Road.

Only one of the slags had equiaxed fayalite, and it was only present in the centre of the sample. This would indicate that the slags were rapidly cooled once out of the furnace. Sample 2 did not contain wüstite, but the other two did. All of them had some magnetite. This seems to indicate that all the slags were cooled in relatively similar conditions and that they could have been produced in similar reducing conditions. Chemically, the only significant peaks of elements were phosphorus, manganese, and sulphur. All this seems to confirm the nature of the assemblage, which appeared to be the primary production of iron (see chapter 6).

Field Lane, South Elmsall

Site C, near Field Lane, is one of great antiquity, with evidence of Bronze Age and Iron age occupations (McNaught 1998; Grassam 2010: 74). The evidence for the latter period consists of four sub-rectangular enclosures within a field system (Grassam 2010: 7). Significant evidence for the raising of cattle was found in the form of large assemblages of butchered animal remains (McNaught 1998: 7; Grassam 2010: 62, 76). This landscape survived to a certain extent in the Later Iron Age and early Romano-British periods, although they are difficult to grasp completely here. Although field systems were potentially still in use during the beginning of the first century AD, only a small quantity of material from that period was found (McNaught 1998: 17; Grassam

2010: 78-79). From what can be inferred from the small number of domestic artefacts, the site probably went out of use by the end of the first century AD (Grassam 2010: 79).

The only activity that could be associated with both the Late Iron Age and the Roman period appears to be a metalled surface around 400m^2, associated with nine pits and post holes, that was excavated and produced a significant assemblage of metallurgical debris associated with the late Iron Age and continuing into the early Roman period (Grassam 2010: 66) (Table 5).

Location	Field Lane		Doncaster Road		Dale Lane			
	Quantity	Weight (g)	Quantity	Weight (g)	Quantity	Weight (g)	Totals	
Smelting Slags								
Flow	6	2011	0	0	0	0	6	2011
Furnace Slag	1	848	0	0	0	0	1	848
Furnace Structure	1	238	6	1447	0	0	7	1685
Fired Clay	7	55	0	0	0	0	7	55
Slag	0	0	16	1531	4	65	20	1596
Tap Slag	1	20	11	1330	0	0	12	1350
Smithing Slags								
Cinder	12	74	0	0	0	0	12	74
Hearth Bottoms	14	2902	0	0	12	610	26	3512
Slag	64	652	0	0	0	0	64	652
Smithing Slag Lumps	11	384	0	0	0	0	11	384
Non Specific Types								
Clinker	3	12	0	0	0	0	3	12
Fuel Ash Slag	16	5	0	0	0	0	16	5
Fired Clay	7	55	0	0	0	0	7	55
Iron Stone	5	21	3	40	0	0	8	61
Vitrified Clay	0	0	4	613	0	0	4	613
Vitrified Lining	15	49	0	0	0	0	15	49
Total	163	7326	40	4961	16	675	219	12962

Table 5: Metallurgical Debris from Field Lane and Associated Sites (Cowgill 2010: 44)

This surface was probably delineated by an older ditch, potentially still visible but not in use at the same time as the metalled surface (Grassam 2010: 17). Considering the metalworking debris, a significant amount of hammerscale was discovered in post holes, strongly suggesting that iron smithing was conducted there (McNaught 1998; Grassam 2010: 46-47). In fact, Cowgill noted that the slags recovered there were “fairly diverse in appearance and do not show the consistency of type that occurs when an assemblage is derived from a single smithy or is the by-product of one smith” (Cowgill 2010: 44). In addition to the material associated with this metalled surface, fourteen smithing hearth bottoms were recovered, along with 64 non-diagnostic examples and eleven smithing slag lumps (Cowgill 2010: 46-47). Furthermore, evidence for copper metallurgy was found with those slags. Interestingly, evidence of smelting activities was discovered (Grassam 2010: 49) but was not linked to the Roman period.

Iron Age or Romano-British Field System, Enclosures, and Trackway, Mexborough

Two or Three enclosures were identified through geophysical survey and then excavated in 2006 and 2008 (00094/01 - MSY372 2006; Williams and Weston 2008). The Roman phase on this site coincides with the establishment of the third enclosure, along with the re-cutting of a pre-existing one and the extension of the surrounding field system (00094/01 - MSY372 2006). Slags were recovered from this site, but no further information was available concerning their date or nature.

Hatfield Lane, Edenthorpe

The excavation of the land off Hatfield Lane by West Yorkshire Archaeology Service revealed the existence of an enclosure complex in association with a rectilinear field system (Weston 2015: 46). This settlement was found through the presence of a high concentration of Romano-British pottery can be found within the field system, indicating either intense activities or settlements (Weston 2015: 46). The settlement developed slowly through its existence to a 'ladder' type settlement. Based on pottery analysis, the site seems to have been occupied from the second half of the second century to the second half of the third century AD (Weston 2015: 47) (Figure 10). The exact nature of the occupation is difficult to discern due to the lack of clear structures in the enclosure complex. Features clustered on the northern side of enclosure 2 might indicate an area of intense activity, perhaps as an annexe to a nearby settlement where crop processing was conducted on an occasional basis, along with some activities possibly linked to pottery production and metalworking (Weston 2015: 47-49). The slag assemblage from Hatfield Lane was analysed by Gerry McDonnell (2015) (Table 6). All the slag was recovered within one single feature (Ditch 2) and has been dated to the second half of the second century AD (McDonnell 2015: 39). The small assemblage (815 grams) contained four smithing hearth bottoms weighing a total of 580 grams (Table 6). Eleven non-diagnostic slags were attributed by McDonnell to smithing activities. Only a portion of the ditch where the slags were found was excavated, and it is important to note that more slags might have been found had the excavation uncovered a larger portion of the ditch. It was suggested in the report that the small dimension of the smithing heart bottoms indicates that the smith or smiths followed a Late Iron Age metalworking tradition rather than a Roman one, a period in which diagnostic pieces would have been larger (McDonnell 2015: 39-40). Finally, this assemblage, although small, seems to indicate the presence of a smithy either in the excavated area or in the immediate vicinity (McDonnell 2015: 40).

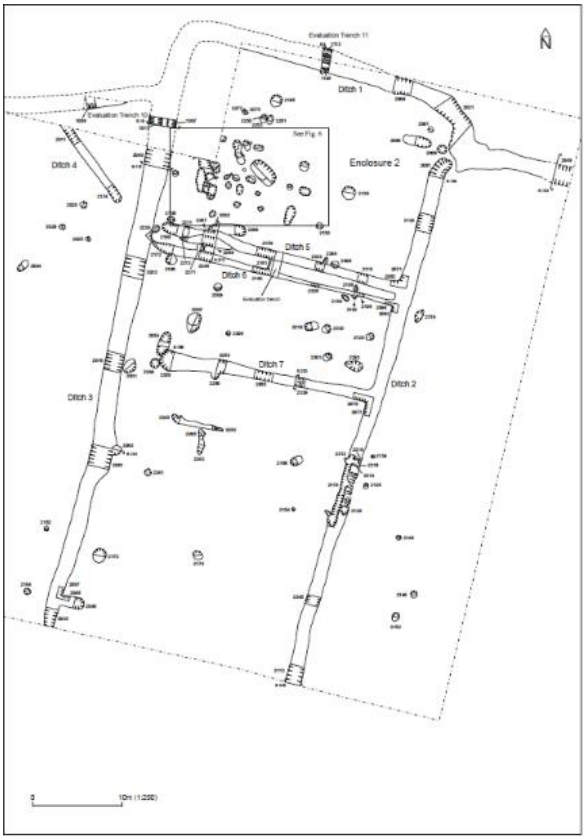


Figure 10: Plan of Area 3 and 4 which Contain Ditch 2 (Weston 2015: figure 5).

Location	Hatfield Lane	
Site Code	HL	
	Pieces	Weight
Iron		
Fragment	0	0
NDS	11	235
Tap Slag	0	0
Furnace Slag	0	0
Smithing Heart Bottom	4	580
Copper Alloy		
Slag	0	0
Fragment	0	0
Lead		
Fragment	0	0
Pyrotechnical Ceramics		
Furnace Lining	0	0
Tuyère	0	0
Fragments	0	0
Total	15	815

Table 6: Metalworking Debris from Hatfield Lane (McDonnell 2015: 40).

Hemsworth Bypass

This site was excavated by West Yorkshire Archaeology Service in advance of the construction of the new Hemsworth Bypass in West Yorkshire. The excavation can be separated into two different sites (Morris 1996: 4). Site A consisted of four ditches and a number of isolated features (stake holes, post-hole, pits, etc.) (Morris 1996: 13). A substantial amount of pottery was recovered, which seemed to place the occupation of the site between the second to the third century AD (Morris 1996: 20-21). It is thought that site A could be domestic in nature, due to the high number of finds there (Morris 1996: 24). Site C consisted of part of an enclosure made up of three ditches and isolated features (Morris 1996: 24). A large oval pit was interpreted as a possible burning area (Morris 1996: 24). Significantly fewer artefacts were recovered from site C, which led the project leader to interpret it as a non-domestic area of the whole site (Morris 1996: 24). Three slags were found in association with a small amount of pottery dating to the second to the fourth century AD

(Morris 1996: 24.). These were the only stratified finds on site C. Sadly, no other information was found on the nature or appearance of the slags recovered.

Holme Hall Quarry, near Stainton

Holme Hall Quarry was excavated by the now-defunct Archaeological Research and Consultancy at the University of Sheffield in the early 2000s. The site was excavated in advance of the extension of the nearby quarry by Tarmac Quarry Products Ltd. The main period of activity on this site probably occurred in the Late Iron Age and Romano-British periods (O'Neill 2007). At that time, an enclosure of sub-circular form was built and was part of what ARCUS interpreted as a rather small farmstead (O'Neill 2007: III). Most of the features found on-site dated to the second to the third century AD (O'Neill 2007: 101). These structures were three hearths, a gully, a number of post holes and a rather large area scattered with heat-affected cobbles that had possibly been used in domestic activities such as cooking (O'Neill 2007: 102). Most of the ceramic remains recovered were concentrated around these features (O'Neill 2007: 101). An enamelled brooch was also found (O'Neill 2007: 102). Outside of this enclosure, the excavators found three ovens, a rubble bank/boundary, a midden, and a number of pits and gullies (O'Neill 2007: 102-103). Two thousand nine hundred sherds of pottery were found within the midden (O'Neill 2007: 103). These date to the late third century (O'Neill 2007: 103). The analysis of the environmental samples showed that the occupants of the farmstead not only cultivated the soil for agricultural products but also raised cattle in significant numbers (O'Neill 2007: 103).

2.20 kilograms of metalworking debris were found at Holme Hall Quarry (Mackenzie 2007: 70) (Table 7). This included one smithing slag, eleven tap slags, 19 furnace slags and 29 non-diagnostic slags (Mackenzie 2007: 70). Although tap slags are generally thought to be typological evidence

Location	Holme Hall Quarry		Total	
	Quantity	Weight (g)	Quantity	Weight (g)
Smelting Slags				
Block	0	0	0	0
Furnace Slag	19	790	19	790
Smelting Slags	0	0	0	0
Tap Slag	11	450	11	450
			0	0
Smithing Slags			0	0
Hearth Bottoms	0	0	0	0
Smithing Slag	10	228	10	228
Non-Diagnostic	29	691	29	691
			0	0
Non Specific Types			0	0
Clinker	0	0	0	0
Furnace Structure	0	0	0	0
Fuel Ash Slag	7	16	7	16
Fired Clay	0	0	0	0
Iron Stone	0	0	0	0
Vitrified Clay	0	0	0	0
Vitrified Lining	0	0	0	0
Total	76	2175	76	2175

Table 7: Metallurgical Debris from Holme Hall Quarry (Mackenzie 2007: 70).

of smelting activities using a tapping furnace, chemical analysis conducted by R. Mackenzie (2007: 73) indicated that these were not created from smelting processes because of the absence of manganese in the chemical composition of the slags (Mackenzie 2007: 74). After a study of the slags from that site present at the Doncaster Museum and Art Gallery, tap slags could not be identified in the slag assemblage. It is to be noted, however, that not all slags were present in the stores and that some of them may have been lost, misplaced, or misidentified. Nevertheless, based on the site report and on personal analysis, it appears that the metallurgical activities taking place at Holme Hall Quarry or in the vicinity during the second and third century AD were indeed smithing.

Although Mackenzie (2007: 73-74) already analysed a selection of slags from Holme Hall Quarry, the metallurgical assemblage from Holme Hall Quarry was selected for further analysis using this project methodology and concentrating exclusively on possible flowy tap slags. Three samples were selected because of their structure which showed some solidified vitrified flow of material from the Doncaster Museum and Art Gallery.

Sample 1 (121d 186 Bulk) (Figure 11) had very thin lath-like fayalite crystals. Well-formed dendritic wüstites were identified and around the most porous areas of the sample. Magnetite was also identified. The sample was extremely rusty and porous.

Sample 2 (Q186 Q5.1) had long, well-spaced, thin lath-like fayalite crystals (Figure 11). Wüstite was rare within the overall sample and was present as individual pieces of oxides. However, Magnetite was present in quantity in the slag, along with a lot of metal prills.

Sample 3 (Q186 QC.2) had only a small quantity of fayalite crystals (Figure 11). When these were visible, they were equiaxed. Wüstite was present all over the sample as individual oxides rather than trees. Magnetite was present, as were prills. The sample was quite porous.

The microstructure of the three samples does not suggest a uniform practice at Holme Hall Quarry as they contain different types of fayalite crystals and marked variation in the types and structures of the oxides. Chemical analysis concurs with the conclusions reached by MacKenzie (2017: 73) with low levels of manganese, an element associated with primary iron production (MacKenzie 2007: 80; McDonnell 1984; 52; 1991: 25; Photo-Jones *et al.* 1998: 30). These macroscopic, microstructural, and chemical results confirm MacKenzie's (2007) assessment of the assemblage as related to iron secondary production.

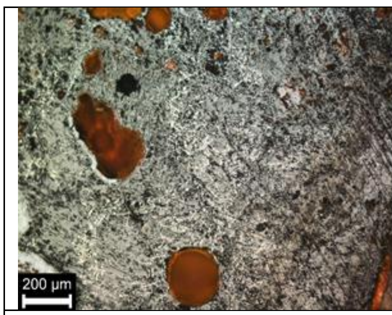
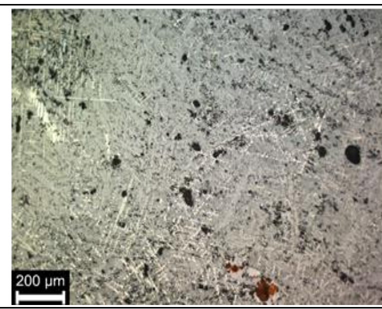
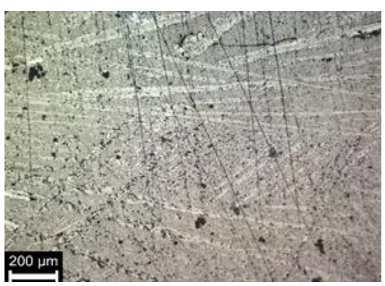
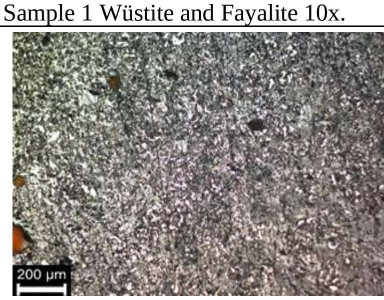
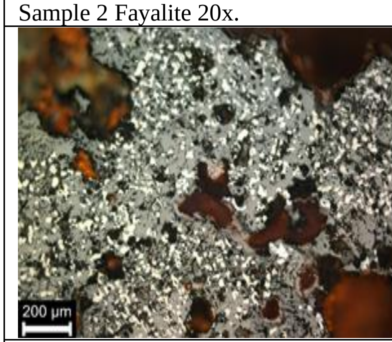
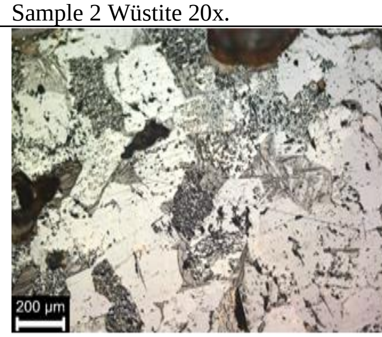
	
Sample 1 10x.	Sample 1 Wüstite and Fayalite 10x.
	
Sample 2 Fayalite 20x.	Sample 2 Wüstite 20x.
	
Sample 3 Wüstite 10x.	Sample 3 Fayalite 10x.

Figure 11: Microstructural Samples from Holme Hall Quarry.

Huggin Lakes, Armthorpe

A series of trial trenches, dug by Northamptonshire Archaeology shed light on the nature of the ancient occupation at Huggin Lakes. A complex of ditched enclosures was identified through geophysical surveys that preceded the trial trenches (Meadows 2010: 1) (Figure 12). The excavation confirmed the presence of these features. The subsequent analysis of the pottery indicated that the site was most probably occupied during the second and third century AD, with possible later occupation in the fourth century AD (Meadows 2010: 18). Activities on site were attributed probably to agricultural endeavours, perhaps a small stock enclosure or a small field (Meadows 2010: 18). The blacksmithing evidence recovered, which will be explored further in the next paragraph, was in support of this primary site function (Meadows 2010: 18).

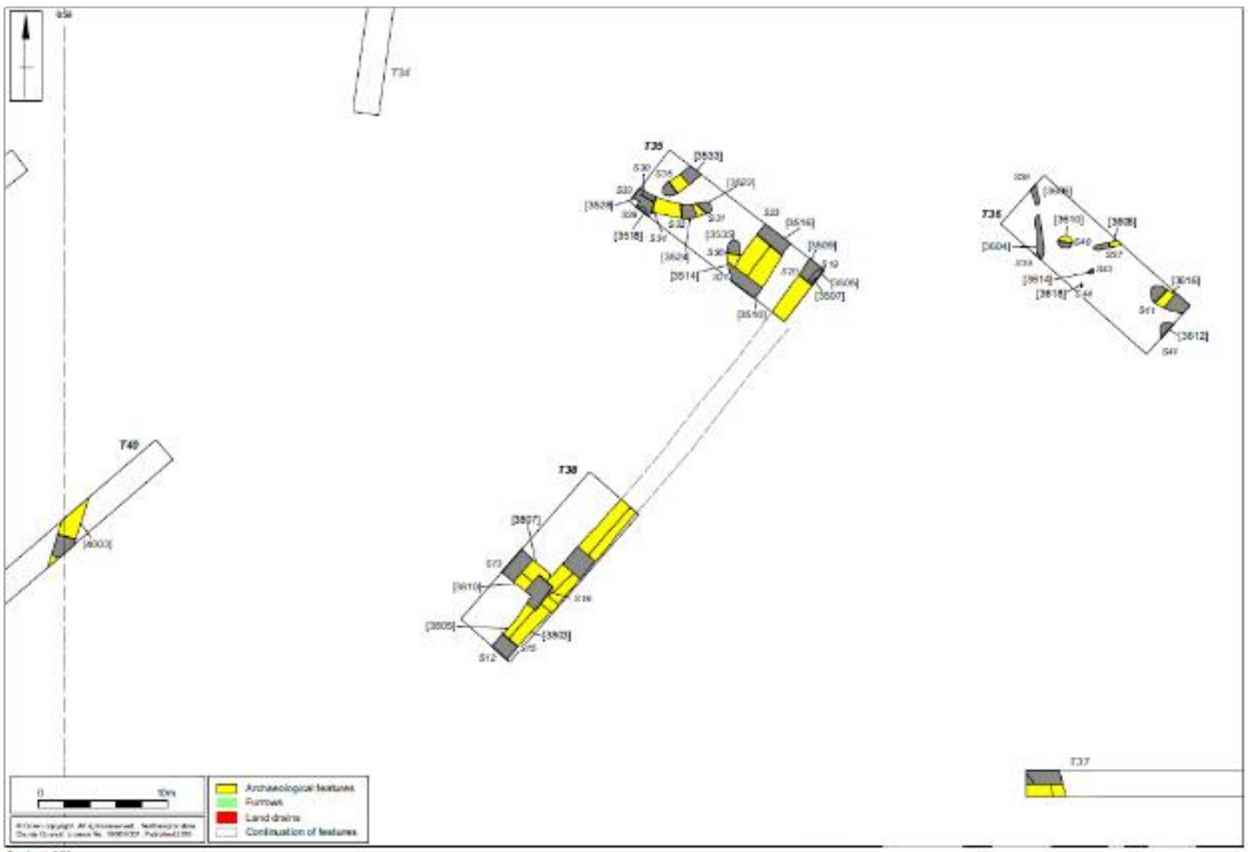


Figure 12: Plan of Trenches 35, 36, 38 and 40 (Meadows 2010: 55).

The metalworking debris found at Huggin Lakes can be subdivided into two groups (Chapman 2010: 15). First, half of a heavily burnt blowing hole, along with two fragments of the same or of a similar blowing hole (Chapman 2010: 15). These were heavily vitrified, as one would expect from that kind of debris (Chapman 2010: 15). Second, a small number of non-diagnostic slags were found (Chapman 2010: 15). These vary in texture from dense masses of slag to more fluid looking ones. Although the evidence is rather tenuous, it would be reasonable to think that the blowing hole and the non-diagnostic slags are remains of smithing activities (Chapman 2010: 15). Further field walking was conducted by the author of the present thesis. Although it was hoped that this survey might find more metallurgical slags, nothing of note was identified.

Romano-British Cropmark with associated Artefact Scatter, Loversall

This artefact scatter has been identified in Loversall within a number of notable cropmarks (02621/01-MSY558). The scatter contained slags, pottery, and flints. These finds cannot be attributed to a specific era or occupation, but the Romano-British, Medieval, and Post-Medieval periods are represented in these discoveries (02621/01-MSY558).

Manor Farm

The archaeological site at Manor Farm, Bessacarr, just to the southeast of the modern town of Doncaster, is one of the most important discoveries in the recent history of the area. It is now set within overgrown former pastures with some woodland in the vicinity (Stubbings 2017a: 11). In antiquity, the site was located inside Carrs or wetlands, which would have been managed by ditches and dykes. The occupation area was situated on slightly higher ground, and this would have profited from better drainage than the low marshy ground (Stubbings 2017a: 35). In close proximity to the site are a number of kilns in Cantley and Bessacarr. Other sites in Armthorpe, such as Huggin Lakes or Gunhills, are also located quite close to Manor Farm.

Since its discovery in the mid-2000s, this fascinating archaeological site has been the focus of a number of investigations. In 2007, a soil auger investigation was carried out on the whole site by Archaeological Research Services (Passmore and Waddington 2007). In 2008, an extensive geophysical survey was done by Stratascan (Smalley 2008). This survey showed rather large areas of magnetic disturbances, including a larger one on the northeast corner of the site. Then, in 2010, 89 trial trenches were dug by Map Archaeological Practice Ltd. (Stephens 2011: 8). The remains of what appears to be a working surface contained a large amount of ironworking debris and iron smelting debris (Stephens 2011: 56). Post-holes around this surface suggest the presence of temporary structures contemporary with the metallurgical activities, perhaps partial shelters to shelter the workers (Stephens 2011: 56). Furthermore, copious quantities of oak fuel ash slags and remains of oak charcoal were discovered on-site, perhaps showing that this was the fuel used in iron smelting and smithing. Datable materials were found in stratified contexts and in association with the metallurgical activities in Manor Farm, which indicates that the site was occupied and in use in the second century AD (Stephens 2011: 56).

Larger scale excavations in 2014-2015 (Blocks 1-3) added further precisions on the nature of the activities that took place on-site (Stubbings 2017a). More slags were found associated with the working area (Phase 2c), along with further deposits of fuel waste material, two hearths and an *in-situ* mortarium from the second century AD (Stubbings 2017a: 19-20) (Figure 13). Further datable material seems to indicate that the main occupation and the use of the working area was spanning from the end of the first century AD to possibly the end of the second or the early third century AD (Stubbings 2017a: 34). While this may seem short in the grand scheme of things, one should not forget that this 100-to-120-year occupation represents far more than the life span of one individual and that this smelting site would have been known and remembered by the people living in the region. Close to the working area, two possible roundhouses were found (Phase 2c) (Stubbings 2017a: 34). These could not be precisely dated through material evidence, although the finds were similar to those found in the working area, so the houses may be of similar date. These have been interpreted as living quarters for the smelters (Stubbings 2017a: 34). A large ditch was dug on the southern side of the working area. This feature may have aided the drainage of water from the working area or ensured a constant supply of water to be used in the metallurgical activities (Stubbings 2017a: 34).

Another part of the site, Block 4, was excavated in 2015-2016 (Stubbings 2017b). A small quantity of slag was found in that part of the site, but most of it comes from the medieval and post-medieval periods (Stubbings 2017b: 32-33). Furthermore, this area of the larger site is not associated with metallurgy but rather with limited pottery production with the presence of a kiln and wasters (Stubbings 2017b: 36). This kiln would have been in use at the same time as the working area with pottery, indicating an initial usage in the Flavian-Trajanic period (late first century-early second century AD) and then a second in the Hadrianic-Antonine period (first half of the second century AD) (Stubbings 2017b: 36).

Preliminary analysis of the slag assemblages from the trial trenches of 2010 and the excavation of blocks 1-3 was conducted by Mackenzie (2011; 2017a). These analyses did not advance beyond the macroscopic analytical stage. Furthermore, it was recommended to hold further microstructural analyses until the site was completely excavated due to its potential national and cross-regional relevancy.

The 89 trial trenches dug on site in 2010 uncovered substantial evidence of iron smelting (Mackenzie 2011: 203-204; Table 8). In total, over 75 kilograms of metalworking debris were found (Mackenzie 2011: 203-204). Also, over 70 furnace slag examples were identified within the debris group (Mackenzie 2011: 204). This amounts to a total of 66 kilograms. In addition, 47 non-diagnostic slags were found, amounting to eight kilograms. These two groupings combined for a total of 133 metalworking slags with a weight of 76 kilograms (Mackenzie 2011: 204).

The assemblage recovered from the excavation of block 1-3 amounted to a total of 140 pieces of metallurgical debris amounting to 129 kilograms (Mackenzie 2017a: 152-166; Table 8). This large quantity of metalworking debris was found in association with bases of furnaces and/or hearths which could have produced these slags and other pieces (Mackenzie 2017: 149-150). The fragments, analysed by Mackenzie (2017a: 149-150), represent diagnostic pieces apparently linked with iron smelting. Initial characterisation seemed to indicate that there is an absence of smithing slags, but further re-examination showed that some were indeed present, and that partial or fragmented smithing hearth bottoms were among the non-diagnostic pieces. Block 4 was not previously analysed. The author of the present thesis was able to weigh the totality of the slags recovered from that later excavation, but due to time constraints, each piece was not counted individually. The totality slags recovered from block 4 amounted to 26 kilograms in total and were all identified as non-diagnostic slags.

Location	**Manor Farm**							
Site	**Trial Trenches 2010**		**Block 1-3**		**Block 4**		**Total**	
	Pieces	Weights (g)	Pieces	Weights (g)	Pieces	Weights (g)	Pieces	Weights (g)
Furnace Bottom	0	0	4	29500			4	29500
NDS	47	8134	76	73136		26000	Over 123	107270
SHB	0	0	2	9000			2	9000
Runs	0	0	24	593			24	593
Smelting Slag	0	0	12	340			12	340
Non-Tapping Block	0	0	14	16000			14	16000
Ceramics	9	1330	8	546			17	1876
Furnace Slag	77	66435	0	0			77	66435
Total	133	75899	140	129115		26000	Over 273	231014

Table 8: Metalworking Debris from Manor Farm (Mackenzie 2011; 2017).

Further examination of the metalworking debris assemblage at MAP Archaeological Associates Ltd showed that the total of all slags recovered from Manor Farm amounts to over 273 individual pieces of debris weighing 231 kilograms (Table 8). Out of this total, the main category is, as expected for most groups of slag, the non-diagnostic pieces, followed by furnace slags. Interestingly, 24 runs of slag were also identified. The assessment of this assemblage suggests that two different smelting techniques may have been used on-site, non-tapping and tapping. This character of the site could be of national significance, and a full assessment and analytical protocol should be put forward once the site has been fully excavated to ascertain the exact nature of metallurgical activities.

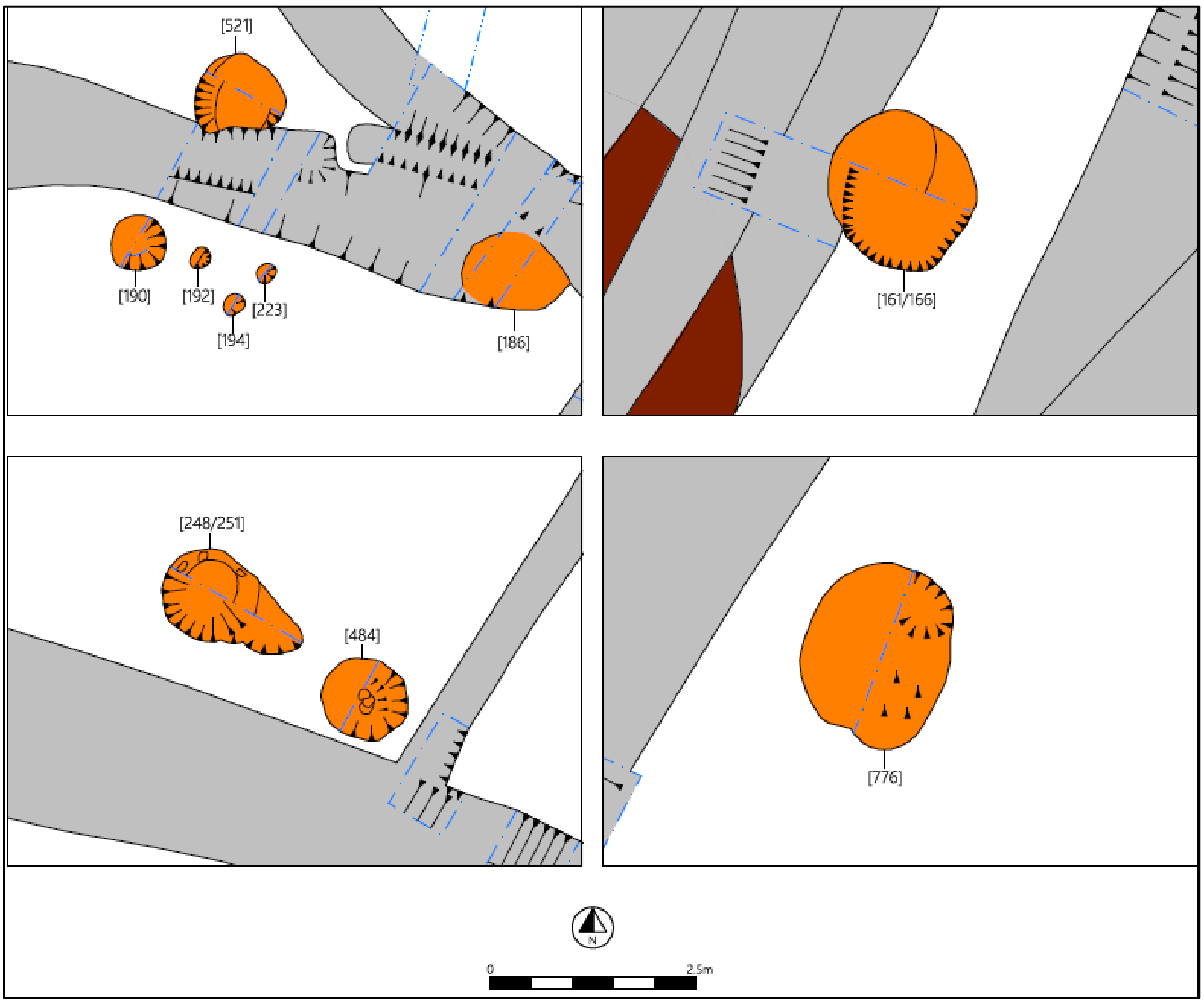


Figure 13: Series of Features in Manor Farm from Phase 2c including Possible Hearths or Furnaces (248, 161) (Stubbings 2017a: 48).

Metalworking finds in Tickhill.

Four areas in Tickhill were geophysically surveyed in 1980 before the development of these fields (SYAS 04090/01-MSY11206; SYAS 04091/01-MSY11207; SYAS 04092/01-MSY11208). No reports were found, but, according to SMR files, a number of items of domestic nature were recovered (SYAS 04090/01-MSY11206; SYAS 04091/01-MSY11207; SYAS 04092/01-MSY11208). These included rings, coins of Roman date, pendants, an ampulla, and a brooch, among other artefacts (SYAS 04090/01-MSY11206; SYAS 04091/01-MSY11207; SYAS 04092/01-MSY11208). Notably, for our purpose, metalworking debris were also recovered during the geophysical surveys. Sadly, no reports exist that could give more information on their nature. The debris also were not located in the Doncaster Museum stores, where the Site and Monument Record for South Yorkshire noted they were deposited.

Navio Roman Fort, Brough-on-Noe.

Located in Brough-on-Noe in the Peak District, the small Roman military site of Navio is at the most easterly point in the study area of this thesis. Founded around 80 AD, it was probably first established as an auxiliary fort used in the pacification of the Peak District during the Cerialis campaign in the 70s AD (O'Neill, Tuck and Whittaker 2017: 2; Dearne 1993). This first occupation ended around AD 120 (O'Neill, Tuck and Whittaker 2017: 2). However, it was not unoccupied for long. The site was reoccupied again around AD 154-158 (O'Neill, Tuck and Whittaker 2017: 2). At that point, the fort contained barracks, granaries, storage areas, and, probably, a *Principia* along with a *praetorium* (O'Neill, Tuck and Whittaker 2017: 2). The granaries of the auxiliary fort were then partially rebuilt in stone, and the barracks were remodelled during the Severan period (O'Neill, Tuck and Whittaker 2017: 3). In addition, in the early fourth century AD, the barracks were rebuilt using stone and timber, while the granaries and the *praetorium* were re-organised (O'Neill, Tuck and Whittaker 2017: 3). Evidence on site indicates that this was the last occupation and that it was definitively abandoned around AD 350 (Dearne 1993: 149). Archaeological work between 1980 and 1983 discovered a possible but poorly understood metal workshop and two roads exiting the fort from the South-Eastern gate, and these archaeological investigations also suggested the presence of a 'civilian' settlement associated with the military site (Frere, Hassall, and Tomlin 1985: 282).

The early discovery of lead artefacts and lead ore during the excavation of the fort seemed to suggest a relationship between the fort of Navio and Roman lead production in the Peak District. The nature of this link has always been difficult to ascertain due to the limited evidence recovered. Geochemical and geophysical surveys took place in 2017 (Clarke 2017) (Figure 14) on the whole area covered by the fort, and it was expanded to encompass possible surrounding zones of activities. This geophysical survey was conducted by Nicolas Clarke (2017) as part of a research group on Peak District Lead at the University of Sheffield. Further work has also been conducted by David Inglis and Joshua Toulson in 2019 and 2020.

Figure 14: Geochemical and resistivity data from Navio. (Clarke 2017: 46)

Anomalies in the chemistry of the soil hint at a possible link between lead-working and the Roman fort (Clarke 2017: 55-56) (Table 9). The exact nature of the production activities is still difficult to clarify, but, when comparing the level of lead present in the soil with other Roman lead production sites in Britain, it seems plausible that primary production took place within the "civilian" settlement (Clarke 2017: 55-56). Furthermore, other high readings of lead were found within the fort in association with storage areas in the *Principia* identified by Richmond (1938) and these high levels of lead were potentially interpreted as being related to the storage of lead ingots (Clarke 2017: 55) (Table 9). More recent work conducted by the University of Sheffield did not produce evidence of lead working (Toulson Forthcoming).

Description	**Min reading (ppm)**	**Max (ppm)**	**Range (ppm)**
Typical background in lead-low areas, UK. (Aston *et al.* 1998)	1	100	50
Regional 'background' levels of lead at a Greek study site (Davies *et al.* 1988)	1	25	12.5
Readings taken from Thespiai city, Greece (Davies *et al.* 1988)	6	55	30.5
Late Hellenistic/Early Roman Villa in Greece (Davies *et al.* 1988)	22	130	75
Small-scale/limited pewter production (Care *et al.*1998)	50	200	175
Background in Derbyshire peat near smelting activity (Livett *et al.* 1979)	150	500	275
Typical background encountered at Navio	200	500	350
Background encountered at Spital Fields (Cropper 2016, Lester 2016)	200	800	500
Background encountered at Pindale	200	800	500
Areas of moderate enrichment encountered at Navio	500	800	750
Lake sediments within 10 miles of an historic lead smelter, USA.	500	1300	900
Areas of moderate enrichment encountered at Pindale	800	1600	1200
Enrichment range at Navio associated with fort interior, vicus outskirts	800	1800	1300
Typical lead soil levels within 300m of historic lead spoil Wales, U.K. (Davies and White 1981)	1000	2500	1750
Roman smelting site (Maskall *et al.* 1995)	1500	3500	2500
Enrichment range at Navio of sough surrounds (>30m from sough)	1600	4000	2800
An historic smelter site in Scotland, U.K. (Mills *et al.* 2014)	1700	3200	2450
High enrichment at Navio vicus, fort 'hotspots'	2000	4500	3250
Enrichment range of Spital field anomaly (Lester 2016)	**3000**	5000	4000
Enrichment range at Pindale of sough outskirts (>20m)	4000	6000	5000
Enrichment range at Pindale near to sough (>10m)	6000	10000	8000
Enrichment range at Pindale adjacent to sough (<10m)	10000	24000	17000
Site of historic ore crushing (Maskall *et al.* 2014)	12000	63000	37500
Readings associated with an historic dressing floor (Maskall *et al.* 2014)	50000	60000	55000

Table 9: Comparison of minimum, maximum, and range of lead concentrations on known archaeological and natural sites. (Clarke 2017: 54).

Remains of a Roman Period Hearth and Coin, Newmarket Road, Cantley

The site at 18 Newmarket Road, Cantley, is associated with the discovery of a hearth dating to the Roman period (01806/01 - MSY516; SYAS 1977).

Pitsmoor

The site at Pitsmoor is only recorded as a Site and Monument Record card (00894/01-MSY431) in the South Yorkshire Archaeology Service Database. It is located in the courtyard of the Byron Wood Primary School. There are no details recorded in the database, nor are there any other documents providing additional information for the archaeological features there. The only data available for that site is that it was a Romano-British iron working site (00894/01-MSY431). The author of this thesis was unable to conduct a fieldwalking survey, as permissions were not granted to access the site.

Red House Farm (Area 7), Adwick-Le-Street.

Open area excavations, carried out by Northamptonshire Archaeology Ltd., gathered evidence of an enclosed rural settlement, which showed signs of internal division of the space. This specific site (area 7) is part of a minimum of two farmsteads potentially related to the nearby settlement excavated in areas 2, 12 and 15) (Upson-Smith 2002: 1 and 7). The ditched areas within the enclosures were associated with agricultural activities (Upson-Smith 2002: 7). It has been suggested that there was a marked change in the alignments of features within the surrounding field system landscape after the nearby Roman road was built across the latter (Ermine Street) (Upson-Smith 2002: 23). While the enclosure was founded initially in the late Iron Age, the recovery of stratified material remains in the ditch fills indicated that the settlement was inhabited into the Roman period, specifically until the second half of the first century AD (Upson-Smith 2002: 7). 267 grams of slags were recovered within area 7 (Upson-Smith 2002: 15-16). These debris were not identified by a specialist in the report. Furthermore, these archaeologically recovered slags were not found in the Doncaster Museum and Art Gallery.

Rossington Bridge Pumping Station

Between 1956 and 1963, a group of kilns was excavated at the crossing of the river Thorne near the Rossington Bridge water pumping station (Buckland, Magilton and Dolby 1980; Buckland, Hartley, and Rigby 2001; 00970/01- MSY4346). This production area was associated with a settlement sprawling on both sides of the Roman road leading south from the fort and 'civilian' settlement at Doncaster (Buckland, Hartley, and Rigby 2001: 5; 00970/01- MSY4346). The production of pottery there follows what has been observed elsewhere in the Doncaster area, with the manufacture of "Parisian", Black Burnished and Grey wares, and mortaria (Buckland, Magilton and Dolby 1980; Buckland, Hartley, and Rigby 2001). Some of the latter were found with the stamps SARRIUS, SETIBOCIUS and SECUNDUA (Buckland, Magilton and Dolby 1980: 146-147; Buckland, Hartley, and Rigby 2001: 45). These stamps were also found in other ceramic assemblages in the area (see the Doncaster pottery production area entry previously written in the chapter) and seemed to link the activities in Rossington Bridge to what was happening in the other pottery workshops around Doncaster (Buckland, Magilton and Dolby 1980: 162-163; Buckland, Hartley, and Rigby 2001: 45-47); 00970/01- MSY4346). The analysis of the ceramics suggests that the assemblages were produced mainly during the mid-second century AD, with some limited activities, possibly in the early third century AD (Buckland, Magilton and Dolby: 146-147). The settlement was inhabited from the second to the fourth century AD (Buckland, Hartley, and Rigby 2001: 12; 00970/01- MSY4346).

Metalworking debris also were found at this site in Rossington Bridge (Table 10). The majority of the debris are associated with secondary production, with a fragment of lead-working and seven smithing hearth bottoms. One tap slag was found, which cannot be taken on its own as clear evidence of iron primary production. Three samples were analysed microstructurally from the assemblage from Rossington Bridge Pumping Station. One of these was a tap slag, while the two others were non-diagnostic slags.

Location	Rossington Bridge Pumping Station			
Site Code	Rbps			
	Pieces	Weight (g)	Totals	
Iron				
Fragment	0	0	0	0
NDS	11	722	11	722
Tap Slag	1	21	1	21
Furnace Slag	0	0	0	0
Smithing Heart Bottom	7	935	7	935
Copper Alloy			0	0
Slag	0	0	0	0
Fragment	0	0	0	0
Lead			0	0
Fragment	4	125	4	125
Pyrotechnical Ceramics			0	0
Furnace Lining	4	42	4	42
Tuyère	0	0	0	0
Fragments	2	107	2	107
Total	29	1952	29	1952

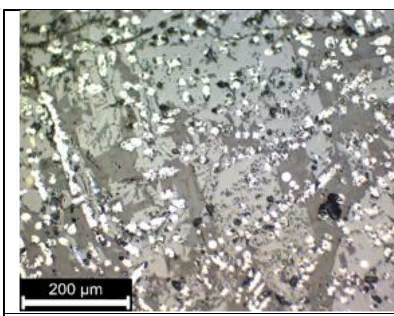
Table 10: Metalworking Debris from Rossington Bridge Pumping Station.

Sample 1 (SS8.2001 54.3.202) was a non-diagnostic slag (Figure 15). Lath-like fayalite crystals were present over the whole sample, and equiaxed crystals were found on top of the sample in smaller amounts. In terms of oxides, only wüstite was observed in the microstructure of the sample. Well-formed dendritic trees were seen in the middle of the piece, ill-formed trees were located on the left-hand side of the slag, and individual pieces of the oxide were found on the right-hand side of the sample.

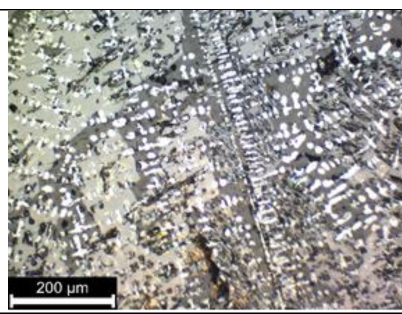
Sample 2 (SS44.2001 54.3.206) was a tap slag (Figure 15). The main phase was composed of large well developed equiaxed fayalite. Wüstite was present in the form of ill-formed trees and as individual oxides. The latter were more common in the middle of the sample. Magnetite was also present throughout the slag. Thin dendrites were also located on the fayalite crystals.

Sample 3 (SS44.2001 54.3.189) was a non-diagnostic slag (Figure 15). Lath-like fayalite was the main phase of this slag. This slag exhibited a lot of magnetite all over the piece. Wüstite oxides were also present in a similar manner. The piece was highly porous, which hid the majority of the structures of fayalite and of dendrites. Indeed, ill-formed dendritic trees of wüstite were found around the porous areas.

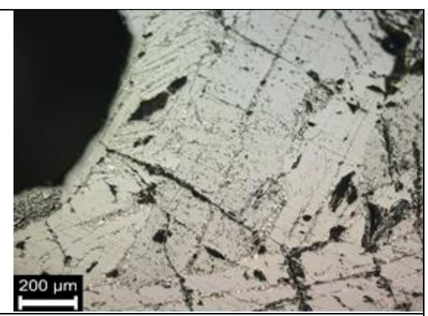
The three slags exhibited different micro-structures, which would indicate that they were made in different manners. Also, a large amount of magnetite was observed within the samples. Chemically, traces of copper and zinc were found in sample three. This would indicate that the two non-diagnostic pieces could have been produced in two different furnaces and/or in two different instances and that they were formed within an oxidising atmosphere. This does not seem at odds with the nature of the assemblage, which was interpreted as iron secondary production.



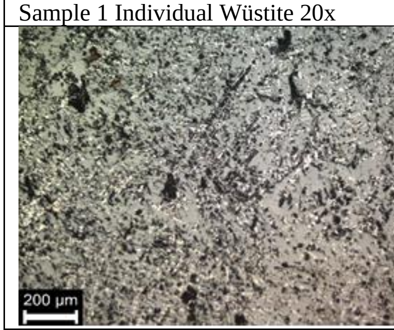
Sample 1 Individual Wüstite 20x



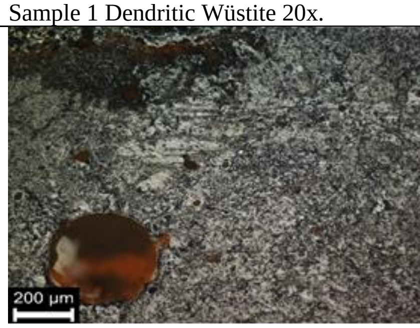
Sample 1 Dendritic Wüstite 20x.



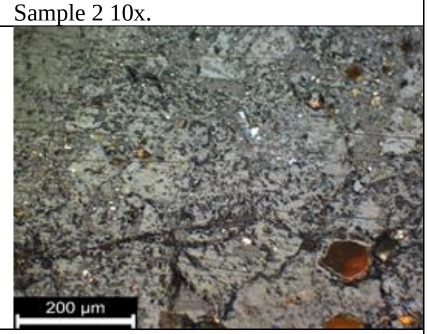
Sample 2 10x.



Sample 2 Wüstite 10x.



Sample 3 10x



Sample 3 20x.

Figure 15: Microstructural Samples from Rossington Pumping Station.

Rossington Grange Farm

Excavation by the West Yorkshire Archaeological Service south of Rossington Grange Farm, near Doncaster, revealed a complex of aggregated enclosures that developed throughout the late Iron Age and the Roman periods (Weston and Roberts 2015: 109). The first enclosure (enclosure 1) is sub-rectangular in shape and has been dated by pottery recovered and radiocarbon analysis to the period between the fourth century BC and the first century AD (Weston and Roberts 2015: 107) (Figure 16). This enclosure was enlarged by the addition of enclosure 2 at the beginning of the Roman period (Weston and Roberts 2015: 111). Enclosures 3, 4, 5, 6, and 7 all were built in the fourth phase of occupation at the site in the late second to the fourth century AD (Weston and Roberts 2015: 112-113). This last phase seems to have been the more intensive one, with the addition of new or remodelled enclosures. This last period of occupation witnessed the building of three kilns in the south-eastern part of enclosure 6 (Weston and Roberts 2015: 113). These are thought to be small late Roman pottery kilns (Linwood type) (Weston and Roberts 2015: 113), but they could also have been used for cereal drying in secondary use. The site at Rossington Grange Farm is clearly linked with the extensive layout of field systems throughout its occupation, with an intensification of the production of agricultural or livestock and of the field systems themselves (Weston and Roberts 2015: 114-115).

A small assemblage of slags was recovered at the site and analysed by G. McDonnell (2015) (Table 11). One tap slag was recovered in a fill on a large pit northeast of Enclosure 2. This sample was then chemically investigated and showed a low level of

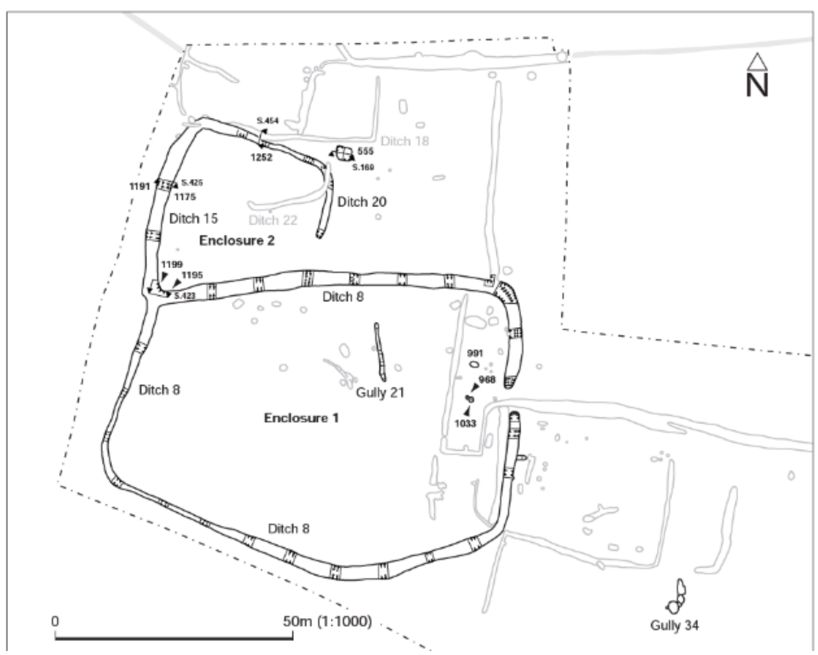


Figure 96: Plan of Enclosure 1 and 2 (Phase 3) from Rossington Grange Farm (Weston, Roberts et al. 2015).

manganese (McDonnell 2015: 82). A curved flowy slag was identified as a possible tap slag flow or a partly formed smithing hearth bottom that could have heated to a liquid state in the furnace (McDonnell 2015: 82). Chemical analysis of this unidentified slag was carried out and revealed a significant level of sulphur and low levels of manganese (McDonnell 2015: 82). This, along with the morphology of the sample, suggests that it is a smithing slag rather than a smelting slag. Copper alloy spills were also found and analysed (McDonnell 2015: 82). These were identified as leaded tin bronze with some silver present. This peculiar composition must have resulted in a rather white colour (McDonnell 2015: 82). According to McDonnell, this would be indicative of an Iron Age date, but it could also be a local traditional technique that was carried out in a later period, perhaps in the Late Iron Age or in the early Roman period (McDonnell 2015: 82). This assemblage, although exceedingly small, suggests that somewhere around the site at Rossington Grange Farm, iron smithing, non-ferrous metallurgy, and possibly iron smelting were carried out.

Location	**Rossington Grange Farm**	
Site Code	RGF	
	Pieces	Weight
Iron		
Fragment	0	0
NDS	3	318
Tap Slag	1	38
Furnace Slag	0	0
Smithing Heart Bottom	0	0
Copper Alloy		
Slag	0	0
Fragment	1	6
Lead		
Fragment	0	0
Pyrotechnical Ceramics		
Furnace Lining	0	0
Tuyère	0	0
Fragments	4	28
Total	9	390

Table 11: Metalworking Debris from Rossington Grange Farm (McDonnell 2015: 83).

Smarson Hill Plantation, South Anston

A large enclosure of 25m by 23m was discovered in Smarson Hill Plantation, South Anston (Radley 1969: 253; 00735/01). It was delimited by a bank of lynchet on three sides, while the fourth side of the site initially was thought to have been left open. However, a trench dug at that spot revealed a bank of rubble faced with upright slabs (Radley 1969: 253). In terms of finds, the site yielded significant amounts of domestic debris, along with several sherds of Dales ware, Derbyshire ware, Samian ware, black soapy ware, and red sandy ware (Radley 1969: 258). A few querns were also recovered (Radley 1969: 258). Based on contextualised pottery evidence, the site seems to have been occupied in the third and fourth century AD (Radley 1969: 259). Slag was also noted, but the exact nature and quantities of materials are unknown.

Smelting Farm, Sheffield

This site in Sheffield has been recorded as a smelter site (00960/01-MSY434). No further information was noted, apart from a possible date range from the early Bronze Age to the Post-Medieval period (00960/01-MSY434).

Sprotbrough

A fieldwalking survey was conducted by Andy Lines from SYAS in 2010 (05771-MSY13342). He identified a number of earthwork features in addition to the scheduled enclosure that is present in the northern part of the site (SYAS 05771-MSY13342). The most notable find that was recovered from this survey is a coin-making hoard that contained small bars of copper alloy (around 10 centimetres in length). Further, field walking in the wood did not identify any other metalworking remains.

In total, over 150 pieces of copper alloy were found in the museum stores that can be attributed to coin making (Table 13). The assemblage consisted of 119 cut sections of bronze rods, all under

Location	Sprotbrough
	Pieces
Cut Sections	120
Straight Lengths	12
strip	1
Globules	4
Round Fragments	9
Wire	1
Sheet	1
Blanks	186
Total	334

Table 13: Metallurgical Debris from Sprotbrough. (Mattingly and Dolby 1982: 22-23).

Location	Sprotbrough	
	Quantity	Weight (g)
Cut Sections	119	134
Straight Lengths	12	80
Tubes	7	20
Globules	3	2
Round Fragments	9	8
Wire	X	10
Sheet	1	5
Blanks	13	13
Total	164	272

Table 12: Metallurgical Debris from Sprotbrough located in Doncaster Museum.

one centimetre in diameter, that were identified as coin blanks, twelve straight lengths, seven sections of copper alloy tube, three globules, nine round fragments, wire, and one small sheet of copper alloy metal. It would appear that this assemblage is only a small portion of what was first discovered, as the article by Mattingly and Dolby (1982: 22) indicates that far more pieces were recovered (Table 12). This is a unique find in the region and indicates a unique knowledge of metalworking at a localised level. These coins were made by cutting pieces off the rounded rods using a chisel (Price 1982: 32-33). The chemical analysis showed that the blanks came from different casts of leaded bronze (Price 1982: 32-33).

Stancil Roman Villa, Tickhill

The supposed Roman villa in Stancil was first excavated in 1938-1939 (SYAS 00964/01-MSY4341; Whiting 1943). The site is still poorly understood, and its definition as a villa is still contentious. Field waking conducted in 1989 by the South Yorkshire Archaeology Unit revealed notable concentrations of rubble, tiles, fine and coarse-ware sherds, glass, and some slags (SYAS 00964/01-MSY4341). These artefacts were found on the surface and were not recovered. Although these slags might stem from the Roman occupation, the presence of medieval or post-medieval finds makes it difficult to say if these slags are truly of Roman origin.

Templeborough Roman Fort

This major archaeological site is located near Rotherham, at a crossing of the River Rother. In 1877-1878, the first operations on site were conducted by Leader and Freemantle under the auspices of the Rotherham Literary and Scientific Society (Freemantle 1913; Leader 1877, 1878) around the south gate. This investigation unearthed parts of the southern fortifications and a number of buildings of the *vicus*. Later, during the winter of 1916 and 1917, a rescue excavation was directed by Thomas May (1922) in advance of the expansion of the Steel, Peech and Tozer Ltd. steel mill. These works included the entire area of the fort, the bathhouses and the “industrial annexe” at the southeast corner of the military fortification. Some years later, in 1938, trenches were dug south of Sheffield Road, and, although no reports were written, a significant quantity of slags was noted but not recovered (Dorothy Greene Collection). Afterwards, another excavation was conducted by W. Wade in 1948. It consisted of three trenches south of Sheffield Road and three buildings of the *vicus* along the road going south from Templebrough (Dorothy Greene

Collection). In 1999, archaeological operations were conducted around the northern parts of the fort (Davies 1999). The major changes in the ground profiles were confirmed, but it was thought that those deeper buried remains might have survived (Davies 1999). In 2004, geotechnical investigations were conducted, and artefacts associated with the *vicus* were recovered (NAA 2004). The final excavation of the site was directed by ARCUS in 2006 (Chan 2006; McCoy 2008). This particular excavation was concerned with the southeast corner of the fort and encompassed parts of the *vicus* and the outer ditches that were an integral part of the fortifications of Templebrough. Finally, it is important to acknowledge the crucial work of Dorothy Greene in the area with her excavation of the western approaches to the fort in 1957 (Greene 1957b) and her general investigation of the Roman roads in South Yorkshire (Greene and Smedley 1958). The access to archive records from the Rotherham Archives and Local Studies, notably the Dorothy Greene Collection, has proven invaluable as the archives not only filled the gaps in the official reports of the excavations of 1877 and of 1916 but also contained information about the excavations of 1938 and 1948, which were never officially published, apart from notes made by Dorothy Greene at the Hunter Society (Dorothy Greene Collection. 2015, 89-F/A/13/1/4 and 89-F/A/13/1/5).

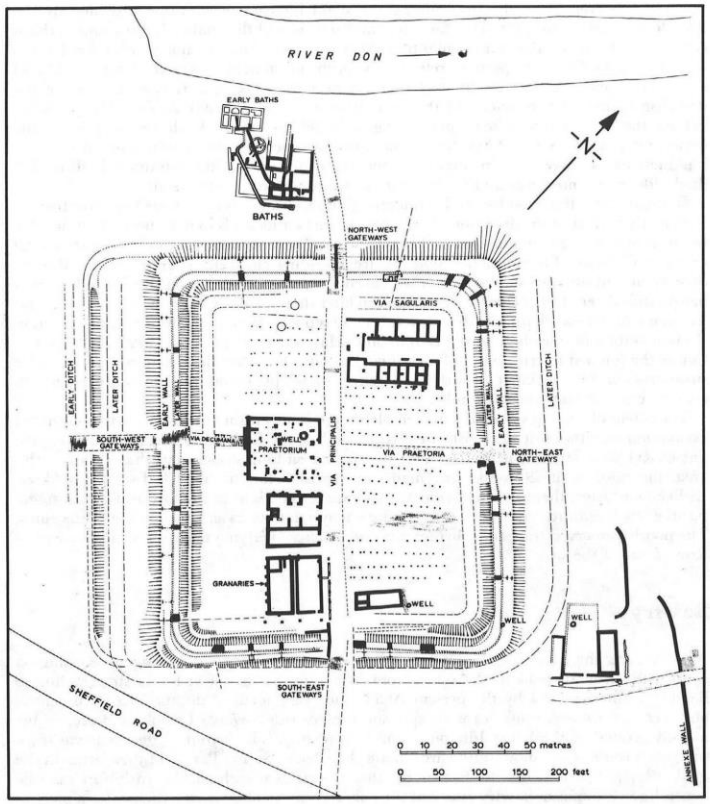


Figure 17: Plan of Templeborough Roman Fort (May 1922).

Three phases were identified by May (1922) and revaluated by Davies (2016). The first phase corresponds to the foundation of the military establishment in the Flavian period, possibly between 54 to 70 AD (Davies 2016: 56-57). The second one is identified as Hadrianic/Trajanic in date, which would set it somewhere around the middle of the second century AD (Davies 2016: 56-57) (Figure 17). A third phase starting in the late third century AD was identified by Thomas May in 1916, but this last possible occupation has not been identified in more recent excavation or in the ceramic record and has since then been refuted by a revaluation of the evidence (Davies 2016: 56-57). The fort was located on a rather important crossroad for the movement dynamics of South Yorkshire as it was located at the crossroad of the Ryknield Street going north-south and stopping at Templeborough, and a probable east-west road going from Doncaster to the Peak District and Whirlow Hall Farm.

The metallurgical debris assemblage comprised 256 artefacts with a total mass of 7078 (Table 14). Most of these are ferrous fragments of various shapes (72% of the total production artefacts; 181/256 artefacts). Also, slags represent 15% (31/256) of the assemblage. When combined and taken as the representation of iron secondary production, these represent 87.85% of the total. In addition to this, 12 fragments of copper alloy material (spills and casting cones) and ten spills and fragments of lead were recovered.

Table 14	Templeborough Fort	
	Pieces	Weight (g)
Iron		
Fragment	181	2168
NDS	31	1430
Tap Slag	2	42
Furnace Slag	2	588
SHB	3	811
Copper Alloy		
Slag	0	0
Fragment	12	305
Lead		
Fragment	10	566
Pyrotechnical Ceramics		
Furnace Lining	8	840
Tuyères	1	51
Fragments	2	165
Crucibles and fragments	4	112
Total	256	7078

Table 14: Metallurgical Debris from Templeborough Fort.

Nine samples were selected for microstructural analysis. These are identified here by their box identifications and their ID numbers for the database presented in this report.

Sample 4 (A/154/90) (Figure 18)

This non-diagnostic slag presented a very glassy and porous (25x) microstructure with localised thin dendritic wüstite. Some parts of the section showed a rather corroded structure with a flow pattern. Upon closer examination, the sample showed a faint rounded crystallised structure that again appeared to be thin dendritic wüstite (200x).

Sample 6 (A/154/90) (Figure 18)

This smithing hearth bottom was very porous with well-formed dendritic wüstite. There were also equiaxed fayalite crystals alongside lath-like forms but frequently interrupted by the porosity noted above. Dendrites were small and well developed but were not evenly distributed.

Sample 7 (A/154/90) (Figure 18)

This sample was identified as furnace slag. Porosity was common, with the main phase being fayalitic laths and frequent well-developed wüstite dendrites.

Sample 8 (A/154/90) (Figure 18)

This non-diagnostic slag showed evidence of corrosion. Both lath-like and equiaxed fayalite crystals were common. Wüstite was well-developed in giant forms of agglomerated dendrites.

Sample 20 (A/306/90.2) (Figure 18)

This sample was a non-diagnostic slag with a largely irresolvable microstructure. Close examination showed some presence of rounded oxides and small localised regions of wüstite (200X).

Sample 22 (A/218/90) (Figure 18)

This smithing hearth bottom was characterised by three distinct phases. The first was a dense glassy matrix which was resolved at greater magnification to a finely disseminated network of wüstite dendrites. Second, an area marked by densely packed, almost equiaxed fayalite crystals interspersed with a patch of oxides that did not display any regular structures. As with the second phase, the final phase presented lath-like fayalite with similar oxides distribution and structure. The dense glassy matrix was concentrated in the central region of the sample with the crystalline

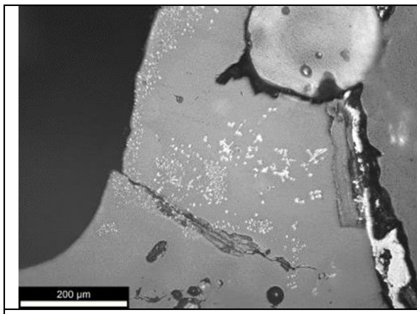
This smithing hearth bottom was heavily corroded and showed a porous microstructure. Distinct phases were irresolvable due to the frequent porosity, although it was noted that there was a common presence of wüstite alongside indeterminate forms of fayalite.

Sample 34 (A/1978.111a) (Figure 18)

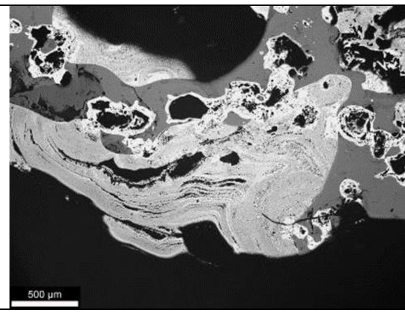
This slag appeared to be a non-diagnostic furnace slag with a dominant glassy phase. It exhibited no crystalline structure except at very high magnification, where it showed some localised regions of wüstite, especially in the vicinity of major pores. Isolated prills of iron were also embedded in the glassy matrix.

Sample 79 (A/104/90) (Figure 18)

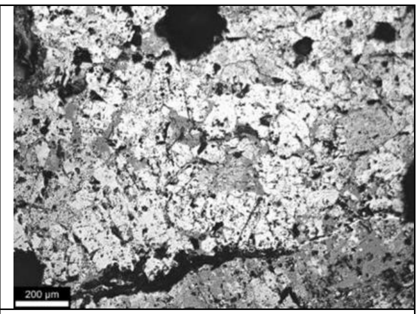
This slag sample presented green corrosion on its surface, characteristic of copper metallurgy. The sample appeared to be poorly consolidated and was quite porous. Its most abundant phase was fayalite. It did not exhibit any particular typical form. Instead, it was present in large patches with rounded edges. Sometimes these patches were interspersed with fayalite structures ranging from equiaxed to lathlike. Large areas were covered with oxides, and there seemed to be a number of probable copper prills, some being located in small, regrouped clusters.



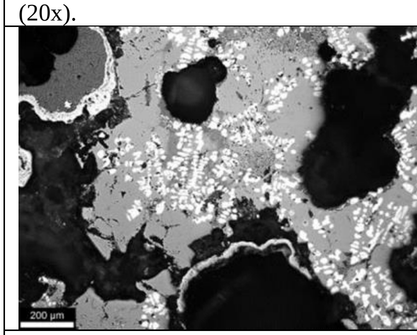
Localised Dendritic Wüstite Sample 4 (20x).



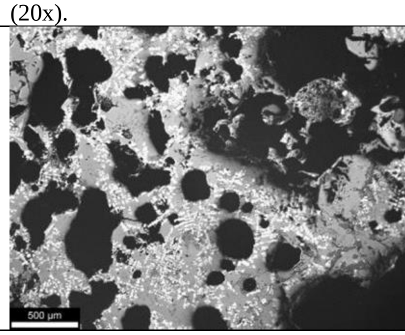
Flowing Corroded Structures Sample 4 (20x).



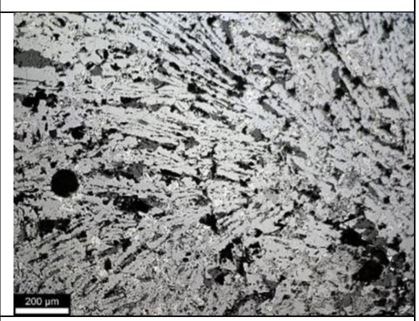
Equiaxed Fayalite Sample 22 (10x)



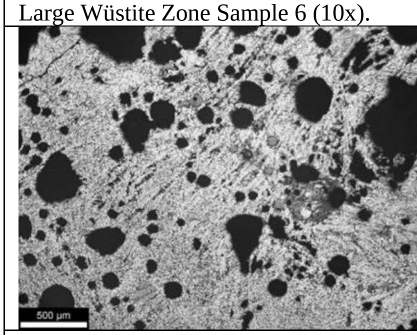
Large Wüstite Zone Sample 6 (10x).



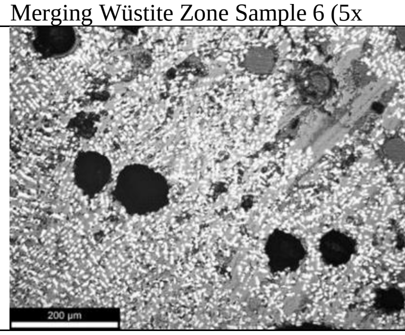
Merging Wüstite Zone Sample 6 (5x



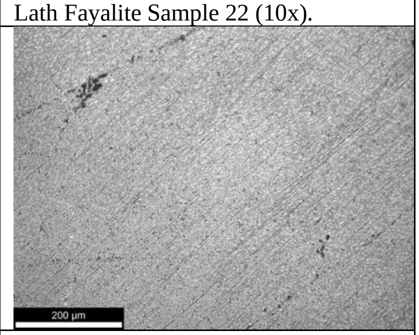
Lath Fayalite Sample 22 (10x).



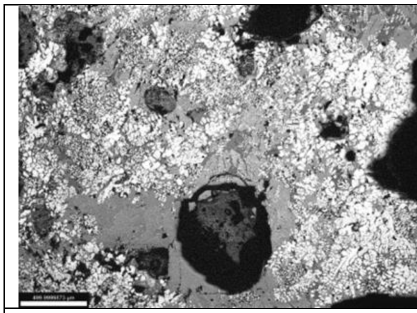
Overview Sample 7 (5x).



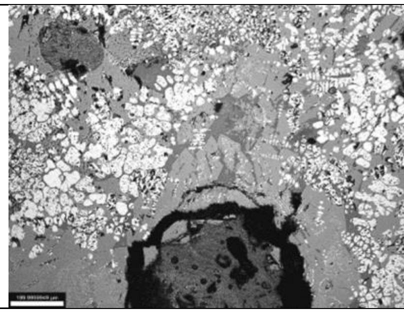
Dendritic Wüstite Sample 7 (20x).



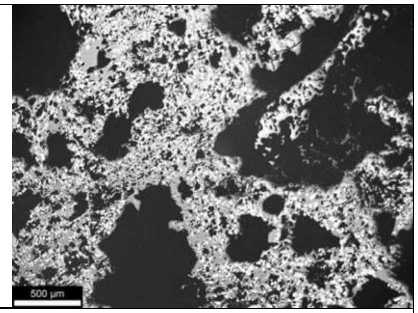
Crystalline Structure Sample 22 (20x).



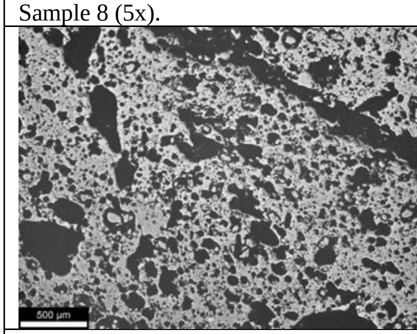
General view with Fayalite and Wüstite Sample 8 (5x).



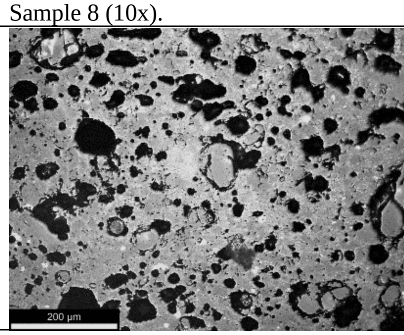
General view with Fayalite and Wüstite Sample 8 (10x).



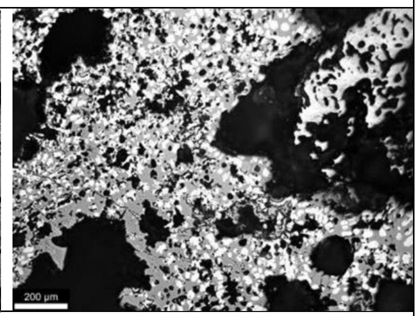
General Structure Sample 29 (5x).



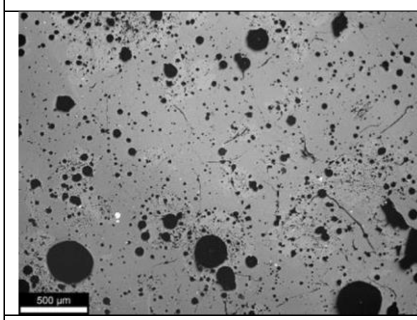
General View Sample 20 (5x).



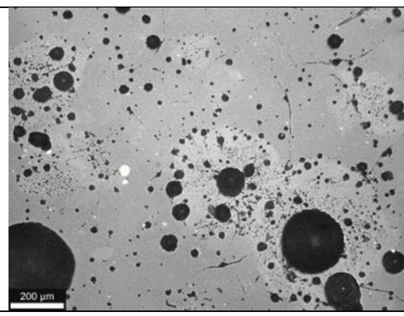
Feint Structure Sample 20 (20x).



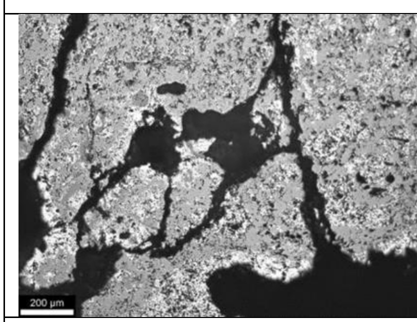
Wüstite Structure Sample 29 (10x).



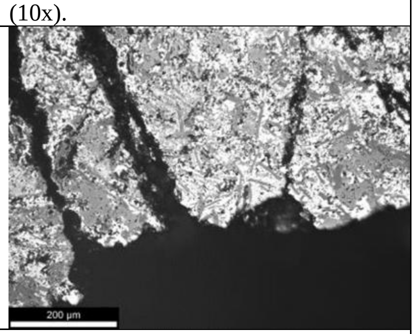
General View Sample 34 (5x).



Localised Oxidic Structure Sample 34 (10x).



Fayalite Structures Sample 79 (10x)



Oxide Structure Sample 79 (20x).

Figure 108: Microstructural Samples from Templeborough Fort.

All samples studied here, except sample 29, came from the 1916 excavation and, as such, they can be attributed, with some confidence, to the industrial annexe of the fort. Sample 29 was recovered during the 1947 excavation and was found in association with buildings in the *vicus* or the filling of the Roman road nearby. The slags analysed here can be grouped into three distinct categories.

First, the greater proportion of slags exhibits structured dendritic wüstite with apparent fayalite structures, be they lath or equiaxed. Second, a smaller number of samples presented a very glassy structure with no apparent fayalite structures and a rather low presence of metal oxides. Finally, sample 79 showed large segments of fayalite structures with rounded edges, along with large spots of oxides and some prills of metals. All in all, these suggested that a reducing atmosphere was present in the furnaces during the formation of these slags. The lack of magnetite and the high presence of wüstite structures in most samples seemed to confirm this. The presence of lath-like and equiaxed fayalite suggests varying cooling rates which do not indicate a uniform practice when it comes to this particular aspect.

The metallurgical assemblage from Templeborough was also characterised chemically to determine the types of copper alloys used and the presence of any metal traces of a selected number of slags that may provide an indication of technological origin. First, the analysis of the metal artefacts showed 48 objects of bronze, two objects of brass and seven objects of gunmetal. This might be considered a fairly typical repertoire of alloys for the Roman period (Dungworth 1995). As for the slags, it appeared that all of them except one showed other traces of elements common in ancient metallurgy (not including iron here as iron silica is the usual main phase of ancient slag and was present in all samples), namely zinc, arsenic, lead, tin and copper. 17 out of 38 samples showed a relatively high copper content. The rarest element in the assemblage was tin and was only present in seven out of 37 samples but in high concentration in these specific slags. 20 out of 37 samples contained a significant quantity of arsenic, and the same number of slags contained a notable quantity of lead. Elevated zinc was noted in 23 out of 37 slags, but the implications of this should be considered with extreme caution. The other slags of each category did not exhibit significant amounts of these metals and had less than 100ppm or, in many cases, were below detection limits (~30ppm).

In light of the macroscopical, microstructural and chemical analysis of the metallurgical debris from Templeborough, three conclusions can be offered. Contrary to what was claimed by May in 1916, there is no clear indication of any primary production activities. Indeed, except for two small tap slags, which could have been produced in secondary activities, no other diagnostic pieces of slag were found in the metallurgical assemblage of Templebrough. However, the chemical analyses highlight a significant amount of manganese in a large portion of the iron slags (38 slags), which is an element often associated with iron smelting (Mackenzie 2007: 80; McDonnell 1984;

52; 1991: 25; Photo-Jones *et al.* 1998: 30). Furthermore, the significant presence of wüstite in contrast to magnetite seems to indicate that a reducing atmosphere was maintained in the furnace/s during the formation of the slags. Also, the presence of slags (4-20-34) that have either a low or a complete absence of oxides could be interpreted as having been formed by smelting activities. However, this hypothesis is not supported by other typological evidence and is only present in one indeterminate furnace slag fragment, which cannot be taken as indisputable proof of smelting activities considering the absence of large amounts of diagnostic debris. Moreover, it is probable that a significant bias in slag collection is a main contributor to the lack of detail about this practice. Indeed, the original excavation that recovered most of the metallurgical debris dates from 1916, when slags would not have been routinely and completely collected. Therefore, although some slags were collected, it is probable that significant quantities were left on site and subsequently put back in the trenches as part of the backfill, which was then obliterated with the extension of the steel mill. Also, it was noted by the excavator Mr Wakelin in 1938 that a significant quantity of slags was uncovered during the operations and interpreted as an extension of the industrial annexe of the fort (Dorothy Greene Collection. 2015, 89-F/A/13/1/4), but it would appear that none of it was collected.

Secondly, it is apparent that specific metalworking activities were undertaken at Templebrough. These seem to relate mainly to iron working and including the reforming and reshaping of objects, but also the production of new ones. Indeed, many partially worked fragments of iron, cut copper alloy fragments and spherical hammerscales, which are evidence of high temperature working where welding can be achieved (Dungworth and Wilkes 2007: 34; Mills and McDonnell 1992: 1; Sim 1998: 102; Veldhuijzen 2009: 161), were identified and would seem to be linked with the creation of new objects on site. Furthermore, two fragments of copper alloy could be associated with castings. This interpretation of the metallurgical activities on the site being primarily linked to secondary iron production practices is also supported by the slags recovered at the Roman fort of Templeborough. Indeed, there are a number of smithing hearth bottoms in the slag assemblage, which is characteristic of this metallurgical activity. Furthermore, the microstructural analysis of the slags seems to support this, as most of them presented a large number of oxides within them, like dendritic and non-dendritic wüstite. This variation in the structure of wüstite can be interpreted as differing cooling rates for the formation of individual slags.

The third result is the characterisation of the multi-metallic nature of the assemblage from Templebrough. Evidence for this peculiar nature is threefold. First of all, there are fragments of metals that indicate the working of iron, copper alloy and copper alloy and lead fragments, along with spills of the two latter metals. Secondly, some slags exhibit copper alloy pieces on them which might be indicative of the presence of copper alloy parts or objects in the heart of the smith. Thirdly, the chemical analysis showed that a large majority of slags contained not only iron but also the combined presence of copper, tin, lead, arsenic, and zinc. Furthermore, the trace analyses on the crucibles of the assemblage showed relatively high traces of lead and zinc, while only low readings of copper. This seems to confirm the macroscopic evidence listed above and adds weight to this argument. This multi-metallic nature is interesting as it gives a clear insight into the crafting practices of Roman military metalworkers, who, it appears, were capable of working different metals.

Gunhills, Armthorpe / West Moor Park I and II

The excavation at West Moor Park II revealed a number of enclosures delimited by ditches along with pits, post-holes, hearths, and ovens. The site was occupied from the Late Iron Age up to probably the 4th century, with a possible abandonment period in the first century AD (Richardson 2001: 61; Chadwick, Powell, and Richardson 2007: 34; Wessex Archaeology 2015: 14). Three excavation campaigns indicated that these enclosures were set in the “brickwork” field system present in South Yorkshire (Richardson 2001; Chadwick, Powell, and Richardson 2007; Wessex Archaeology 2015). Similarly to the development of this specific type of field system elsewhere, the one around Armthorpe seems to have developed over a period of time from the Late Iron Age.

In West Moor Park, evidence from light industrial activities was found, with four ovens, corn driers or kilns, and several other features indicating activities relevant to cooking or heating. Surprisingly, no buildings suitable for year-round living were discovered in that part of the site (Richardson 2001: 35; Chadwick, Powell, and Richardson 2007: 67). The only standing structures present appear to have been lean-to shelters or similar temporary constructions (Richardson 2004: 34-35; Chadwick, Powell, and Richardson 2007: 67). Thus, there is a lack of “any demonstrably ‘domestic’ habitation” (Chadwick, Powell, and Richardson 2007: 67). It is to be noted that severe truncation of the features could have altered our modern perception of the site (Richardson 2001: 38). Nevertheless, it has been interpreted that this part of the site, or even perhaps the whole area, could have been inhabited only periodically. Recognising the agricultural nature of the area, it seems possible that, if this site (or parts of it) was used in this way, there might have been a link between occupation and seasonal or agricultural cycles. (Figure 19)

Along with the agricultural activities that are noted at West Moor Park, metal-working activities have also been identified from the presence of metallurgical debris. A total of 104 of these remains were found, amounting to 37.924 kilograms (Table 15). Out of this total, three non-diagnostic slags (125 grams) were identified, along with a quantity of hammerscale and prills (Cowgill 2001: 26; Cowgill 2007: 53-54). Apart from these debris, the majority of the slag assemblage is linked with

Location	West Moor Park		West Moor Park 2		West Moor Park Wessex		Total	
	Quantity	Weight (g)	Quantity	Weight (g)	Quantity	Weight (g)	Quantity	Weight (g)
Smelting Slags								
Block	7	4202	3	2858	0	0	10	7060
Furnace Slag	0	0	0	0	0	0	0	0
Smelting Slags	19	21359	0	0	0	0	19	21359
Tap Slag	52	9920	3	161	0	0	55	10081
							0	0
Smithing Slags							0	0
Hearth Bottoms	0	0	3	649	0	0	3	649
Smithing Slag	3	125	0	0	0	0	3	125
Non-Diagnostic	6	112	8	9	13	8221	27	8342
							0	0
Non Specific Types							0	0
Clinker	2	4	0	0	0	0	2	4
Furnace Structure	1	297	0	0	0	0	1	297
Fuel Ash Slag	0	0	1	2	0	0	1	2
Fired Clay	0	0	21	205	0	0	21	205
Iron Stone	2	783	0	0	0	0	2	783
Vitrified Clay	7	688	0	0	0	0	7	688
Vitrified Lining	2	181	0	0	0	0	2	181
Total	101	37671	39	3884	13	8221	153	49776

Table 15: Metallurgical Debris from West Moor Park I and II (collected from Cowgill 2001: 26, Cowgill 2007: 53-54 and Wessex Archaeology2015: 12).

the primary production of iron. Seven blocks of slags (4202 grams), usually associated with non-tapping smelts; 52 pieces of tap slag (9920 grams), normally related to tapping smelts; 19 non-diagnostic smelting slags (21359 grams); and six pieces of vitrified clay probably from furnaces make up this part of the assemblage (Cowgill 2001: 26; Cowgill 2007: 53-54). Most of the metallurgical debris were found in a group of ditches dating to the second century and were located in Industrial Area 2. The more recent excavation by Wessex Archaeology also revealed some metallurgical debris in the form of 8 kilograms of non-diagnostic slags (Wessex Archaeology 2015: 12). The report stated that these might have been linked to non-tapping furnaces because of the lack of flowing textures and are thought to be a redeposition from somewhere else in the area. These have been classified as non-diagnostic slag in the present research. The presence of block slags and tap slags at the same site, and indeed in the same feature, is quite surprising. These two types of metallurgical debris are formed by two different smelting techniques, which are normally not thought to be used simultaneously (Cowgill 2001: 27; Paynter 2007a: 209). Indeed, most sites where block slags have been recovered are of Middle or Late Iron Age date, while tap slags began to appear gradually in the Late Iron Age (Paynter 2007a: 209; Cowgill 2001: 27; see chapter 2). At West Moor Park, the two are present together or at least close to each other in time, which could indicate one of two possibilities (Cowgill 2001: 27-28). First, the presence of the two techniques might indicate that the assemblage is transitional in nature and was created by smelters going from one technique to the other or experimenting with the two methods (Cowgill 2001: 27-28). Second, the two techniques could have been used to produced two different alloys of iron (Cowgill 2001: 27-28). In this hypothesis, it is plausible the craftspeople could have thought that one furnace would have seen better than the other to produce a specific type of iron (Cowgill 2001: 28).

Metallurgical activities on-site appear to be concentrated in the second century and are related to smelting and smithing.

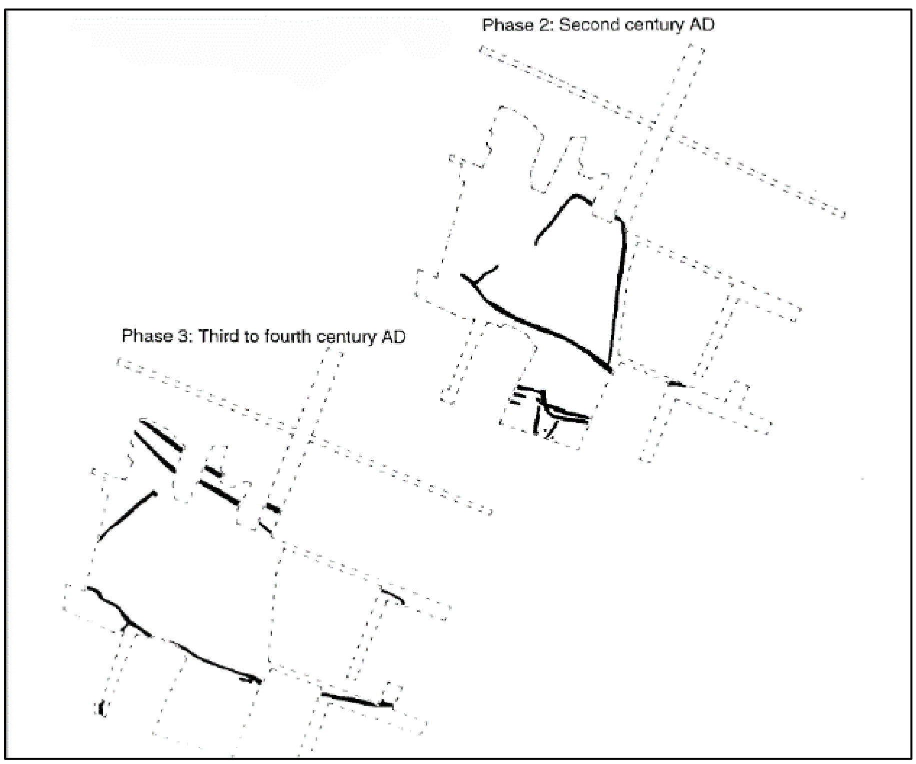


Figure 19: Plans of West Moor Park Phase 2 and 3 (Richardson 2001: 55).

Whirlow Hall Farm.

Dug by Archaeological Research Services, Whirlow Hall Farm, in modern Sheffield, is a unique site in the area. It appears that the first occupation of note was an enclosure delimited by a ditch and possibly a number of internal pits which are thought to be from the late pre-Roman Iron Age (Waddington *et al.* 2017: 119). Then, in the first or early second century AD, this enclosure had its shape modified (Waddington *et al.* 2017: 119). Its unique character for an enclosure of that period is the construction of a rectangular building with stone foundations (Waddington *et al.* 2017: 119) (Figure 20). The perimeter of the building was ‘metalled’ with stone chippings and some fragments of Roman pottery sherds (Waddington *et al.* 2017: 119-120). Radiocarbon dates of 55 to 219 cal AD were given to this occupation (Waddington *et al.* 2017: 62). A post was set in the middle of the entrance and consolidated with stones in the post hole (Waddington *et al.*, 2017: 62). The occupants of the enclosure during the Roman period had access to a number of what is thought to be ‘Roman’ ceramic products and glass artefacts (Waddington *et al.* 2017: 22).

The presence of the rectangular stone building, the stratigraphical interruption between the Iron Age enclosure and the Roman period one, and the material culture found in association with it could indicate that the site was occupied by people who wanted to obtain objects and type of construction associated with the Roman world (Waddington *et al.* 2017: 121-122). A limited number of artefacts linked to metallurgical production was also found at Whirlow Hall Farm. Three pieces of slag, including one smithing hearth bottom, were found associated with a number of iron artefacts (Lortie and Doonan 2017: 85). More intriguing is the place of lead metallurgy on-site (Doonan 2017: 100-101). One piece of lead dross, one rolled sheet, a bar and five lead waste or slag pieces were recovered from Whirlow Hall Farm (Doonan 2017: 100-101). From there, it seems relatively clear that not only smithing activities occurred on-site, but also that lead was worked there (Lortie and Doonan 2017: 89; Doonan 2017: 101). The nature of the lead debris seems to indicate not only lead working (melting and forming) (Doonan 2017: 101), but also alloying (Doonan 2017: 100-101). The group of lead alloy artefacts showed a degree of alloy variability (Doonan 2017: 100-101).

Location	Whirlow Hall Farm					
	Metal Detection		Excavation		Total	
	Quantity	Weight (g)	Quantity	Weight (g)	Quantity	Weight (g)
Lead Waste	5	546	0	0	5	546
Lead Sheet	1	131	0	0	1	131
Lead Bar	1	37	0	0	1	37
Lead Dross	1	42	0	0	1	42
Non-Diagnostic Slag	0	0	2	66	2	66
Smithing Hearth Bottor	0	0	1	303	1	303
Cinder	0	0	3	3	3	3
Vitreous Material	1	72	0	0	1	72
Total	9	828	6	372	15	1200

Table 16: Metallurgical Debris from Whirlow Hall Farm (Waddington et al. 2017).

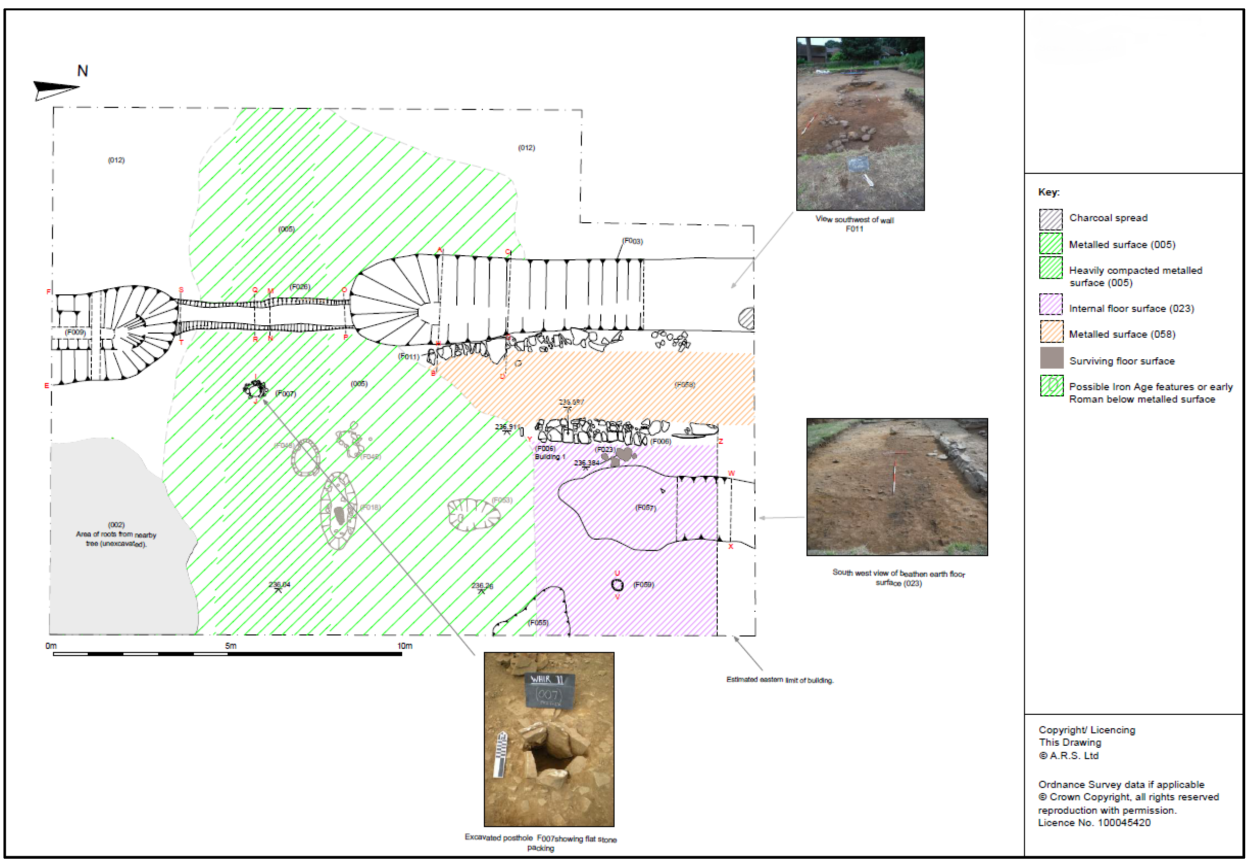


Figure 20: Plan of the Roman Features in Trench 1 (Waddington et al. 2017: 25

Whirlow Hall Farm is also marked by the discovery of a lead anomaly in the soil chemistry along with the presence of pewter waste, lead dross and lead sheets (Doonan and Slater 2017: 106) (Figure 21). Geochemical surveys uncovered peaks of lead within the enclosed area, the most notable peak being in the central zone of the enclosure (Doonan and Slater 2017: 104). This zone gave a reading as high as 634ppm, which is more than three times the average (169ppm) background levels of lead at Whirlow Hall Farm (Doonan and Slater 2017: 104). The presence of lead dross and lead sheets makes it likely that some limited or localised lead working was present at Whirlow Hall Farm (Doonan 2017: 100-101). This metallurgical activity on the site might have been located on one of the possible roads over which lead ingots could have travelled between the Peak District and the Humber estuary.

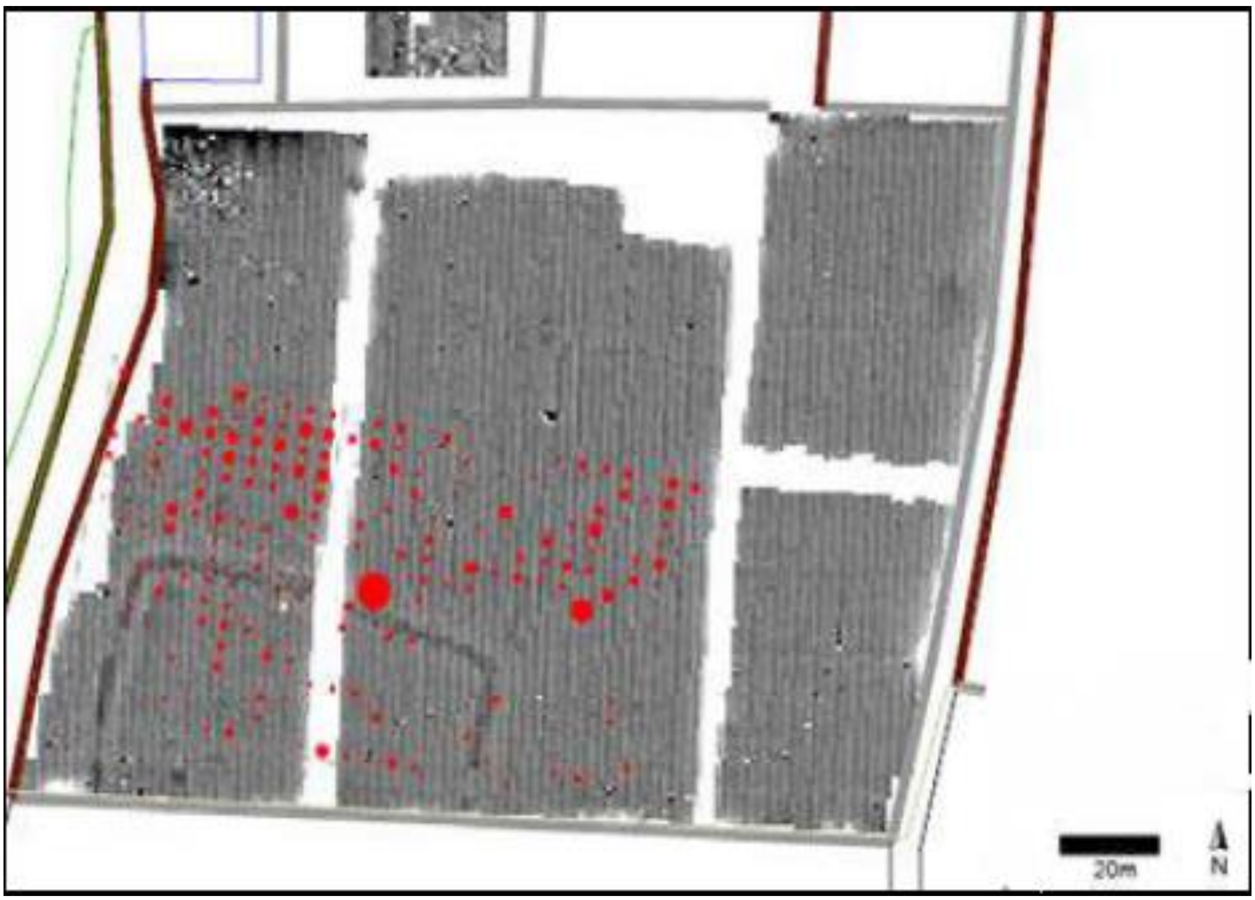


Figure 111: Lead Levels overlaid on the Magnetometry Survey at Whirlow Hall Farm (Doonan and Slater 2017: 104).